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# Science and Invention

FORMERLY

ELECTRICAL EXPERIMENTER



## MUSIC !!
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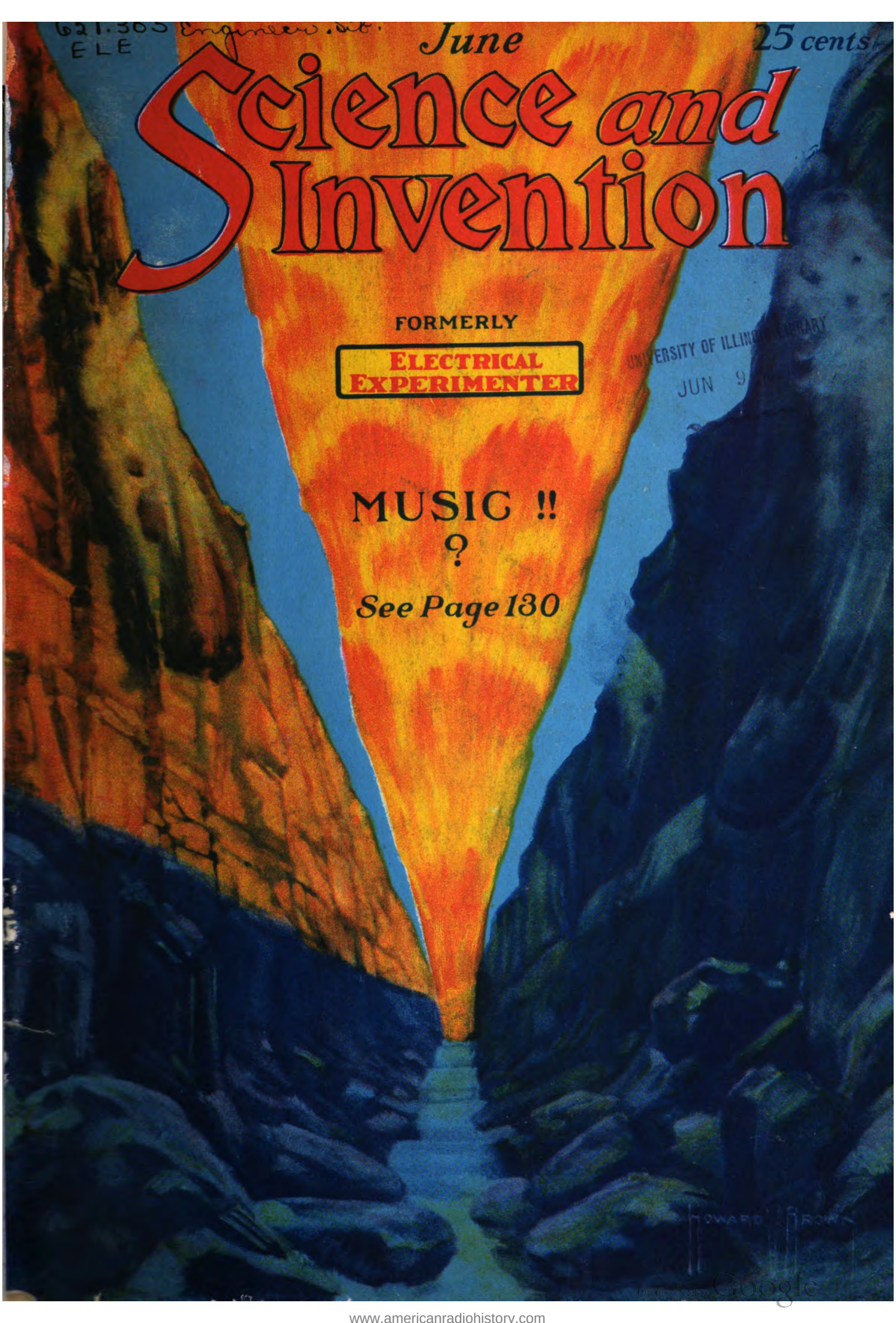
See Page 130



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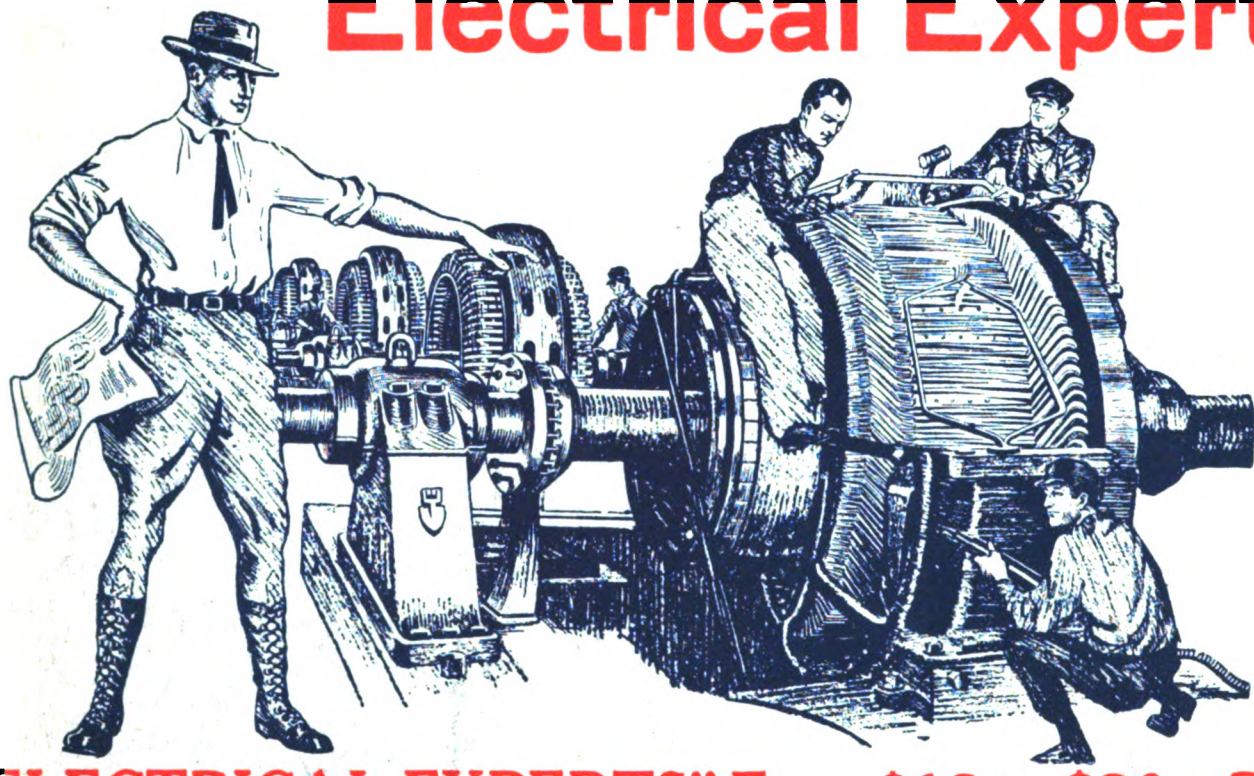

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Vol. IX
Whole No. 98

# Science and Invention

FORMERLY
ELECTRICAL EXPERIMENTER
233 FULTON STREET-NEW YORK

June, 1921
No. 2

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# Hidden Forces

WE use today but one fundamental force: electricity. All other forces which man uses or has used before can be traced back to the electrical current, in one way or another. All the energy we use on earth today has its origin in the all dominant sun. We laugh at the savage sun worshipers, when we ourselves worship the sun at every hand. Our daylight, our heat, our very lives are dependent upon the sun. There is no question today that the solar energy which we receive continuously from our great luminary is purely electrical. It is now over 50 years since the famous Master, Clerk Maxwell gave us his wonderful demonstrations that light and electricity are one and the same thing.

Every time we ride in a steam train we use up stored solar electricity. We trace the steam to the coal, the coal to carbonized forests sunken below the surface of the earth, the forest back to the sunlight of centuries ago.

If we use an automobile, the case is the same with but slight variation. The power we derive from Niagara may be electrical at the moment we use it, but it was solar electricity less than a month ago. For the water that goes over the falls would not be there if the rivers did not feed the great lakes. And the rivers would be dry but for the rain, while we would have no rain without the sun evaporating the oceans to form clouds and saturate the atmosphere with moisture.

So we see that *all* forms of energy we use today are simply stored solar energy—electricity in one transformation or another.

The same in general terms applies to radium—for it is electrical in nature—and radioactivity is bottled solar energy, but just how it is bottled we do not know as yet.

There are forees however, which we dimly surmise today, that are not electrical in nature, and which so far we have been unable to use, and which do not depend upon the sun either directly or indirectly. Atomic energy is one of them. This energy, as its name implies, is born in the atom. It is a force unto itself, depending on no outside force or effect to produce it. It is true that we do not know how to use it today, as we have as yet not found the key. We are like the savage child that witnesses the destructive force of a forest fire, but who has not as yet learned how to make fire and how to harness it. Or like our great-grand-fathers, less than 100 years ago, who lived on top of coal deposits, while they burnt wood to keep from freezing, and who did not know that a binful of that black rock could haul a hundred people over a distance of several hundred miles.

But we know today—thanks to physics and mathematics—that if we could harness the inherent atomic energy of one gram of iron, it would more than equal the explosive energy of fifty tons of dynamite. Or it could haul a train readily from New York to Chicago. But as yet we are savages, and it is in Nature's wisdom not to let us play with such super-forces for a while at least. Which may be for the best—because we probably would use the new force to kill each other in our next "Great War."

The other great natural force is gravitation. It also does not depend upon solar energy. It is a great force unto itself. While many thinkers claim today that it is electrical in origin, just as many deny it. And the latter class so far has the best of the argument because it has never been proved conclusively by experiment that gravitation is affected electrically, or that the electrical current is influenced by gravitation. Harnessing gravitation, i.e. depriving matter of its weight, would be just as great a discovery as the unlocking of the atom's energy.

Perhaps atomic energy and gravitation are closely interlocked. The future will tell.

H. GERNSBACK.

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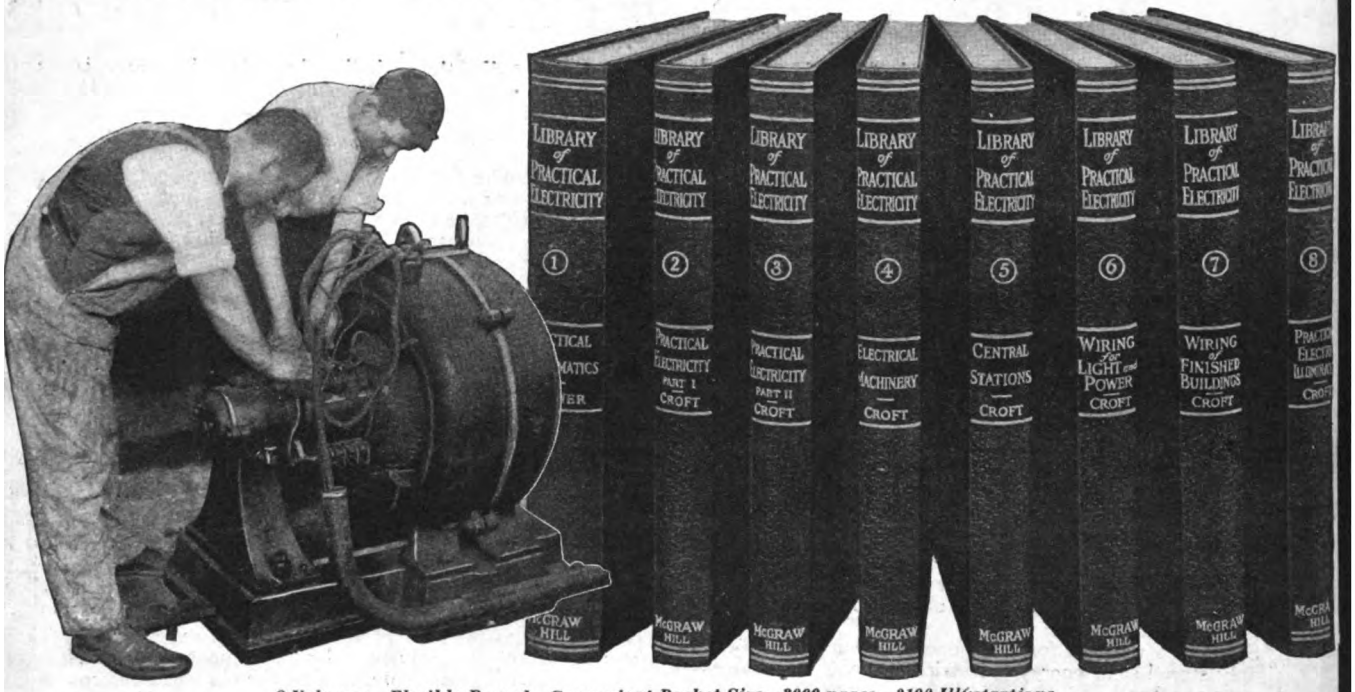


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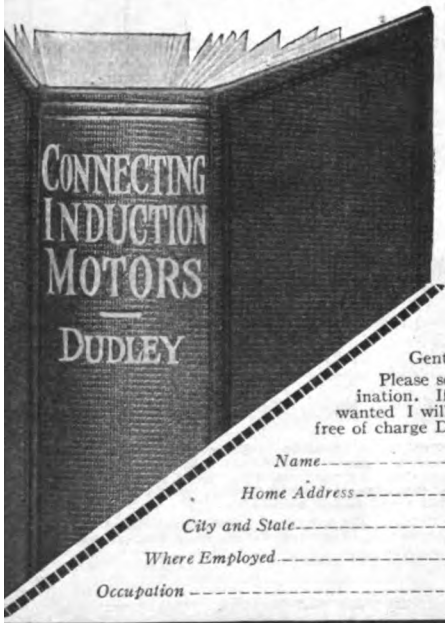


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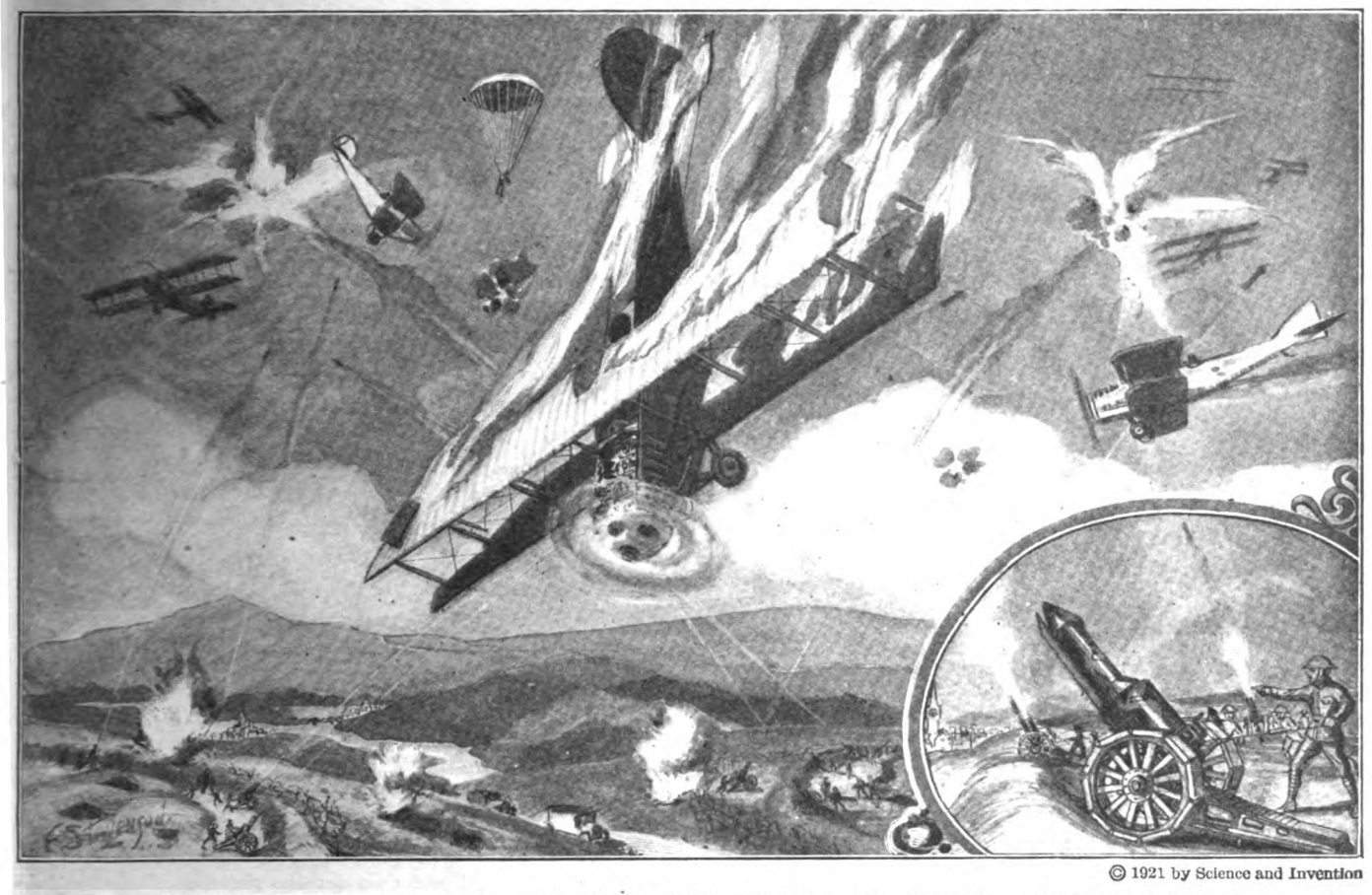
Whole No. 98

Science and Invention

H. GERNSBACK,- EDITOR
H. WINFIELD SECOR,- ASSOCIATE EDITOR
T. O'CONOR SLOANE, Ph.D.,- ASSOCIATE EDITOR

JUNE
1921
No. 2

# Rockets Filled With Powder and Oil to Ignite Airplanes





**The Illustration Above Shows an Airplane Battle of a Future War—the Aircraft Being Attacked by a New French Type of Rocket Filled with Explosives and Oil. These Rockets are Intended to Set Fire to Airplanes and Besides, They Will, upon Bursting, Hurl Pieces of Steel Shell Thru the Thin Walls of the Metal Cabins of the Planes. These Rockets May Moreover Contain Liquids for Creating Poisonous Gases in Large Volume. The Rockets are Fired from Special Guide-mounts Which Can be Placed on Auto Trucks, so as to be Readily Mobile, thus Rendering the Aviator's Chances of Bombing the Firing Device and Crew Very Uncertain.**

THE French military experts are said to be developing a number of extremely clever and powerful engines of war. Among other new war devices is a shell to be propelled by a series of explosions, each giving a fresh impetus to it, and calculated to keep the projectile in flight, rocket-fashion, for 100 miles or more.

Another invention of far-reaching importance is a gigantic aerial bomb, which will exert such a terrific explosive effect when detonated, that bombing planes equipt with these bombs can destroy a whole city, army corps or fleet.

The present illustration shows one of the latest developments which is being worked out in France—a huge rocket filled with explosives and oil and intended to ignite or set fire to airplanes. These rockets can be constructed quite cheaply and are fired from a special guide or guide-mount as shown in the illustration. When the rockets reach the predetermined altitude, tor which their time fuse has been set, the explosive within the rocket head, will blow it to pieces, when the highly volatile oil within the rocket will ignite and streams of fire will sear the sky, as hundreds of these bombs are fired on the approach of an airplane squadron. These rockets are arranged so that they may contain liquids which will vaporize quickly and produce powerful poisonous gases, so that if the plane is of metal construction and cannot be ignited, the gas will make it very uncomfortable for the aviators, especially if some of the gases recently discovered are used, which act in such a manner as to cause those caught in them to rip their gas masks off.

Of course, it would seem that the airplanes, attacked by such rockets, might attempt a counter attack, either with machine guns or else with aerial bombs dropt thru the air, but it would be difficult for the airmen to ascertain the exact locations from which the rockets had been fired and with the present highly developed and rapidly improving *camouflage*, and also by the utilization of moving gun or rocket mounts, carried for example on rapidly moving auto trucks, it would be almost impossible to locate a place for a bomb attack or to assail with machine-gun fire the men who had fired the rockets.

# Hello! Is This Havana?

**UNITED STATES JOINED TO CUBA BY LONGEST SUB-SEA TELEPHONE CABLES**

"HELLO! Havana, this is New York talking!" We may now go to the nearest telephone and call up Havana, Cuba, the nearest wet spot to the U. S. and order a half dozen high balls if you feel that way via telephone, thanks to the successful researches of the engineers of the American Telephone & Telegraph Co., which has made telephony possible over a 115-mile submarine cable, extending from Key West, Fla., to West over the long viaduct of the Florida East Coast Railroad, which reaches out to the "key" on which Key West is located. Between Key West and Havana, however, stretches a gap of about 115 miles. The water averages some 3,000 feet in depth, and in some stretches is over a mile deep. Across this gap there sweeps that most famous of ocean currents, the Gulf Stream. Telephone cables had never been laid for such a distance, or in water of such a depth.

The officials of the Bell System and of the Cuban Telephone Company determined, however, that the public service required telephone connection across this gap.


Photo at Top Shows One of the Cuban Cable Gang Holding a Piece of Steel-Wire "Armored" Sub-Sea Telephone Cable. Center—Seamen on Cable-Boat Operating "Brake" and a Telephone Cable Passing Over the Stern.



**A Few Weeks Ago an Epoch-Marking Event Occurred in the Telephone World, When the Longest Distance Undersea Telephone Cables, Each of the Three Cables Measuring 115 Miles in Length, Were Duly Opened to the Telephone Public. On this Occasion President Harding Felicitated President Menocal of Cuba on the Opening of the Telephone Circuit Between the Two Republics. President Harding Appears in the Center of the Upper Left Hand Photo, as Does Also General Pershing, While President Menocal of Cuba Appears in the Upper Right Hand View. Full Details of This, the Longest Sub-Sea Telephone Circuit in the World, Are Given in the Accompanying Article.**

Havana, Cuba. While you may not have the privilege of drinking the high balls, you can with a good imagination at least obtain a good psychic smell, and enjoy the exhilarating thrill of talking from any point in the dry U. S. to someone on the isle of wetty wetness. That is, you can enjoy the thrills of talking for three minutes from New York (or other American point) to Havana, providing you have the necessary wherewithal—namely $13.65, if you will talk to anyone answering the call at Havana. If you are real fussy about it and wish to talk only to a certain party and Central has to hunt around and find said party, then the fee exacted is $17.05 for three whole minutes.

The engineering features coupled with the opening of the U. S.-to-Cuba submarine telephone cable or rather cables, as there are three of them, marks a wonderful advance in Science. Heretofore it has only been possible to talk over a very short distance, a few miles at most, with a cable placed under water, owing to the huge condenser or electrostatic charging effect—this and other untoward electrical effects making the transmission of telephone communication impracticable.

The new service was opened on Monday, April 11th, by President Harding and President Menocal of the Island Republic, who exchanged renewed assurances of friendship and good-will.

As an added feature, Washington and Havana, as well as other cities scattered across the country, listened to a report from a wireless telephone operator at Catalina Island, in the Pacific Ocean. The distance from Catalina to Cuba is 5,700 miles, and the feat is said to have established a new distance record for transmission of the human voice by a circuit of radio, wire and cable.

The ceremony at Washington was in charge of the American Telephone and Telegraph Company and the National Press Club, and the invited guests, numbering several hundred, were provided with receivers connected with the new circuit.

Several years ago the telephone circuits of the Bell System were extended to Key West and other untoward electrical effects making the transmission of telephone communication impracticable. The problem was turned over to the Development and Research experts of the Bell System to develop the means of carrying out the project.

As a result, three separate cables have now been laid between Key West and Havana. Each cable is approximately 115 miles long, consisting of a single copper conductor, insulated with gutta percha. The three cables are laid several miles apart except at the extreme ends, so that if one cable is broken, the others will continue in service.

### Cables Carry Telephone and Telegraph Messages

Each cable will carry, not only a telephone conversation, but also at the same time, two telegraph messages in each direction. One of these circuits will use wave frequencies lower than the voice frequencies (about 15 cycles per second); while the other will use wave frequencies higher than the voice frequencies (about 5,000 cycles per second).

(*Continued on page* 181)

# Locating Big Guns by Their Sound

**By MAY TEVIS**

ONE of the most interesting men in France is the veteran master of the science of Experimental Phonetics, the distinguished Catholic priest, l'Abbé Jean Rousselot. There has just been created at the College de France a special chair of Experimental Phonetics, the funds for whose support are included in the Budget of the Bureau of Public Instruction. This is a fitting reward for the labors both in peace and in war of this illustrious scientist, who has been studying the phenomena of sound nearly all his life, and who, beginning with a poorly-equipped laboratory of only four rooms at the College de France in 1897, made so many improvements in the simple phonetic apparatus which was all he then possest, that in the course of a few years his laboratory was taken as a model for no less than 18 others in various countries, the chief of these being at Hamburg.

The Abbé, who is now in his 75th year, was apprenticed to a nail-maker in his boyhood, but he soon attracted attention from his teachers by his keen mind and especially by his eager interest in language. It was not long before this interest extended from the dry text before him to the living speech that written language represents. Year by year his devotion to this study continued to grow until it embraced not only the sounds of the voice, but the mechanism by which they are produced, i.e., the mouth and lips, the nostrils, the larynx, the tongue and the teeth, and the organs of respiration. It was but a step further to undertake the study of the complementary organ of speech—that is, the ear which receives the impressions of speech and transmits them to the brain.

Not content with even this wide field of research, his enthusiasm led him to undertake researches in the entire field of sound and, finally, in the realm of sound in ballistics. It has been happily said of him that he has taught deaf mutes to speak and big guns to hold their tongues. It was through his study of voice production and his analysis of the motions and changes of form of the lips, mouth, larynx, nostrils, etc., that he was able to so analyze speech into its elements, that he could teach children and adults whose deafness had prevented their learning to speak thru imitation, as normal children do,—to produce vowels, consonants, and finally words and complete sentences. It was his study of sounds of all sorts and his decomposition of them into

## The Work Done in Experimental Phonetics by the Abbé Rousselot

their elements by means of various delicate instruments, some of which are shown in the accompanying illustrations, that gave the good Abbé the power during the bitter days of the war to render an invaluable patriotic service to bleeding France by locating the gun batteries of the enemy.

As early as the summer of 1915 he was stationed at Fontainebleau taking records on revolving drums of all the wild confusion of sounds which reigned there—and then, from the study of these tracings, each representing a given sound, calculating the intensity, the pitch, and the timbre of the latter. Possest of these data he was able to determine, by means of carefully worked out tables, not only the exact position *but the calibre of every gun in the German batteries.*

There seems something almost miraculous, indeed, in the precision with which he was able to distinguish such various sounds coming from various distances, as that of the explosion of the charge or the sound wave coming from the mouth of the gun, the whine of the projectile in the air, and the noise of the shell's explosion—and this amidst the myriad of other noises made by the wind or by echo, by the explosion of mines or by men's voices. For days on end he camped in the forest of Fontainebleau devoting his time, his strength and his skill to "La Belle France" in this manner, while from October, 1917, to November, 1918, he was occupied in making experiments on French submarines and in teaching their crews to detect their hidden German foes.

Some of the earliest work done by Rousselot which laid the foundation for the important labors just described, was a study of the penetrative power of various sounds, ranging from whispers to deafening noises. Thus he found that with an ordinary voice, no sound of which was clearly perceptible at a distance of 9.6 meters, the hearer could understand the vowels a, e, i, o, u, when the distance was decreased to 9 meters, while the consonants all required a lesser distance, but one of varying degree, in order to be comprehended.

### THE MECHANICS OF SOUND PRODUCTION

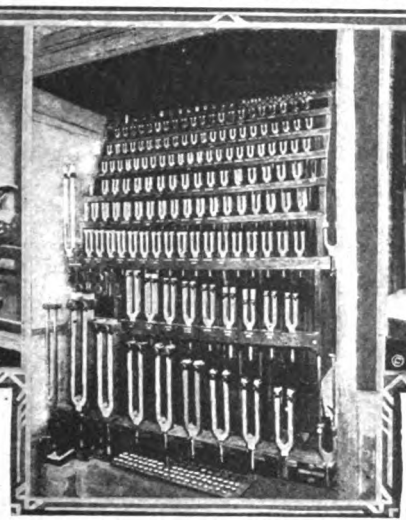
While Rousselot has invented a number of devices for studying or recording sound, such, for example, as his *nasal olives*, which are small rubber bulbs pierced by an aperture to be placed in the nostrils for registering variation in the force of breath employed, his chief mechanical work has been in the line of developing and perfecting instruments devised by earlier workers in the field.

Thus it has long been known that tuning forks vibrate in harmony with sounds uttered near them when these are of the same pitch. It is evident, therefore, that by having a sufficiently large battery of tuning forks any composite sound can be analyzed into its elements, since each fork will pick out and record the tone with which it is in harmony. Such a battery of tuning forks is shown in one of our pictures, ranging from the great fork at the bottom which sounds with the dull and sullen tone produced by 32 vibrations per second, to the tiny one at the top whose legs oscillate at the enormous rate of 40,000 vibrations per second, and which utters a correspondingly high and faint "squeak."

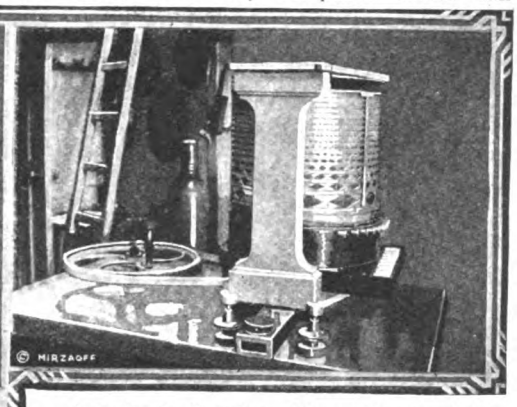
A recording drum or *tambour* is also a well-known device for recording the tracings produced by the vibration set up by sounds. In another picture we see such a recording drum connected with a mouth-piece over which a speaker bends.

Again, the siren is a very old apparatus for producing and counting the vibrations of sound waves. In its simplest form the siren consists of a disc of metal, pierced with a circle of holes at regular intervals and made to revolve in front of a jet of air. As it revolves the air flows thru each hole in turn; at first while the disc is revolving slowly mere puffs of air are perceived, but when it revolves so fast that these puffs are no longer to be distinguished separately, a musical tone is produced, which increases in pitch as the velocity of rotation of the disk is increased. The huge siren shown in our illustration is based on this same principle, but is far more complex and elaborate, as is apparent at a glance.

The Abbé Rousselot in His Laboratory; Various Pieces of Apparatus are Shown, Including Two Specially Constructed Toothed Disks for Studying the Tones and Overtones of Sounds.



**A Most Interesting Battery of Tuning Forks as Mounted Under the Direction of the Famous Abbé, Ranging from Thirty-Two Vibrations per Second up to Forty Thousand, Covering Practically the Range of Audition of the Human Ear.**




Apparatus for Registering Human Speech and Also the Air Pressure or Current Coincident with it; the Koenig Siren as Perfected in His Laboratory by the Abbé Rousselot.

# Scientific Stage Illusions

By H. WINFIELD SECOR

ASSOCIATE MEMBER, AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS

TO say that so-called stage illusions or tricks of magic are founded on certain peculiarities in the field of science may sound, perhaps, somewhat far-fetched, but such, however, is a fact in many instances. To begin with how many of us ever thought for a moment that the sword swallower we saw at the circus or dime museum, ever actually swallowed the swords, even tho he handed them to us for close scrutiny? Of course he was using trick swords which *folded up* or *telescoped* by pushing a secret button, as he apparently past them down his throat—but it seems that we were or are all wrong, for we learn on the pledged word of Robert Houdini in his new book—"Miracle Mongers and Their Methods," that practically no first-class sword swallower ever has used a telescopic or collapsible sword, but due to the scientific fact that when the head is thrown back the oesophagus and mouth are placed in a practically straight line, the performer, after sufficient practise to accustom the lining of the oesophagus to this unusual effect, can actually swallow not one sword, but in some cases as many as seventeen swords simultaneously. Madame Edith Clifford, Champion Sword Swallower of the world, has succeeded in swallowing a 26-inch sword blade or in other demonstrations ten thin blades, which are removed one at a time, states Houdini. To be sure these swords are not sharp, i. e., they do not cut the tissue.

### Man in Hot Oven Trick

For many years, altho not in favor at the present time, there were performers, who amused the people of both this country and Europe, with many hair-raising varieties of *fire-eating* and *heat resisting* tricks of the Black Art. Possibly one of the most popular tricks at one time was that in which a man enters a large hot oven, in which the flames can be seen thru a mica or grill-work door, the performer afterward emerging with a steak or piece of other meat cooked by the intense heat during his stay in the oven. Altho, as Houdini—the great miracle worker of the present day, points out in his book, there were, undoubtedly, several of these human salamanders, who could withstand remarkably high temperatures, even up to 300 degrees Fah. and more, there is a certain trick method which was used by some of the magicians and which we show in the illustration at Fig. 1.

The oven might be constructed, for example, of sheet iron with a large window in the upper part of the door covered with plate glass or mica, with pieces of cotton waste soaked in alcohol, placed inside the oven and which could be ignited either by the performer after he entered the oven and locked the door, or else by an attendant passing a lighted taper thru a small hole in the oven wall. Other pieces of cloth soaked in alcohol are placed on top of the oven and when ignited, present a very spectacular effect, especially if the oven is arranged sufficiently high above the stage so that the audience can assure themselves that no mirrors or other artifices of the stage magician have been used to trick them, such as traps to permit the performer getting thru the bottom of the oven while the fire is burning. Salt may be added to the alcohol to make a more spectacular flame.

The fire-eater?—Oh, yes! we almost forgot to mention that he invariably wore an asbestos suit, and further—as we all know, heat rises very rapidly. A strong draft of cool air is sucked in thru holes in the bottom of the oven, by the action of the blazing waste, and moreover the performer usually laid on the bottom of the oven, with his mouth directly over either an opening in the floor or else over a small pipe thru which he breathed fresh air. The piece of meat to be cooked was of course placed near the top of the oven so that some of the blaze and heat would reach it. When the blaze died down after a few minutes, the performer arose, opened the door and walked out with the *cooked meat.*

**How red hot swords are swallowed, steel boiler "escapes" made, and how Houdini gets out of the milk can full of water just in time to save himself from being asphyxiated—these and many other scientific stage mysteries are explained in the accompanying story. P. T. Barnum was right it seems, when he said, "the American public likes to be fooled." He did not mean this in a sarcastic way, but simply stated the fact that Americans like to be entertained by master magicians. If you do not think that Barnum was right, just study a few of these tricks and propound them to your best friends or to the folks at home. You will be surprised indeed at the simplicity with which the keenest minds are often misled and shall we say "double-crost" or entertained?**

Those interested in Black Art performers of a generation or more ago, who swallowed not only tacks, nails and poisons, such as arsenic, but also boiling oil and a hundred other kinds of miscellaneous hardware and junk, and "got away with it," will find it extremely interesting to read all about them in Houdini's "Miracle Mongers and Their Methods."

### The Disappearing Elephant.

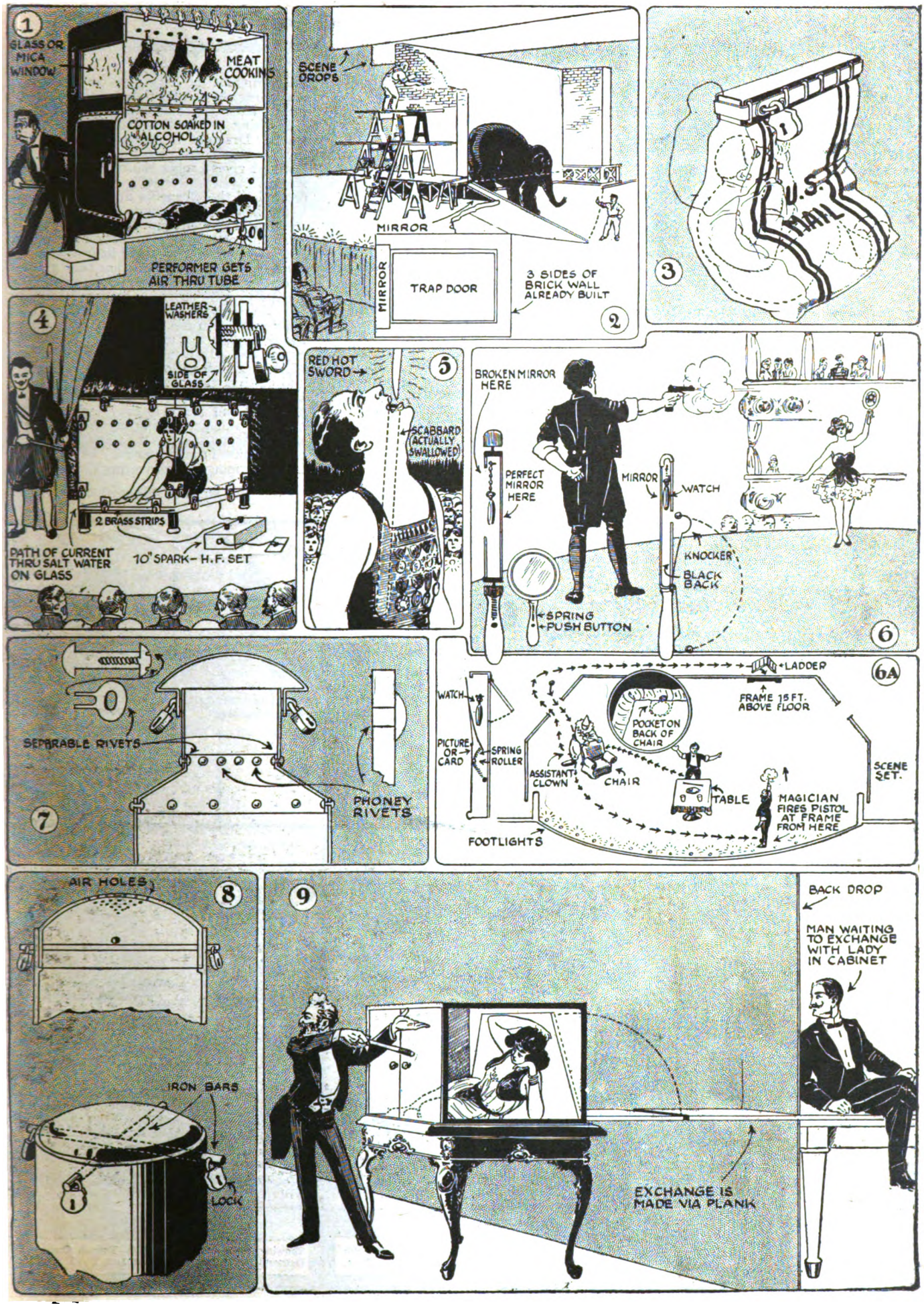
Perhaps you were fortunate enough to have visited one of the New York theaters a season or so ago, when the art of magic was called upon not only to make a rabbit appear from a magician's high silk hat, or from a hat borrowed from a spectator, but to actually cause a full grown elephant to disappear right before your very eyes and surrounded by a solid brick wall at that! This disappearing elephant trick is illustrated in Fig. 2. When the curtain goes up, the rear and two side brick walls are exhibited already built. The elephant is then, with all due ceremony, paraded across the stage and led up an incline onto the platform supporting the walled inclosure. Masons then start in building up the front brick wall, and at the crucial moment when the elephant is all locked nicely inside his little brick jail, lo and behold—the same elephant comes ambling across the stage; and after some of the bricks have been knocked away you are convinced indeed that there is no trace of the elephant or even of his ghost left in the brick wall inclosure. The diagram in Fig. 2 shows how this trick was accomplished; after the front wall was about completed the elephant was led down the inclined floor, which was hinged, and was then led along underneath the stage, thence upstairs upon the stage once more, while the hinged floor was pushed up in place again. The action of the hinged floor was rendered invisible to the audience—thanks to a mirror placed at the proper angle under the front of the platform as indicated.

### The Mail-bag Escape

The *mail-bag escape* is perhaps one of the best tricks of this nature performed, even at the present day, the audience being completely mystified as to how the performer gets out of the mail-bag once he has been locked in, especially if locked in the bag by men from the local Post Office Department, and using a standard mail sack fitted with the lock used officially. Fig. 3 illustrates how the escape from the mail-bag is made. To begin with the performer in some cases uses his own mail-bag, made exactly like a government bag in every particular and provided with a standard Yale or Corbin lock; or else he may challenge the Post Office officials to lock him in their own bag, provided with their own lock. In the latter case the performer does not see the bag or the lock until he is going to be placed in it. By his expert knowledge of all such locks therefore, he has to provide himself with a suitable skeleton key or else a standard key to fit the lock on the P. O. mail-bag. If he uses his own mail bag and lock, he of course knows just what key to use. This key is secured to a piece of strong cord and this he secretes on his person before coming on the stage. The committee from the audience pull the straps tightly thru the loops on the bag and finally snap the padlock in place. The curtain of the cabinet is pulled down and in a few minutes the performer appears—free from the sack and also free of any handcuffs or leg-irons, with which he may have provided the committee, in order to make the trick seem more difficult. This trick is beautiful in its simplicity, the only thing being that you *must* know ahead of time what kind of lock is going to be used on the bag, or else take a long chance of guessing which type of simple skeleton key will unlock the Post Office padlock. As soon as the curtain is dropt on the cabinet, the performer, gets hold of his skeleton key secreted on his person (attached to the sole of his foot with adhesive tape if in swimming tights and bare legs, (or carried in the pockets of his suit, if in evening dress), which key is fastened to the end of the string as you will remember. He thrusts his key out thru the small slit-like space in one corner of the bag, which may have to be forced open a little to make room for the key to be pushed out. The key is allowed to dangle down eight or ten inches. The string is tied fast to a vest button so that the key will *not* be lost; the performer then *feels* thru the canvas of the bag until he gets hold of the key—and noting the position of the lock he fumbles around with the key until he enters the key into the lock and opens it! He makes his escape, feeds the strap back in place and snaps the lock in place. The rest of the story is simple. He then appears before the curtain of his "Magic Booth," a free man once more. Aha!

(*Continued on page* 174)

# Modern "Magic" and How They Do It



# Dynamite Boosts Plant and Tree Growth

## How Blasting the Soil Enables Roots to Gather Food and Water from Lower Soil Strata

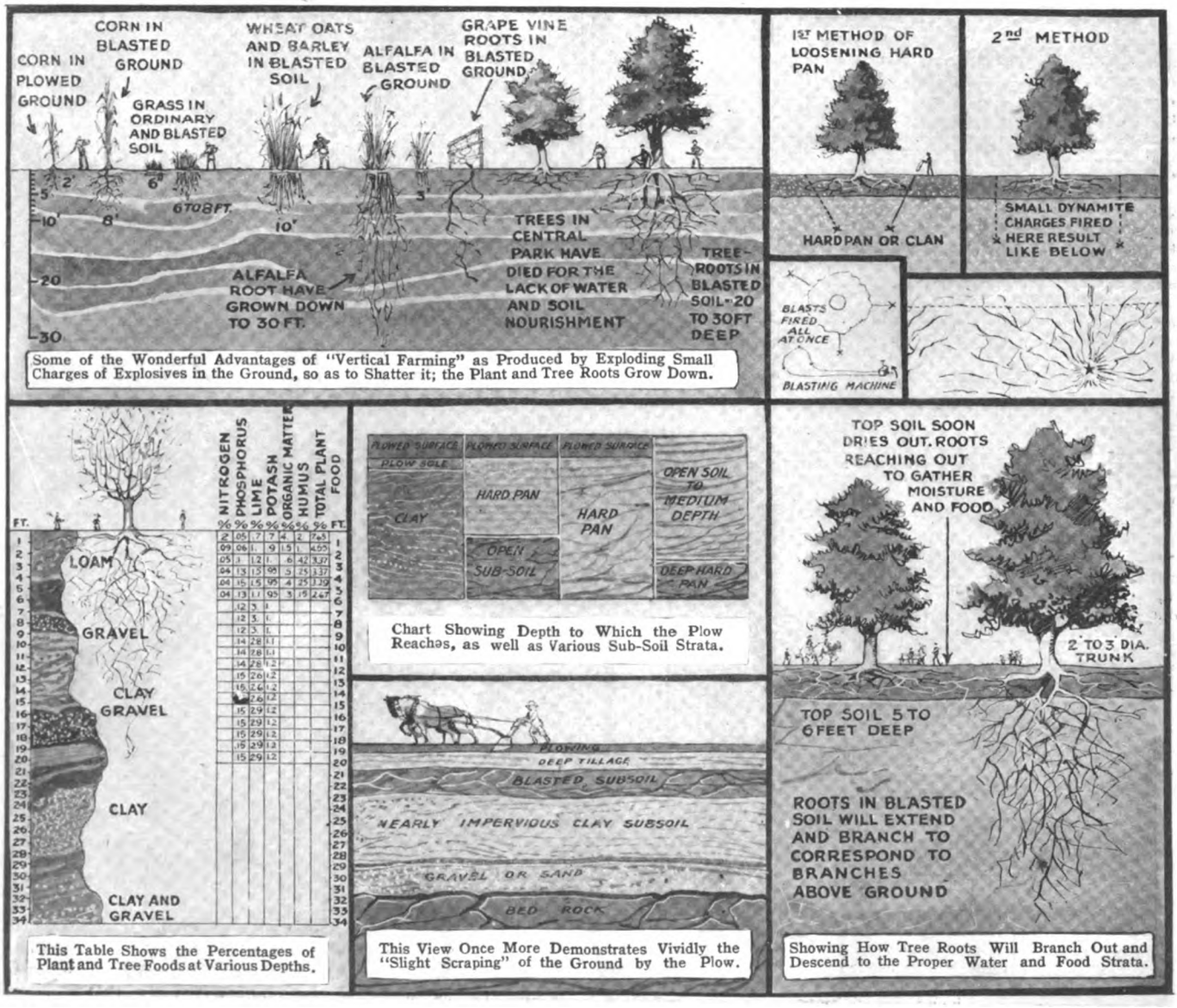
IT is admitted that present methods of cultivation do not penetrate sufficiently into the earth, and that the use of specially prepared agricultural explosives would seem to offer the desired remedy. It is admitted by all authorities in agriculture that the plow and harrow do not go deep enough and they advise the use of subsoilers. Scores of books explain how and why each piece of machinery turns over the soil, reduces it to fineness, forms mulches, saves water, breaks clods, aerates, stimulates bacteria, etc.

If all this wealth of invention and labor is worth while bestowing upon the first few inches of the soil, why is it not worth following the roots down to their second foot of growth, their third, and even their eighth and tenth foot when they flourish at those depths. The only reply is, "Yes, it would pay, but how can it be done?" It can be done economically, quickly, and thoroly by the use of explosives. Deep plowing is recommended by all authorities "wherever the resisting soil will permit." Machinery, made especially for deep work may be stopt by the hard sub-soil, but nothing can resist the explosives. The farmer plows, harrows, and spends a vast amount of time, labor and money in cultivating the surface foot and rejoices in the wonderful alchemy that follows his endeavors—the mysterious activities he has set in motion. He works cheerfully and with confidence, largely because he can see what he is doing. In the new agriculture he must work by faith and reason at depths where he cannot see with his eyes what is taking place. The result will place before his eyes, in the form of bumper crops, proofs of the benefits of his work. The new agriculture simply points out the benefits acquired by the thoro cultivation of the foot, or two feet, and by explaining how and why this is accomplished, points out the value of extending the cultivation further down by the simple means of explosives—all of which is pointed out by Prof. Gilbert Ellis Bailey, Dept. of Geology, in the University of Southern California, in his book entitled, "Vertical Farming."

The harrow warms and aerates the soil, and promotes activity by oosening and separating the soil particles at the surface. Explosives do the same, breaking, loosening, pulverizing at depths machinery cannot reach. Drainage is recommended by all, because it removes excess of water, admits air, and gives proper moisture conditions. Explosives have drained many a field and secured all these benefits at far less cost in time, labor and money than the usual methods of ditching and tiling involve.

The importance of nitrification is proven, but why confine it to the thin furrow slice, when the action of bacteria has been proven at depths of six feet in the humid soils of the East, and still deeper in the porous soils of the arid and semi-arid regions of the West? Why not loosen the soil and secure proper conditions by the use of some charges of explosives? It is admitted that there is much of plant food below the shallow plowed and cultivated ground, and that the roots will go down if they can. Why not open the way and make it easy for them by cracking and pulverizing the soil with explosives as far down as the roots care to go? It is admitted that water may be stored, as in dry farming, by converting the soil itself

(*Continued on page* 162)




Some of the Wonderful Advantages of "Vertical Farming" as Produced by Exploding Small Charges of Explosives in the Ground, so as to Shatter it; the Plant and Tree Roots Grow Down.

This Table Shows the Percentages of Plant and Tree Foods at Various Depths.

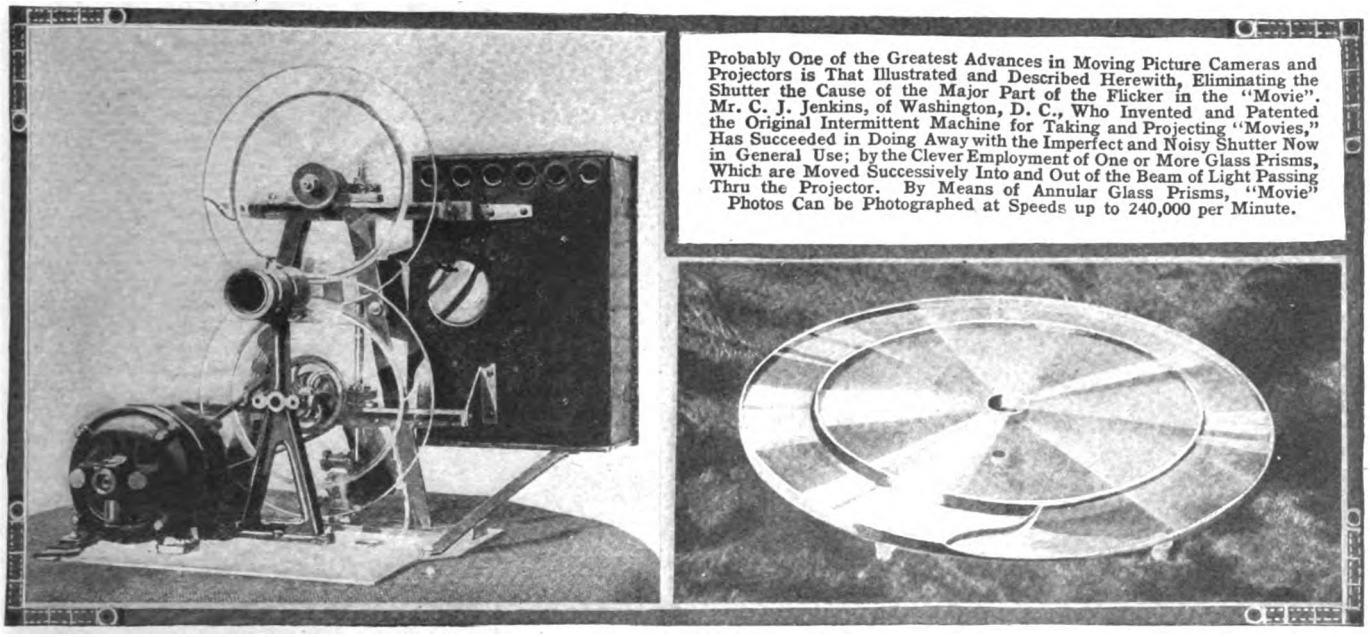
Chart Showing Depth to Which the Plow Reaches, as well as Various Sub-Soil Strata.

This View Once More Demonstrates Vividly the "Slight Scraping" of the Ground by the Plow.

Showing How Tree Roots Will Branch Out and Descend to the Proper Water and Food Strata.

# 240,000 "Movie" Photos Per Minute

**By C. H. CLAUDY**



Probably One of the Greatest Advances in Moving Picture Cameras and Projectors is That Illustrated and Described Herewith, Eliminating the Shutter the Cause of the Major Part of the Flicker in the "Movie". Mr. C. J. Jenkins, of Washington, D. C., Who Invented and Patented the Original Intermittent Machine for Taking and Projecting "Movies," Has Succeeded in Doing Away with the Imperfect and Noisy Shutter Now in General Use; by the Clever Employment of One or More Glass Prisms, Which are Moved Successively Into and Out of the Beam of Light Passing Thru the Projector. By Means of Annular Glass Prisms, "Movie" Photos Can be Photographed at Speeds up to 240,000 per Minute.

THE heart of the ordinary moving picture machine is the intermittent motion, by means of which the film is stopped in front of the lens, held stationary while the shutter opens, and then moved forward the length of one picture while the shutter is closed. This operation normally occurs sixteen times in a second. It can be made to occur one hundred times in a second, *but not faster*. If the mechanism is speeded up beyond one hundred stops and starts in a second the film tears.

The whole mechanism is small and delicate, but yet must be made sufficiently rugged to be accurate, for any inaccuracy in its working is magnified in proportion as the picture on the screen is larger than the film which makes it. Both because of its small size and the need for making it accurately, and because it has limits of speed, inventors have for years sought to produce a picture mechanism the movement of which would be not intermittent but continuous . . . which would, in other words, permit the picture on the screen to appear even though the film which produced it was continuously moving.

A thousand schemes have been tried and failed. Now comes C. Francis Jenkins, of Washington, D. C., who invented and patented the original intermittent motion machine, with a totally new idea in projectors which permits the film to move smoothly and continuously, while the moving pictures resulting from it remain each one in its stationary position, on the screen.

Mr. Jenkins' device is not a theory nor merely a patent—it has been made, tried, tested and is now in use, although not yet upon the market commercially.

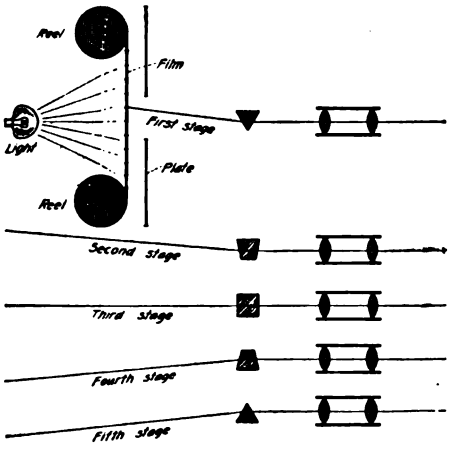
### Glass Prisms Solve the Problem

Mr. Jenkins' scheme is simple enough in conception. If the film is to move and the light rays proceeding from the lens, which have first passed through an individual picture on the film, are to remain in a stationary position on the screen, some method must be provided by which these light rays can be continuously bent, this bending to be opposite to, and equal in amount and speed with, the movement of the film. In other words, Mr. Jenkins' device puts a *hinge* in the light rays. To understand how this is done, imagine a prism of glass of any length, we may say two feet. This prism is triangular in cross section at each end, but the right

## No Intermittent Motion or Shutter Used in New Flickerless "Movie" Projector and Camera

hand end is a triangle with apex *up* while the left hand end is a triangle with apex *down*. In other words, this prism is made so that it reverses itself between its ends. In its center it is not a prism but a bar of glass with parallel sides.

If such a prism be moved through the path of a stationary beam of light, it will throw




**The Diagram Above Will Help in Understanding How the Jenkins Prism "Movie" Machine Causes the Beam of Light to be Past First Thru the Lenses and the Picture, and then off the Lenses. A Prism has the Property of Bending a Ray of Light to a degree depending upon the position and shape of the prism. The Jenkins prism is of constantly changing shape, and as it revolves, it is clear how the beam of light is first past thru the film and lenses and then shunted to the screen.**

that light on a screen in a band which moves, up or down, as the prism is moved from one side to the other. But if the band of light be itself moving and the prism is moved so that the movement it would cause in the stationary light beam is the reverse of the moving light beam motion, then the beam of light beyond the prism *will stand still*. The prism bends the beam *up* as fast as the film movement makes it move down; it thus remains stationary.

Mr. Jenkins takes a circular plate of glass and grinds upon the edge of one side such a reversing prism, thus bending his straight reversing prism into a circle. By revolving this reversing prism in the path of the light rays as they come from the film, he bends them in an opposite direction to an amount equal to their movement as caused by the movement of the film. The result is that the picture on the screen remains in position, even tho the film is in continuous movement.

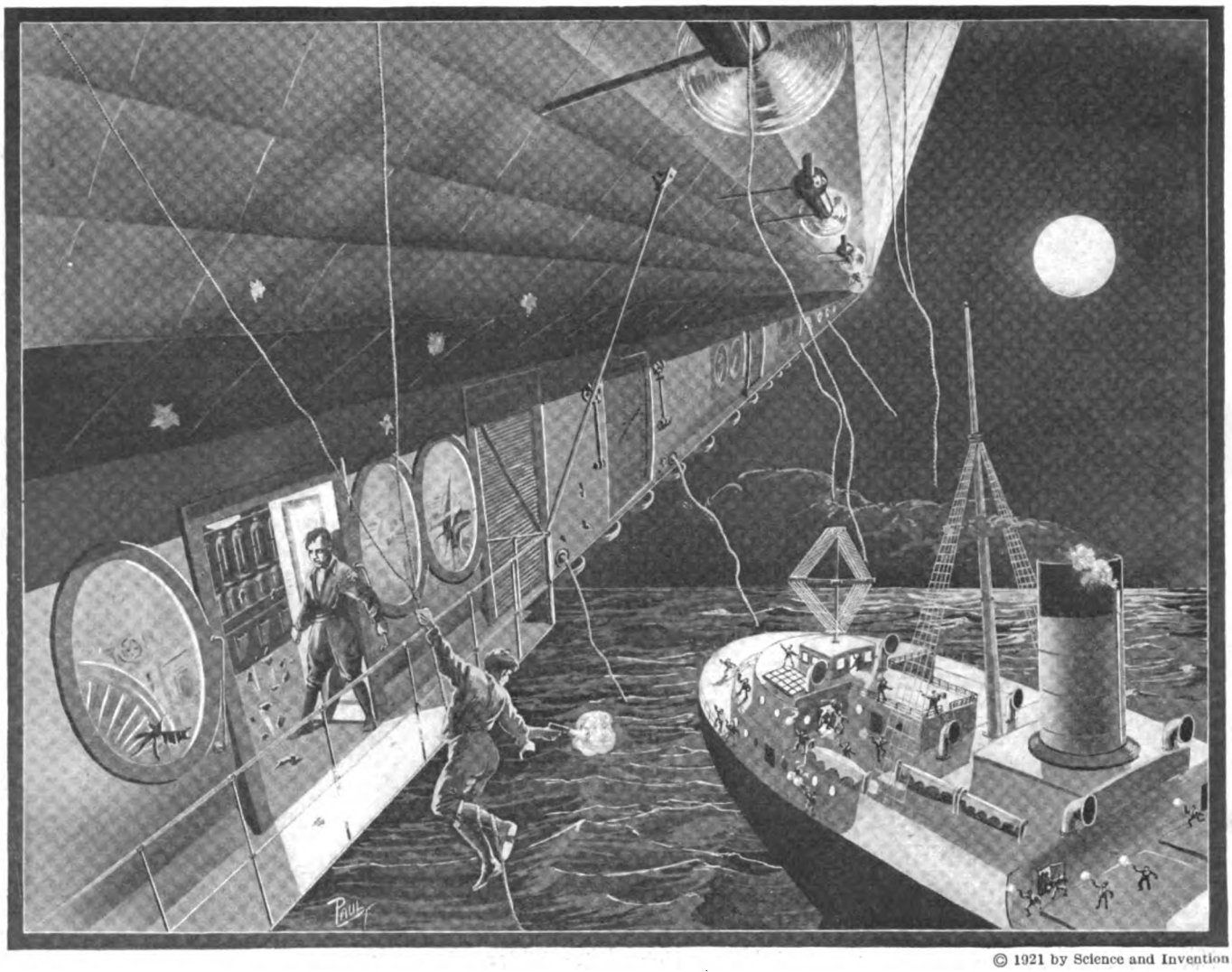
In the illustration here reproduced, two such prisms on the edges of two circular plates of glass are shown; this plan is merely a matter of convenience of manufacture, it being easier to put two prisms on two plates of glass than one on each side of a single plate of glass. But that is a detail of manufacture, and in commercial machines either both sides of the prism would be upon opposite sides of a single plate or the angles would be so calculated that only one cutting of a reversing prism would be needed on one side of a single plate.

### Films Move Continuously—No Intermittent Motion.

The advantages gained by such a mechanism are numerous. In the first place the intermittent motion with all its delicate parts and possibility of wear and derangement, is dispensed with entirely. In the second place, the film, moving continuously is not subject to wear and tear as it is when started and stopped with great rapidity. In the third place, there is no shutter necessary with the continuous motion projector. As the film is in continuous motion but without that showing on the screen, there is no need for a shutter to mask its change in position. Eliminating the shutter not only simplifies the mechanism but makes it possible either to show as bright a picture as we ordinarily see with half the light we usually have to use, or to show a picture twice as bright with the same light. Some shutters, of course, are closed but a third of the time, in which case the Jenkins projector shows a gain of light efficiency over such intermittent machines of but 50% instead of 100%.

These advantages are enormous, the Jenkins projector is simplest, least subject to wear, least expensive and most accurate.

(*Continued on page* 191)





**". . .'Hold on! For God's sake, Hold On.' I Cried to Young, as I Gript the Deck Rail of the Air Liner and Swung Myself Aboard. I Leaned Over the Rail and Looked For'd and Saw a Pair of Legs Dangling in the Air . . ."**

# The Deflecting Wave

## By HERBERT L. MOULTON

### A Radio-Dirigible Story

THE great air liners of the Aero Transit Corporation carried neither pilot, engineer nor crew in their silent flights back and forth between the two hemispheres. Pierre DeFoe, the President of the Corporation, had developed, two years prior, the radio-controlled mechanism that guided these giant liners across the sea and was just now beginning to reap the reward that his inventive genius warranted.

The Corporation's English landing field lay just outside of Liverpool. At the Northern end of this field a single steel tower, five hundred feet in height, supported an antenna, the lower end of which terminated in a small, brick building two hundred feet from the tower's base. In this building were housed the sensitive instruments that Pierre DeFoe had conceived and invented. Entirely automatic in their operation, they kept as many as fifty air liners on their respective courses over the Atlantic at the same time.

At a point midway on Long Island was a field almost identical in character with the English station, operating control apparatus for American-bound air-liners.

The instruments at these two stations had but one function to perform at all times: the emission of a continuous wave of a certain length. Each air liner itself carried the instruments that automatically controlled the ship's rudders and kept the nose of the giant craft headed for its destination. Two powerful Diesel engines turned the dynamos which generated electricity for the several motors. To be more specific, there were eight motors, each connected direct to a huge propeller, the latter driving the liner thru the air at a speed of from 75 to 100 miles per hour.

As has been said, each master station emitted a continuous wave through the ether, and as long as this wave was sent out, all the air liners bound for that station would hold to their course, irrespective of changing winds, storms or other meteorological conditions. When a liner came within one mile of a station, it left the master control and an operator in the auxiliary tower brought the craft down by means of a manual control, until it rested upon a huge cradle on tracks. It was thus towed over the field and in to the unloading hangars.

Once every hour an air liner left the Liverpool station while another made its departure from the Long Island field. Tons of express and freight were carried over the Atlantic, the Corporation's passenger service being a separate organization, operating regular air liners which carried both pilots and crew.

For the past year DeFoe had been negotiating with the Government for the trans-Atlantic mail contracts. He pointed out to the officials in Washington the fact that his Corporation maintained a 48-hour running time between New York and Liverpool; that the factor of safety was as great, if not greater, than that possessed by the steamships; and that he could transport the mails at a cheaper rate than could the steamers, as his air liners were automatic in their operation and did not require an operating personnel.

DeFoe had just arrived at that point in his negotiations where the Post Office officials were about to affix their signatures to the coveted mail contracts, when the unexpected happened.

On November 1st, 1927, the "Ramapo," one of the Corporation's largest air liners, left the Long Island airport with twenty

(*Continued on page* 166)

# French Dolls Imitate Humans

BY OUR PARIS CORRESPONDENT

FOR many centuries the world has been greatly interested in marionettes, from the wire-operated suspended figures of the more pretentious installations down to the Punch and Judy exhibitions of the itinerant showman of England and the Continent. In France an ingenious artist has developed automatic dolls that wind up and go thru their motions by machinery, so that they perform their evolutions unassisted by the hand of the performer. Triboulet is not only an artist of high reputation, but is an ingenious mechanician; he produces elaborate exhibitions of these miniature figures all operated by springs; their machinery is wound up like that of a clock. The machinery is quite complicated; levers are thrown in and out of action, and these operate subsidiary mechanism making, it may be, a figure smoke a pipe, whistle, wink, bow and perform a quantity of everyday actions with a surprisingly humanlike grace. The great war interfered naturally with this entertaining pastime for the public, but now it is coming to light and M. Triboulet is producing some of his most remarkable achievements, figures drest by expert dressmakers and operated by the artist's wonderful machinery. In this country we have had the privilege of seeing various marionettes, some of the Italian school, and others of the Anglo-American school, as we may term the very elegant productions of Mr. Tony Sarg. It is to be hoped that we will soon have a chance to see M. Triboulet's mechanical acrobats, comedians and perhaps tragedians in their lifelike presentations on the mimic stage.

Marionettes, often quite complicated, are operated by wires. They are suspended by wires from the hand of the operator; there may be other wires to operate their legs and arms, to roll their eyes and the like. A quantity of wires are sometimes used on a single figure and to keep a play going a number of operators are needed.

Triboulet's work is an advance on the old hand-controlled figures. Each actor operates individually, and once set on his course over the boards of the stage, takes care of himself, his prompter or operator simply having to supply the dialogue.

There is considerable literature on the subject of marionettes, but this is a new departure as developed by M. Triboulet.

Top Center: M. Triboulet in His French Workshop, Painting the Heads and Arms of His Mechanical Actors, Thus Preparing Them to Make Their Bow and Play Their Part Behind the Footlights on the Miniature Stage.

Photos © by Kadel & Herbert

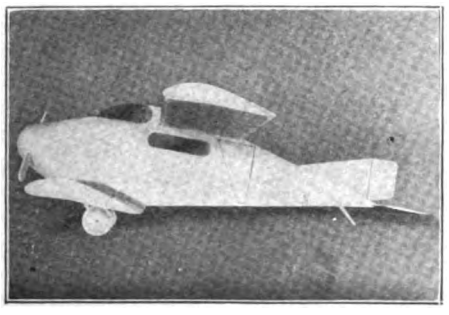
Center Photo: A Clown Musician; This Represents Quite a Complicated Piece of Mechanism as the Figure has not only to go Thru the Motions of a Hand Organ Player, but Music has also to be Produced.

Left Photo shows one of Triboulet's clown performing a marvelous acrobatic stunt, that of actually balancing a miniature chair on his foot while he lies on his back on the table.

At Left: A Village Scene Participated in by a Number of the Triboulet Mechanical Actors with Vivid and Lifelike Action. These Toy Actors are Operated by Cleverly Constructed Spring Motor Mechanisms and Various Levers Arranged to Cause the Figures to Walk, Bow, Smoke, Etc.

# A New All-Steel Airplane

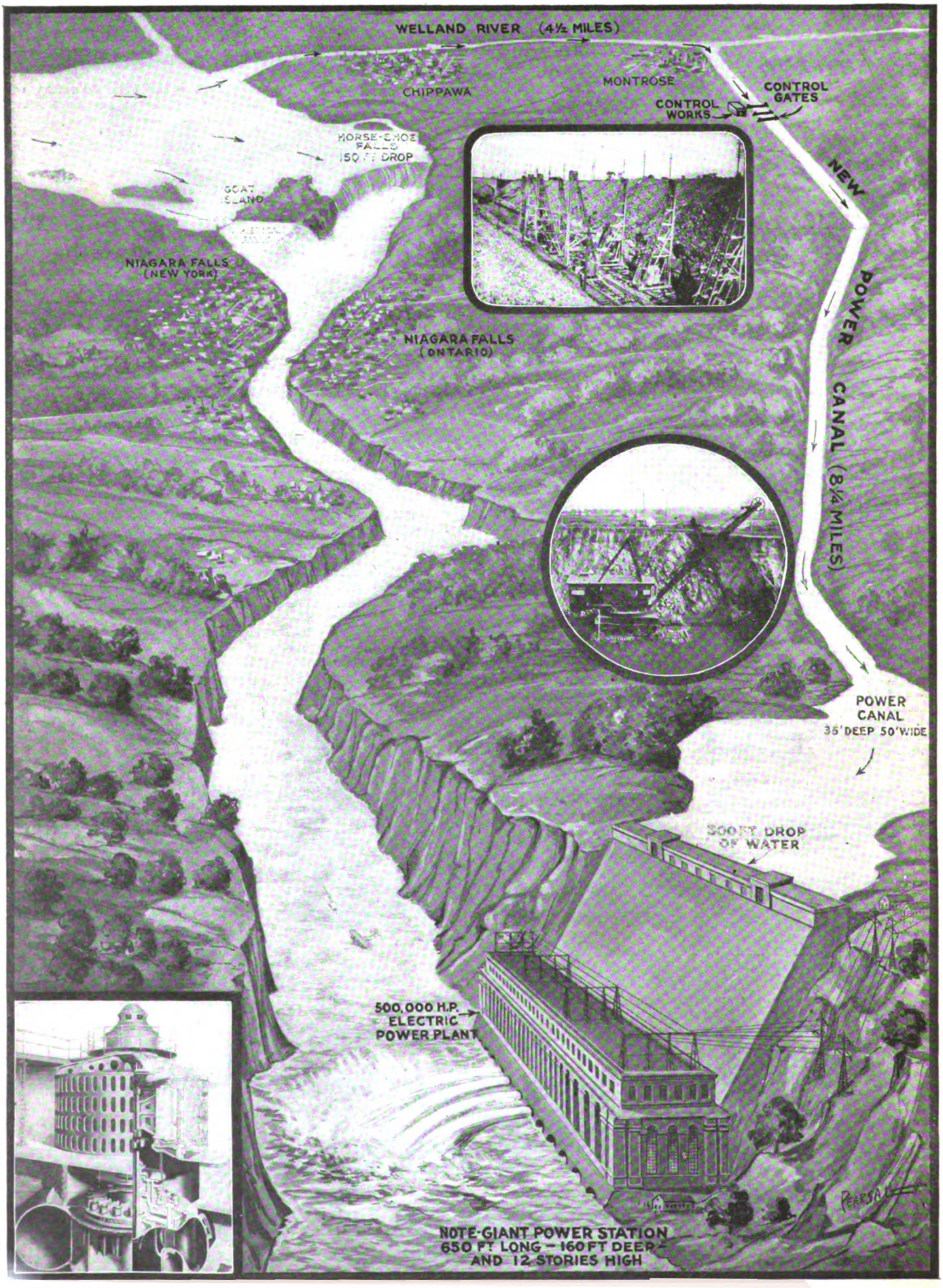
A very compact and elegant airplane of most striking design is shown in the photo herewith. Its smoothness of contour and approximate stream lines will at once attract the observer's attention, but the really characteristic feature of it is, that it is made of steel; struts and wires, sources of air resistance and even involving a certain amount of danger, are dispensed with. The construction of the machine with these parts eliminated, reduces, it is claimed, head resistance some sixty or seventy per cent. The wing-spread of the machine is 32 ft. 9 inches and its length is 29 ft. 6 inches.



An All-steel Airplane; Notice the Stream Line Effect, the Absence of Struts and Wires, and the Mechanical Appearance of the Structure.

The machine is designed for quantity production. Its weight is sixteen hundred pounds and it will carry a ton. Its speed is put at one hundred miles per hour. If the machine in its performance plays up to its appearance, it certainly will mark a decided advance in aerial science. In its design great care has been taken to obtain at once safety and perfect control.

# Chippawa Power Canal To Develop 500,000 H. P.



# Gain 500,000 H. P. by Outwitting Niagara River

**By WILLIAM BUTLER**

## The Queenston—Chippawa Power Canal Takes Water From Above Niagara Falls

THE new Chippawa Power Canal now being constructed by the Hydro Electric Power Commission of Ontario is one of the world's greatest engineering feats. The Hydro Commission was appointed, May, 1906, by the Legislature of the Province of Ontario to undertake the development, generation, transmission and distribution of electrical energy at cost to various municipalities thruout the province.

Can you imagine mere man trying to double or triple the gigantic force of Niagara Falls? Yet that is the aim in view in the construction of this canal, work on which will be completed by September, 1921. This new power development is the first effort made to utilize the full head of water between Lake Erie and Lake Ontario. At Niagara Falls only a portion of the total head is converted into power.

Altho the development was promoted in 1914 it was not until 1917 that the grave power shortage thruout the province, caused by the war, compelled the Hydro Electric Power Commission to look for an increased supply of electrical energy. Ordinarily it was designed to develop 200,000 horse power at a cost of some ten million dollars, but, because of the great power shortage, the capacity of the plant was increased to 500,000 horse power. This was done by slightly widening the excavation. The cost of the new development will be over fifty millions of dollars.

How will the great force of Niagara be so improved upon to yield all of this added power? Niagara Falls drops only 150 feet whereas the drop at Queenston will be 305 feet. Power is generated by water turning turbines. The amount of power depends on the speed and size of the turbines; and the speed depends on the amount and head of water turning them. The farther the water falls, the greater the power it generates. The Chippawa canal will outwit Niagara by developing almost half a million horse power, which is three to four times greater than the production of any plants now at or near the great falls.

The total length of the Canal is twelve and three-quarter miles, of this, four and one-half miles follow the bed of the Welland River, the course of whose water is reversed, and the remaining eight and one-quarter miles of earth and rock excavation are from Montrose to the forebay just above Queenston. The Welland River runs sluggishly into the Niagara only a short distance above the Falls. By dredging and cementing, the Welland River is made to run backwards. Water will then flow up it, out of the Niagara River and then into the canal proper. An ingenious ice skimmer has been designed for skimming off floating ice.

The magnitude of the undertaking is almost bewildering to the laymen. Over seven miles of the canal is cut thru solid rock. In the rocky portion of the cutting the walls are vertical, the canal is thirty-five feet deep and fifty feet in width. In the short sections thru earth the canal is 35 feet wide at the bottom sloping out to 160 feet at the top. Some 15 million cubic yards of material have had to be blasted and removed. Over 2600 men are employed.

A double track railway 45 miles in length skirts the whole works. The majority of the engines, employed in carrying away the excavated material, are electric, altho a few steam engines are used. The engines used here are much larger and more powerful than the average electric engine. There is no loss of time and no waste motion as one train of cars moves off to the main disposal dump, another train is ready to be loaded.

Many interesting and curious machines are in operation. Some of science's greatest engines are used on this work. One of the centres of interesting things are the three steam shovels which weigh three hundred and seventy tons each, and are said to be the largest shovels ever used on this continent. To illustrate their greatness: the shovels lift eight cubic yards of material at one bite. The shovels are moved on a specially constructed track under their own power. Practically all the machinery on the job is electrically operated. The channeers or submarine drills which pound twenty feet deep into the rock are said to be the most powerful on earth. Fourteen shovels and dredges are at work continually. The largest hydraulic dredge known, "The Cyclone," loaned by the Toronto Harbor Commission, is operating in Chippawa Creek.

The forebay previously mentioned is a huge reservoir just above Queenston where water is stored for supplying the various electrical units.

The deepest cut is at Lundy's Lane with a total depth of 145 feet, and is made up of 70 feet of earth and 75 feet of rock. Considerable difficulty was at first encountered because of quicksand, but this difficulty was later solved. From Chippawa to Queenston the total fall in the canal is about 10 feet and the flow of the water will be six feet per second.

Contracts have been placed for five 45,000 K.V.A., 12,000 volt, three-phase, 25-cycle, 187½ R.P.M. vertical generators. Voltages as high as 132,000 for line transmission will be used.

Next September when the water is turned into the canal the people of Ontario will have for themselves the largest individual power development in the world, and will shortly be able to boast of possessing the largest power house in the world. It is now in course of construction and when completed it will be the latest in electrical and hydraulic equipment. Located at the base of the cliff the power house in comparison looks small, yet the Hydro administration offices in Toronto—a six story building—would fill only a corner of the building.

Here is a vivid way of illustrating its size: If it were possible to place the power house in front of the American Falls, that great sheet of water would be entirely obliterated. The dimensions of the building are approximately as follows: Height 160 feet; length 650 feet; and depth 160 feet. The building will be of structural steel and concrete and the floor is sixty feet above water level. The superstructure is going up rapidly and several 150 ton cranes are in operation. The rear portion of the building will be used for offices and storage purposes. Telegraph and loud-talking telephone communication between the dynamo and main control rooms will be provided.

Access to the power house is provided for at the top of the cliff. There is an elevator down to the half-way level and a tunnel leads to the generator room. The main generator room will be 60 feet high and the same number in width. The thrust bearings in these generators are designed to carry a load of 1,000,000 pounds. About 100,000 cubic feet of air per minute will be required to cool the generators at full head. The weight of the air passing thru the generator every three hours will equal the weight of the generator itself.

The project is strictly a Canadian enterprise both in its conception and execution. It is interesting to note that over 75 per cent of the engineering staff received their training at the Provincial University. Another interesting point is that 80 per cent of the electrical equipment is made in Canada, the cost reaching close to $4,000,000.

# Wiring for Uncle Sam in France

By FRANK H. BROOME

*Ex. Lieut., Sanitary Corps, A. E. F.*

## The Tale of the "Acrobatic Electricians"


**The French Wounded Were Agreeably Surprised to See This "Human Stepladder" Stunt by "Butts" and "Mike" for Quickly Testing a Row of Sockets for a "Short-Circuit."**

"ATTENTION!" called Top Sergeant "Jack" Stripes at the entrance to ward number 1, Base Hospital No. —, A. E. F. France, on Saturday morning at the usual weekly inspection. "Mike," standing on the top of a French ladder, splicing some leads for an inspecting light for Lieutenant Jones, momentarily forgot his perilous position, dropt his pliers and snapt to attention. A roll of tape being tost to him from "Butts" on the floor just mist his head and finished its flight out thru a window. Colonel Lief and Captain Brush stopt for a second and then smilingly continued their inspection.

"How do you get that way?" said Butts.

"Well, he might just as well have knocked me off the ladder as scare me to death," replied Mike, regaining his pliers and obtaining another roll of tape.

Butts and Mike, two old radio operators and electricians, went to France with the hospital in August, 1917, and were assigned as the electricians. Their entire kit of tools consisted of Butts' pliers and screw driver and Mike's battery tester. Thus they started and continued for several months. A French step-ladder was obtained, a socket and some wire taken from an unused room of the old French school, converted into the hospital, and a trouble lamp were added to the outfit. Mons. Riquier, the French electrician, supplied some fuse wire, which, with the rest, was kept in a box under Corporal Butts' bed in the squad room.

A basket of old burned-out lamps was discovered under the desk of the director of the school and by patient shaking some of these were made to burn and supplied lamp renewals for some time. This was all in the old days before the excellent Service of Supplies of the Army was organized so that anything could be obtained on call from a pin to a locomotive.

After several weeks of manipulating, all the circuits were put in condition and nearly all the lights made to burn.

Great commotion was heard one day and someone volunteered the information that a patient had arrived—a patient indeed, a French farmer had been celebrating and had got his arm in a threshing machine. No operating room had been set up as yet, and it was necessary to move the operating table into a convenient place and there was no light handy. Butts and Mike were called and went into consultation. They remembered a circuit that they had just been repairing and went and pulled out the entire circuit and made up a portable with flexible cord, using No. 12 B. & S. rubber covered wire. The operation was successful but the portable died.

**The "Gang" in France—the Author Is Seen in the Center Holding the Improvised "Wheatstone Bridge" Described in the Story**

The first big job was to install an X-ray machine, a 10 K.W. affair, with a synchronous motor. That sounded fine to two old radio bugs, and they went to it "toot sweet." However this machine had been on the S.S. ——— when she was sunk in the Lower Bay and after being salvaged and repacked, what was left of it was in pretty bad shape.

The first thing to do was to unpack it and clean it up a bit. Fortunately the transformer was entirely mounted and filled with oil and being water-tight was none the worse for wear. The control cabinet however looked about done for; the marble top was cracked in several places, all the switches were corroded, the the auto-transformer was entirely water soaked and all the core rusted, the polarity indicator was rusted and corroded. The rectifying cabinet did not get wet but was badly damaged from being knocked around and the motor supports were badly split and cracked. Luckily the micanite rectifying disk was still whole. All the small parts such as the timer, spring leads, etc., were either broken, destroyed by the water or missing entirely.

A water rheostat had to be made to dry out the windings of the autotransformer by electric heat. For this a galvanized iron pail filled with salt water and with lead electrodes immersed in it, was used and served its purpose admirably.

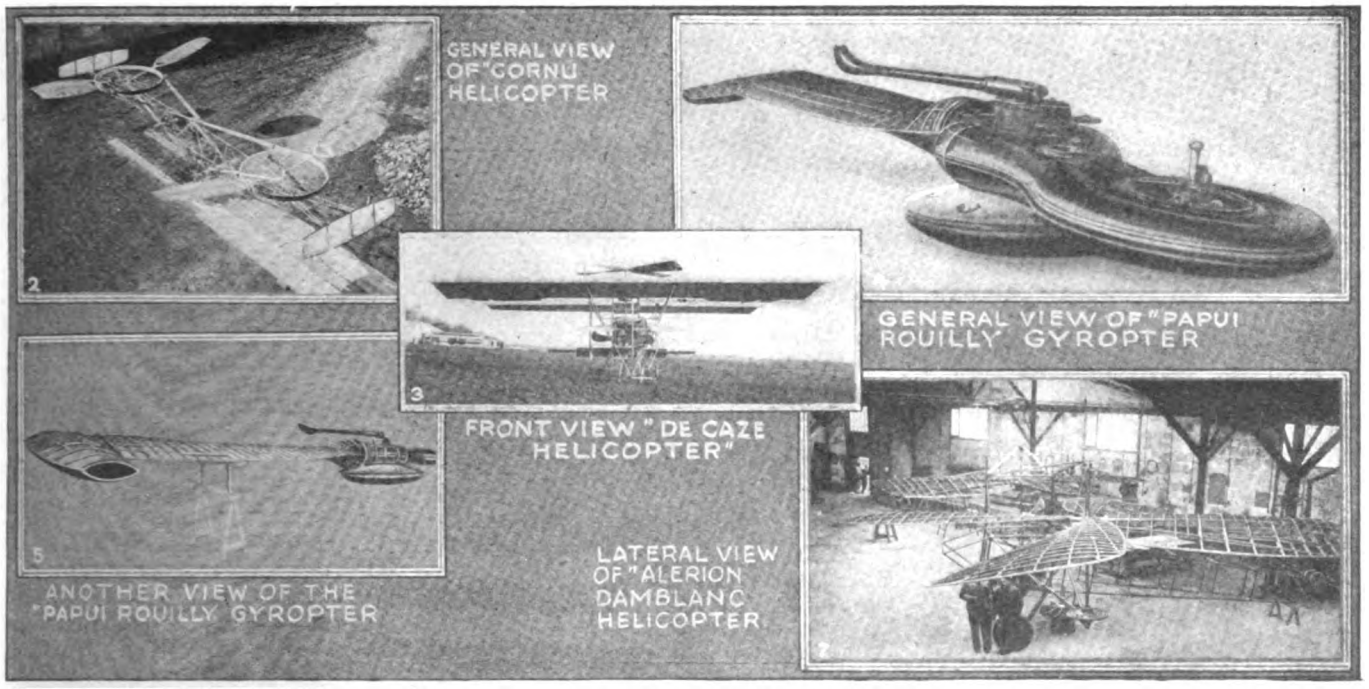
Among the missing were the instructions for installing, but it was not long before the entire outfit had been dried out, screwed together and set up, altho it was necessary to take apart the polarity indicator and solder the connections with a two-pound soldering iron. The machine was still running three months ago when last heard of.

With the process of enlarging the hospital Sam Strong and Jack Tallman came on the scene and took up the extension work, leaving the maintenance to Butts and Mike. With the increase of work a shop was obtained and well equipt and stocked with French electrical material.

There was a lack of any testing instruments and when the motor in the French pumping station, leased by the Army, broke down, the trouble had to be found. This happened to be a three-phase-wound, rotor type, induction motor of German construction — other similar motors used from time to time for various purposes were made in the United States, England, France, Spain and Portugal. The handiest piece of test apparatus to be made was a slide-wire bridge, the slide wire being of German silver wire obtained from the dentist, other parts were taken from old dry cells. Instead of a galvanometer, a phone receiver from the French inter-communicating system was

(*Continued on page* 177)


**"Mike" Forgot His Perilous Position and Snapt to "Attention" at the Sergeant's Command**




**Several Interesting Types of French Helicopter Planes are Illustrated Above. The World War having Interfered Greatly With the Development of This Type of Flying Machine.**

# Will the "Helicopter" Be the Flying Machine of the Future?


## By E. H. LEMONON

RECORDING SECRETARY OF THE FRENCH AERIAL ASSOCIATION


THE first suggestion of the Helicopter is found in the works of Leonardo da Vinci, where a design is described of an Helicopter formed by a "great screw turning about a vertical axis." Towards 1768, Paucton lays down the principle of a machine having "two turning mills, one to support the apparatus and one to drive it along."

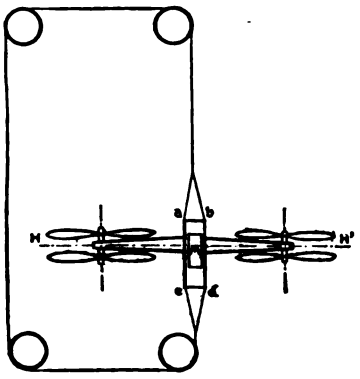



**Fig. 1. Principle of the Ddfaux Helicopter, Which Actually Flew. An Engine M Rotates Two Pairs of Horizontal Screws, H and H'. These Screws Turn Two-By-Two in the Same Direction, Each of the Two Lateral Pairs Turning in Opposite Directions.**

In 1784, Launoy and Bienvenu built a machine consisting of a bow which was bent while making the string perform some revolutions round the arrow which bore at its free end a screw formed of four feathers. The lower part of the apparatus had another screw, and in flight the arrow and the upper screw turned in one direction and the lower group turned in the opposite direction.

During the 18th century there were many attempts in this direction, but none attended by any great success.

In 1862, Ponton d'Amécourt had an interesting machine built. The boiler was made of aluminum and the cylinders of bronze, and the pistons worked two screws 10.56 inches above the ground turning in opposite directions. Total weight 6 lbs., boiler 3¼ inches high and 4 inches diameter. Total height of model, 2 feet.

In 1877, Enrico Forlanini built a remarkable steam Helicopter, which for the first time left the ground bearing its own engine. The steam generator was a little hollow sphere filled two-thirds full of water previously heated to a pressure of 160 lbs. to the sq. inch. The engine drove one supporting screw and the machine rose 5.2 inches and remained in the air 20 seconds.

In 1903, Colonel Renard, established by calculation the "possibility of sustaining in the air a flying machine of the Helicopter type, using internal combustion engines in their actual state of lightness."

In 1905, Dr. J. Richard flew the machine "Leger" for a few minutes. It had two co-axial screws superposed with a diameter of 210 inches, turning in opposite directions. Total weight, 187 lbs. An electric motor drove the screws and the accumulators which supplied the electric energy were on the ground, connected to the Helicopter by two conductors.

The brothers Dufaux were the first to produce an Helicopter rising by its own means carrying its engine and gasoline. In 1905 they built a machine, the model of which from the very first rose by its own means, carrying a useful load of 13 lbs. The engine M had two double-acting cylinders and air-cooled by small fins. It drove two pairs of horizontal screws H and H' each having a diameter of 80 inches, and placed at the ends of rigid bracing in tubes of steel a b c d. These screws turn two by two in the same direction, the two lateral pairs turning in opposite directions. They are made with great care with radii of hollow wood and covered with glazed silk. Total weight of Helicopter, 38 lbs. Normal speed of engine, 1,500 revolutions per minute, giving a little over 3 h. p.

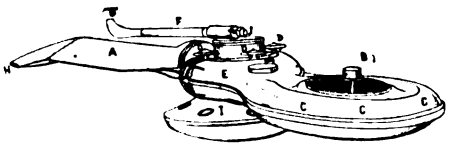


**Fig 6. Papui—Rouilly "Gyropter." The Hollow Wing C-E-A, Has a Current of Air Sucked Thru It By the Engine B, the Air Escaping From the Tip H; the Reaction on the Surrounding Air Causes the Wing to Rotate and Lift the Apparatus Into Space.**

In 1907 Breguet and Richet constructed their "Gyroplanes." The first weighed 1,364 lbs. and rose easily with its pilot nearly six feet above the earth. Area of

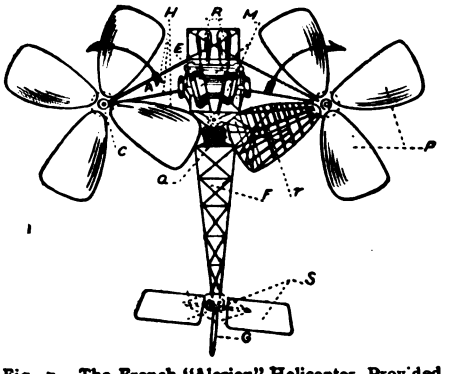


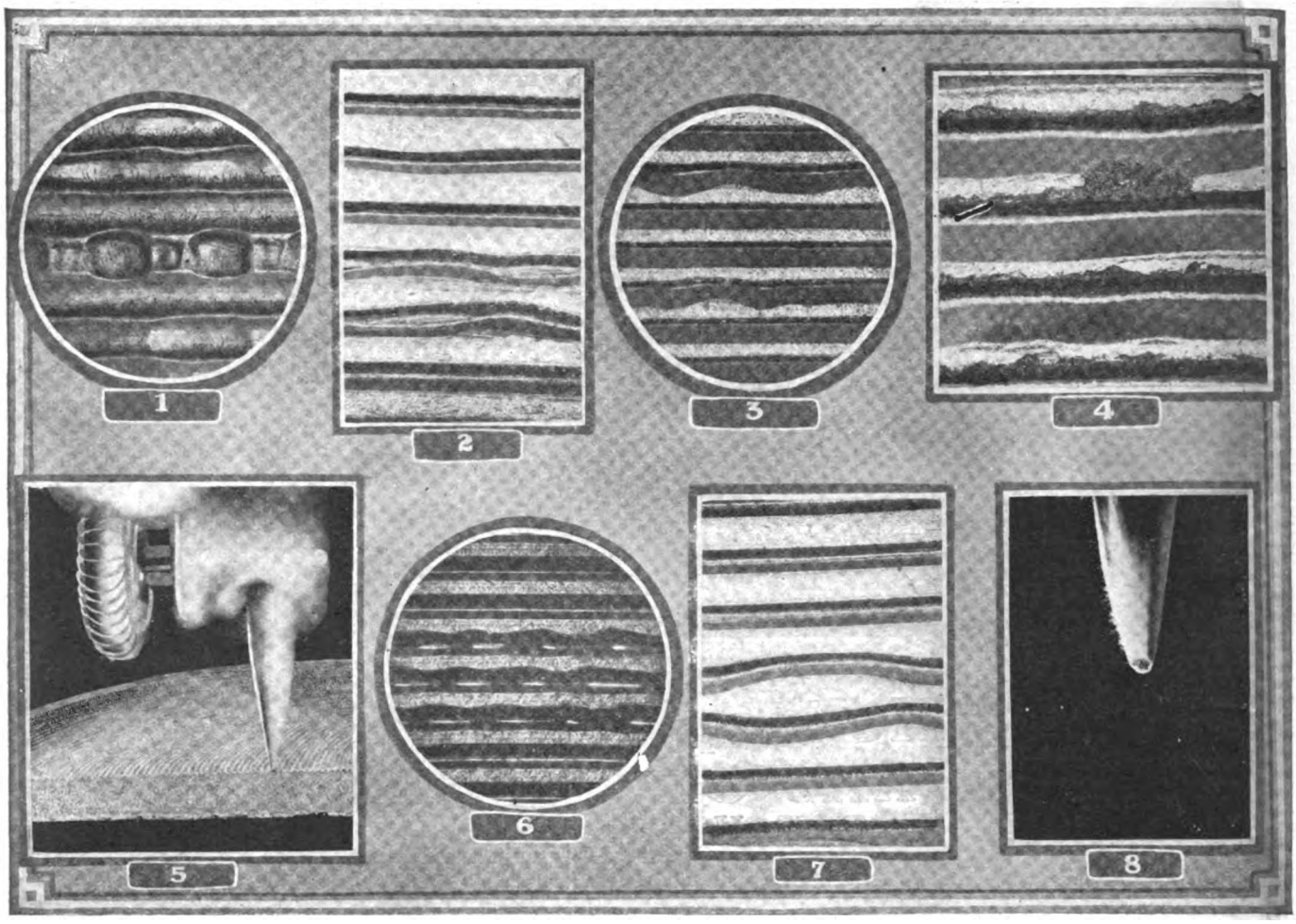

**Fig. 7. The French "Alerion" Helicopter, Provided With "Revolving Wings." The Plane Has the Usual Fuselage, Rudder G, and Stabilizing Tail Plane, S.**

wings (rotary), 280 sq. feet. Engine, 45 h. p. The second had screws giving a vertical thrust of 1,056 lbs., h. p. 37. The machine flew horizontally about 20 minutes.

Paul Cornu constructed an Helicopter the screws of which covered an area of 65 sq. feet, h. p. 12, bearing weight of 572 lbs. With two men on board the total weight is 721 lbs. The machine rose easily, its engine developing 15 h. p.

In 1912 Vicomte Decaze constructed a machine with two planes of 250 sq. feet each in tandem. There are two supporting screws superposed and co-axial 13⅓ feet in diameter turning in opposite directions, and driven by a "Gnome" engine of 50 h. p. To left and right two small planes stabilise the machine Their efficiency is constant what-

(*Continued on page* 182)




1—Emerson Record, Vertical Illumination × 25; 2—Record About 60 Times × 25; 3—Combination Record Cut × 25; 4—Lateral Cut Record After Playing Very Often, Vertical Illumination × 50; 5—Looking At Record "End On" With Recording Needle in Groove Oblique Illumination × 3½; 6—Emerson Combination Cut × 25; 7—New Columbia Record × 25; 8—Used Steel Needle Showing Worn Point × 25. The Figures Following the Multiplication Signs Indicate the Magnification in Diameters.

# Frozen Music

## How Music Is Produced by the Phonograph Record and Its Needle

By H. GERNSBACK

MEMBER OF AMERICAN PHYSICAL SOCIETY

A *LETTER from Bac Teria to his friend Mike Robe.*

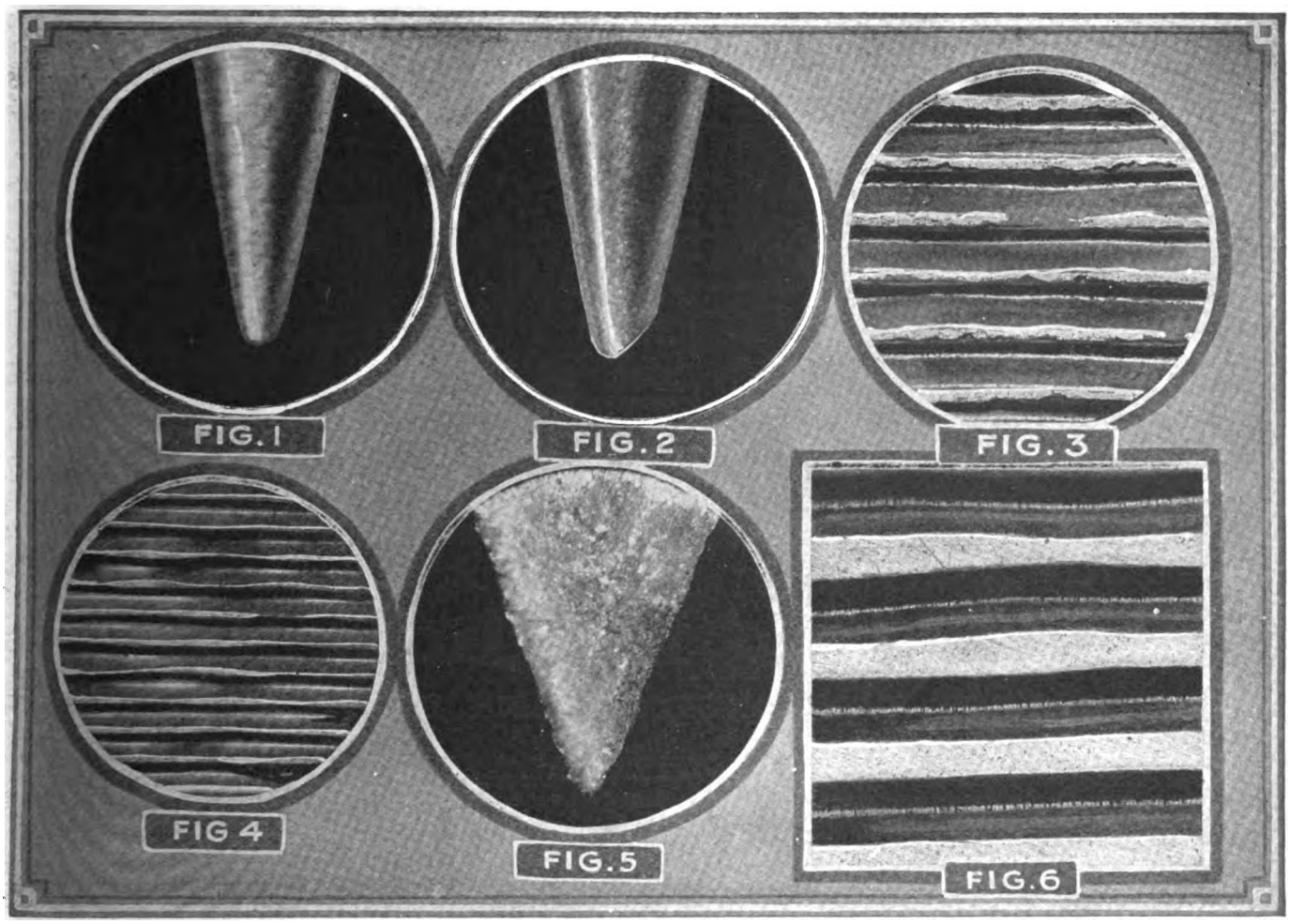
My dear Mike:

It is now a long time since I have left you, and strange things have happened on my recent voyage. I hope this letter reaches you in good health and that your several thousand children are doing well, and that you are still able to count them. As for myself, you will remember that I was torn away from you by a gust of wind, and while floating, I suddenly saw beneath me a large black shining disc of tremendous proportions. It looked like an entirely new world to me, and I don't recall having seen it described by any of our scientists.

In company with several hundred other Microbes, of your illustrious family, I settled down gradually upon the shining object and as we drew nearer, we saw tremendous canyons paralleling each other as far as the eye could reach. These crevasses, seen from a great height, looked very regular and uniform, but as we came closer at the end of our journey, we could see that they were very rough, which puzzled us greatly. We settled slowly down into one of these tremendous canyons, and finally after a long voyage partially in the dark, we landed at the bottom of the valley, which at first looked like a river to me, due to its silvery white appearance—at least it looked so before we descended. But once we were down, we noticed that it was simply a hard, wide river-bed which we at first took as a distinct bed of a great stream. Accompanied by the rest of the family, I immediately started to investigate our new surroundings.

It seemed as if we were in a strange valley or canyon, with slightly sloping walls that were very rough and uneven. One of my friends, a geologist, noticed that the walls with their protruding rocks apparently consisted of mica- and shellac-like formations. Everything was mostly black, but here and there white rocks protruded from the irregular walls; only the very bottom seemed fairly smooth as if polished by some gigantic instrument. For many days we walked along this canyon, and it seemed to have no end. We saw the sun pass over us three times, and still we progressed upon our path which seemed without termination. On the fourth day, we suddenly became aware of the fact that our canyon seemed to move, beneath us, carrying us along. Looking up at the sun, we saw the latter moving rapidly, and had it not been for the jarring motion that felt like a terrific earthquake, we would have sworn that the sun described large circles in the heavens. We were pondering over this for a long time, while the motion of our canyon increased, when all of a sudden a tremendous noise made itself felt that shook us to our very hearts. Then without warning, there suddenly burst upon us gigantic notes and sounds, not unpleasant to hear, but they were so loud that we were almost deafened. While we were still debating this strange phenomenon, one of our friends suddenly pointed up to the sky and we saw rushing by at tremendous speed a silvery white tower of gigantic proportions, but it disappeared almost instantly. Within a short time it made its appearance again in the same part of the heavens and continued to do so for some time. The sound seemed to fill the entire heavens, and increased every second. My friend, the geologist noted that every time the tower appeared it seemed to draw nearer to us, and it dawned upon us suddenly that sooner or later, it would come rushing thru our canyon because the geologist had an idea that the canyon in which we stood was nothing but a tremendous spiral.

It was very true. Soon we felt that the




1—Unused Needle, Vertical and Oblique Illumination × 50; 2—Used Needle, Vertical and Oblique Illumination × 50; 3—Lateral Cut Record, Record Played Very Often, Vertical Illumination × 27; 4—Edison Record × 25; 5—Fiber (Bamboo) Needle, Vertical Illumination × 27; 6—New (Okeh) Record, Lateral Cut Vertical Illumination × 50. The Magnification Is Exprest in Diameters.

tremendous shining object was indeed coming nearer, because we could feel the walls of our canyon vibrate. Also, every-time it passed us now, we felt a certain amount of heat which its passage produced. Finally the cataclysm came! Far in the distance we saw the shining white tower approaching—it pierced the sky as far as the eye could reach. The sun shining upon it gave it a weird brilliance all of its own. It came on with a tremendous speed, inconceivable for you to understand. We just had time to jump into a cave which the geologist had noted before, and then everything seemed to happen at once. Our whole organisms shook, and the air and heaven were filled with sounds that will never be forgotten. We could see the white metallic tower rushing by us, knocking down rocks and portions of the canyon's walls as it went by screeching tremendously. We were knocked flat on our backs from the cyclonic on-rush of the air; the heat became insupportable, produced no doubt by the friction of the tower against the walls of the canyon. Smoke and dust filled the air, while rocks and stones came tumbling down like an avalanche from all sides. After that the sounds gradually decreased and suddenly stopped entirely. My hearing, however, is entirely lost for the time being and I am too broken and unnerved to continue my voyage, so I am sending this letter by my friend the geologist who seems to have fared better than myself. I trust to join you in the near future.

* * * *

The above fanciful tale is written only with the idea of explaining to the reader how the ordinary phonograph record and its grooves would appear to a microscopical human being. When we look at the ordinary record, we do not realize the wonders contained in the black disc, and its ubiquitious needle. There are many things, however, that our scientists study in order to find out just how to better and how to perfect records, and how to tell the public to use the same. It is not the purpose of this article to explain the manufacture of phonograph-records, which is a story by itself. Rather do we take the record and the needle as we find them in order to explain their physics.

There are several styles of phonograph records. First we have the old style, hill-and-dale groove, which means simply that the needle moves up and down as it passes thru the grooves. The record most used today, however, is of the lateral cut type, meaning that the bottom of the needle is always at the same height, not travelling up and down, but moving sideways like a pendulum. The next type is a combination of the two, namely up and down or the hill-and-dale variety and the lateral cut as well. This gives rise to a complicated motion of the needle. In the hill-and-dale type, it is apparent that the needle being pushed up and down operates the diafram and the sound box in an up and down fashion. This vibration gives the sound. The faster the needle vibrates up and down, the higher the note or pitch of the sound. The slower its up and down vibration, the lower is the pitch of the sound.

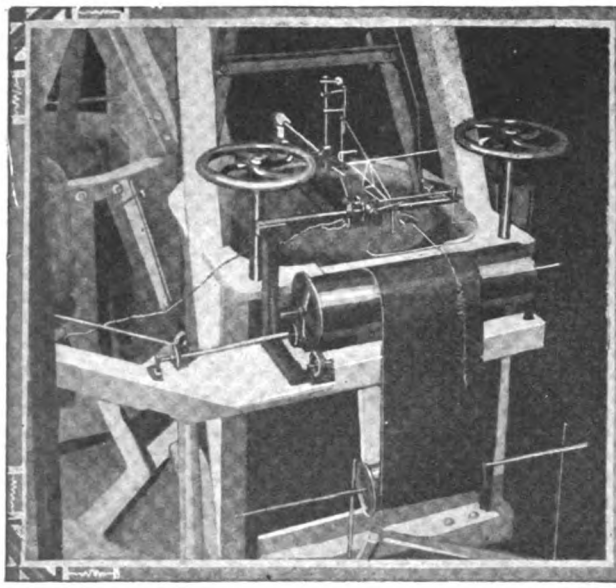
In the lateral cut such as used in the Victor and Columbia records, the needle vibrates back and forward because the channels or grooves are not strictly parallel to each other, but are of a wave-like or snake-like contour. The more snake-like sharp curves there are, the higher is the pitch of the sound, and the fewer the waves or bends in given lengths of the curve, the lower the pitch.

So much for the *modus operandi*. Let us now see what happens to the needle as it travels in its groove. It should be noted that if a very hard needle is used, such as for instance Tungsten-steel or other refractory material, the walls of the groove are worn away rapidly. For that reason soft steel needles have been found the best for all-around work, because *here the needles themselves wear down while the walls of the groove are preserved* to better advantage. It has been found in actual demonstration that where diamond needles or the like are used, the record soon becomes played out. Our illustrations show: Fig. 1, an ordinary new-style needle as it appears in large magnification. In Fig. 2, the same needle is shown after it had played once. Note the oblique cut produced by the grinding effect of the record groove-wall against the steel. It should be noted that if the record needle is left in place, and the same record is played again, not much harm is done. The great crime, however, is to use a needle that has once been played on another record. There is not one chance in ten thousand that the worn needle will fit the groove correctly. Instead, *it will act as a cutting tool* and will begain cutting material away from the sides of the groove-wall, thereby spoiling the record in a short time.

Many claims are being made on certain patent needles, but it is safe to say that few of them are good for the record in the long run. Soft steel needles of the common variety are probably the best, despite all other claims. A study of our photographs (which unfortunately could not be produced in their full size, due to lack of space) is very interesting.

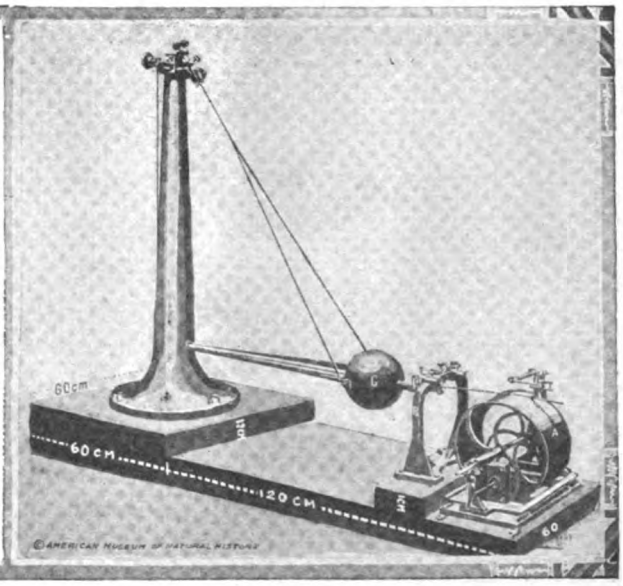
Fig. 3 is particuarly noteworthy. This

(*Continued on Page* 177)



Apparatus At Left is the "Seismograph" at the American Museum of Natural History. The Moving Paper Strip Shows the "Wiggles" Recorded From a Distant Earthquake.

At Right—Standard Form of "Seismograph" With Suspended Weight "G," Which Actuates a Recording NeedleOver Time Drum A.




# Recording Earthquakes

## By PROF. T. O'CONOR SLOANE, PH.D. LL.D.

WHEN an earthquake occurs, however restricted may be the area of disturbance, the tremor it produces in the earth goes over the whole surface, and by sufficiently delicate instruments could be detected at any point on land. On water, of course, the conditions are such, that it would be practically impossible to detect the slight disturbance to which the water is undoubtedly subjected by each distant earthquake. There are, however, records of ships, so close to submarine earthquakes, that they were shaken up by the waves produced thereby.

What we speak of here, however, is the obtaining of records of earthquakes at stations on the surface of the land; and by the instrument called the *Seismograph*, earthquakes, thousands of miles distant from the observing station, are detected; the time of the disturbance at the Seismographic observatory is accurately noted, and rather elaborate calculations give the locality of the earthquake proper. The object of the Seismograph is to make the earth record its own tremors on a moving strip of paper, and an independent clock makes marks on the paper periodically, so that the handwriting of the earthquake has its time exactly registered.

When we want to record the rotation of the earth on its axis, we use a mechanism quite independent of the motions of our sphere, and this mechanism is a watch or a clock; but the Seismograph avails itself of the tremors of the earth, and makes the earth inscribe on paper its own motions so far as the earthquake shock is concerned.

If we hold a stick of wood by one end depending from our hand, so as to represent a pendulum, or hold a weight at the end of a string, also representing a pendulum, and move the hand rapidly back and forth, a definite point of the stick or of the weight itself in the other case, remains practically stationary. Now let us suppose that instead of the hand a massive support, built up from the native rock if possible, be used to give a point of support for our pendulum; then if the earth shakes, the massive support will move back and forth, the pendulum bob will remain stationary due to its inertia, and a pencil attached to it would make a mark upon a piece of paper, longer or shorter, according to the motion of the earth due to an earthquake. This variation in length is due to the relative intensity of the earthquake and also to its distance. The motion of the pendulum is restricted to absolutely one direction and by having two of them, one swinging in the meridian, and the other one swinging at right-angles thereto, a double record of every earthquake would be obtained and from these two co-ordinate observations, and from their relative intensity, the earthquake could be located.

A very simple apparatus can be used to illustrate the principle, and the illustrations show two typical constructions. In one case, the pendulum restricted in its swing to one direction, has its motions dampened by a thin rubber band stretched across the base and attached to the pendulum as shown. A pencil is attached to the pendulum and a piece of paper resting upon the base of the instrument is placed below the point of the pencil which rests upon it. If now the instrument be pusht back and forth rapidly, the pencil will make a mark on the paper, and if the paper were arranged to travel across the base, a sinuous mark would be given, making a sort of a wave line. If the base of this instrument were attached firmly to the earth, it is obvious that its tremors, if great enough and in the right direction, would be marked upon the paper.

The next cut shows an instrument based on the reverse principle. Here we have a pendulum inverted, its base resting in a cup-like depression in the base, and kept by rubber bands in a vertical position. After what has been said, its action will be clear; the pencil is attached in this case near the top, and the paper is carried by a little block; moving the base back and forth will give the same lines on the paper as before, the weight at the top of the pendulum remaining approximately stationary.

These are the crudest possible representations of the principle. The real instrument is constructed with the most elaborate care as to the suspension. The record by proper arrangement of a system of levers is magnified perhaps sixty times or more, so

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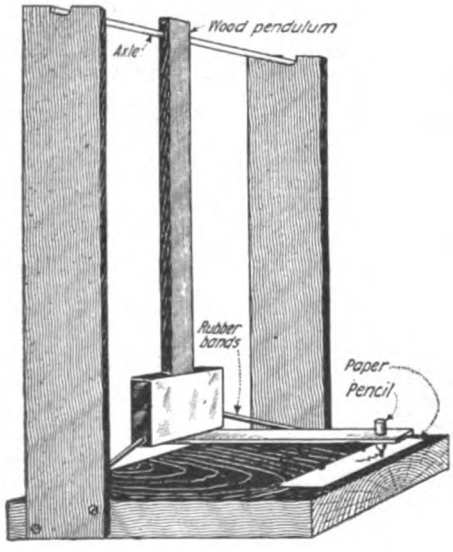
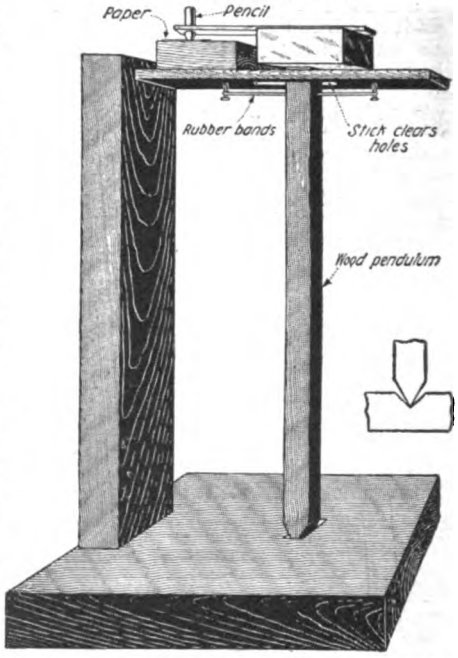



**Experimental Model of Earthquake Recorder With Weight Placed Below Suspension Pivots or Axle. This Apparatus Records Vibrations of the Earth in One Direction Only.**




**Opposite Type of Earthquake Recorder to That Shown at Left, the Weight Being Placed Above the Pivot. The Vibrations of the Earth, as Before, in One Direction Only are Recorded By the Pencil on a Strip of Paper.**

# Famous Women Scientists

OUR illustration presents some of the leading women workers of this age, and our readers will be interested in learning the special work done by each. Our government has long recognized the technical skill, conscientiousness and industry of the fair sex. The woman's mind is particularly strong in special and detailed operations of science and technology.

We are soon to be honored by a visit from Madame Curie, the world renowned scientist of the College of the Sorbonne in Paris, whose life-work has been devoted to the study of radium. After all that she has done for the world, she is a poor woman; her life has gone for the good of humanity, and America is now accumulating a fund to buy her one gram of radium, so necessary to prosecute her work.

Her portrait occupies the center of the page, and her four American sisters in science are grouped around her. We now return to them and will give a few words to the work of each of these distinguished investigators. One is a leading worker in the Federal Department of Agriculture—the other three are in the service of the National Museum, Washington, D. C.

Mrs. F. W. Patterson is one of the leading experts in the Federal Department of Agriculture. She is a leading authority on the fungoid diseases of plants, and is constantly working in this all important field of work to arrest the destruction and impairment of plant life.

The National Museum, familiar to all visitors to the National Capital, enjoys the services of the other three representative women workers.

Miss Pearl Lee Boone is an authority on cephalopod mollusks, and acts as assistant to Dr. Paul Bertsch of the Division of Biology at the Museum. That she does not confine her attention to cephalopods is evident from the cut, where altho an octopus and a squid appear as cephalopodous objects for her study and investigation, the bunch of lilies in the background shows that she has not lost the sense of beauty, so strong in her sex, and has at least an aesthetic feeling for botany.

Miss Mary J. Rathbun is an associate in zoölogy at the National Museum and internationally recognized as the leading authority in the world on crabs. In the photograph Miss Rathbun is seen examining the fossilized claw of a member of the crab family, who died some ten or twenty million years ago. She is the author of a number of books on her favorite subject.

Women are supposed to dread snakes, but Miss Doris Cochrane of the National Museum is an exception to the rule. Miss Cochrane, an exceptionally gifted young naturalist, is special assistant to Dr. Leonard Stejnege, chief of the biological division of the National Museum and since the recent death of Dr. Burroughs, dean of American naturalists. Miss Cochrane is handling one of the serpent tribe, apparently indifferent to its supposedly repellent traits and appearance.

The advent of women into the field of science has not been a sudden one, for the gentler sex have quite frequently shown their aptitude and qualifications for this sort of work. One has but to consider for a moment the fact that practically the whole of the present generation is being educated in the public schools of the country by young women, who have had the necessary intensive training, as provided in the Normal schools and colleges. If women can show such high ability in this exacting work of guiding the minds and destinies of our future Napoleons of finance, industry and science—surely they are to be encouraged and given every opportunity to help in the great work of science; particularly in the realms of medicine and biology. From the study of diseases in animal life has come much of our present-day knowledge.


**Women Are Supposed to Dread Snakes but Miss Doris Cochrane of the Museum is an Exception to the Rule. Miss Cochrane, an Exceptionally Gifted Young Naturalist, is Special Assistant to Dr. Leonard Stejnege, Chief of the Biological Division of the National Museum.**

**Madame Curie, the World Renowned Radium Scientist, Appears in the Center Photo. On Her Visit to This Country She Will be Presented with a Gram of Radium for Her Research Work.**

**Miss Mary J. Rathbun, Associate in Zoology at the National Museum, Who is here Seen Examining the Fossilized Claw of a Member of the Crab Family who Died Some Ten or Twenty Million Years Ago. She is the Author of a Number of Books on Her Favorite Subject.**

# Audion Amplifier Magnifies Heart Beats

By S. R. WINTERS


The Photos Above Show Gen. George O. Squier, Chief Signal Officer of the U. S. Army, Together with a Patient to Whom Has Been Attached His Latest Invention, a Powerful Amplifier for Listening to the Heart Beats. The Amplifier is so Powerful That the Various Actions of the Blood Passing Thru the Heart Valves Can be Distinctly Heard and Analyzed by a Whole Room Full of Experts. The Heart Beats Can be Sent Over a Telephone Line of Any Length and Then Amplified to Fill a Room, if Desired.

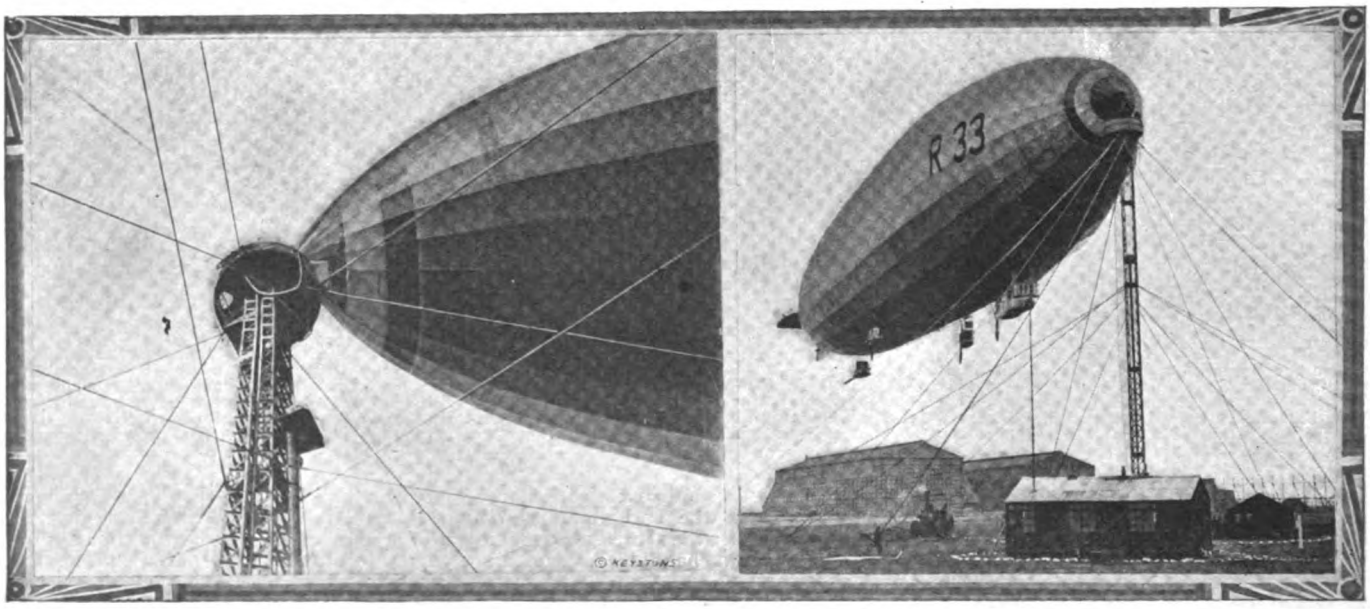
AN interesting demonstration was given recently to a group of medical men from the Army and elsewhere, of a novel device recently developed in the Signal Corps Laboratory at Washington, under the direction of General George O. Squier, whereby heart beats may be amplified thousands of times and made audible to a large audience in an amphitheatre.

The principle involved is similar to the one used in the large amplifier employed on March 4th to increase the volume of the President's inaugural address in front of the Capitol.

A special heart transmitter has been designed which rests by its own weight over the patient's heart, who is lying on a couch. The passage of the blood thru the different valves of the heart causes vibrations in an air chamber, which faithfully reproduces all of the various actions of the blood passing thru the different valves of the heart. These are transmitted over the wire to an amplifying apparatus, which consists of a group of regular standard Signal Corps vacuum tubes, such as are used in wireless telephony and telegraphy reception and when amplified actuate a special receiver attached to a large horn which projects the sounds thruout the building.

At the demonstration the group of doctors could hear the action of the heart thus magnified and could discuss at pleasure among themselves the peculiarities of each patient. The patient need not be in the same building, but can remain at home at any distance from the receiving apparatus, which would usually be in a hospital, since the high frequency carrier current which transmits the sounds along the wire by means of electric waves guided by an ordinary telephone line, furnishes a *perfectly silent vehicle* for transmitting all of the delicate variations of sound caused by the heart, to the receiving apparatus. It is thought this method will furnish a superior means to physicians and surgeons for diagnosing heart diseases of all kinds, and for studying the circulation of the blood in any part of the body.

# "Hitching Posts" for Airships




The two photos above illustrate the latest type of *hitching* post for dirigible airships. In the near future we will undoubtedly see a great many of these steel towers erected all over the country, as a new American corporation has just been formed to provide airship transportation between the larger American cities. They plan to open a *New York to Chicago air service* by the spring of 1922. The steel tower here shown is provided with an elevator for the passengers and also carrier pipes for supplying fuel and gas for inflation of the balloon compartments. It has been found that this type of anchorage for the giant air-liners, such as the R-33 here shown, is the best, particularly in stormy or windy weather, as it is very dangerous to have these large and rather delicate aircraft near the ground, for they have the undesirable habit of bumping themselves to pieces even in a medium wind, if they are anchored or held down by ropes near the surface of the ground. A dirigible close to earth is like a ship in shallow water.

# Why Insects Fly Towards Light

**By Dr. E. BADE**

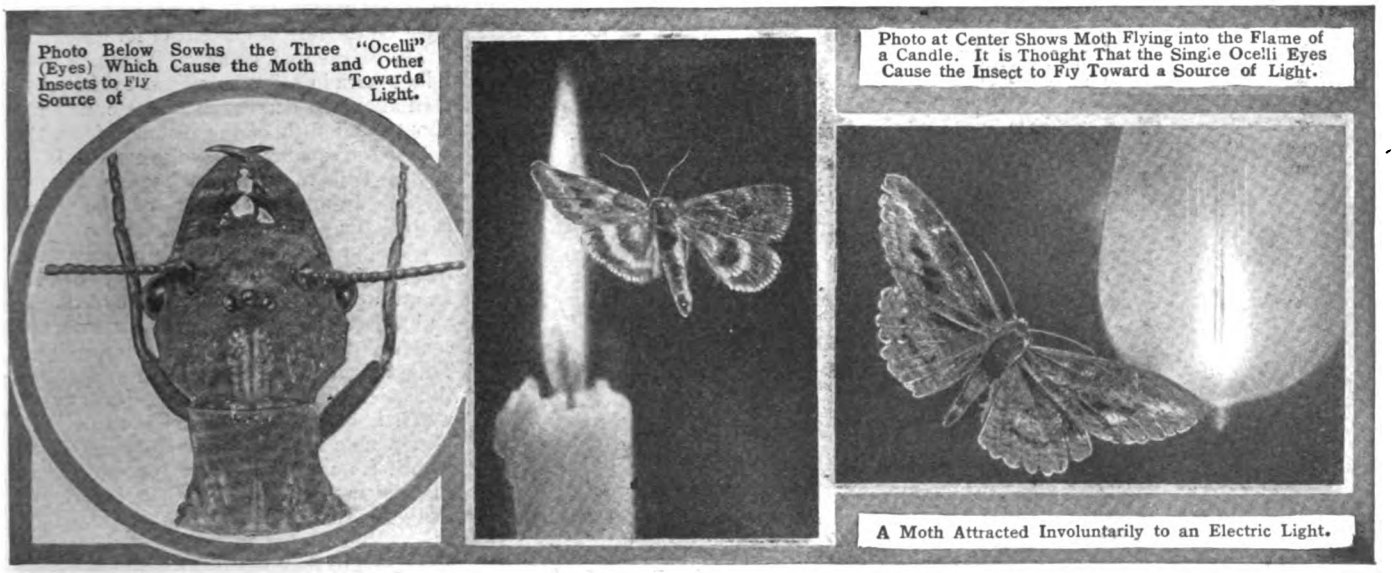


Photo Below Sowhs the Three "Ocelli" (Eyes) Which Cause the Moth and Other Insects to Fly Toward a Source of Light.

Photo at Center Shows Moth Flying into the Flame of a Candle. It is Thought That the Single Ocelli Eyes Cause the Insect to Fly Toward a Source of Light.

A Moth Attracted Involuntarily to an Electric Light.

HOW insects see and how their eye resolves the picture has, as yet, not been satisfactorily explained. We know how the eye is formed, know its structure to its minutest detail, but its action can not be determined with absolute accuracy from these facts.

By far the greater part of the insects have two kinds of eyes: simple or dot-like eyes also called *ocelli*, and the main or compound eyes.

The simple eyes are generally found on flying insects. These are not faceted altho they are composed of a group of simple eyes. The number of optical cells composing the eye varies with the different species of insects. Where there are only a few, the animal can only distinguish between light and shadow. The range of sight increases with an increase of the active optical cells. In their detailed structure, except for a few minor individual characteristics, the simple eyes are exactly similar to each facet of the compound eye.

The compound eyes are often very large, curved, and protruding far from the head. They are seldom flat or flattened. When seen under the magnifying glass or the microscope, the eye seems to consist of numerous hexagonal facets. The number varies from about 100 to 27,000 and each of the six-sided faces act like an individual eye. This means that the extreme end forms a cylindrical or rodlike organ. It consists of two lenses, four cones which break the light, and seven or eight optical cells. Each of the facets is divided from the others by a black pigment, so that each of the facets acts like an independent eye and forms a part of the visible picture. Thru the combined action of all facets, the object viewed is brought to a harmonic whole. But each part of the compound eye makes only that part of the object visible which lies in its axis. At the end of the retinal lining a reduced, upright image is then produced, which consists of many partial pictures mosaicly brought together.

The range of visibility is by no means great, in all probability insects cannot see further than about six feet, and if they are able to notice motionless objects has not, as yet, been determined.

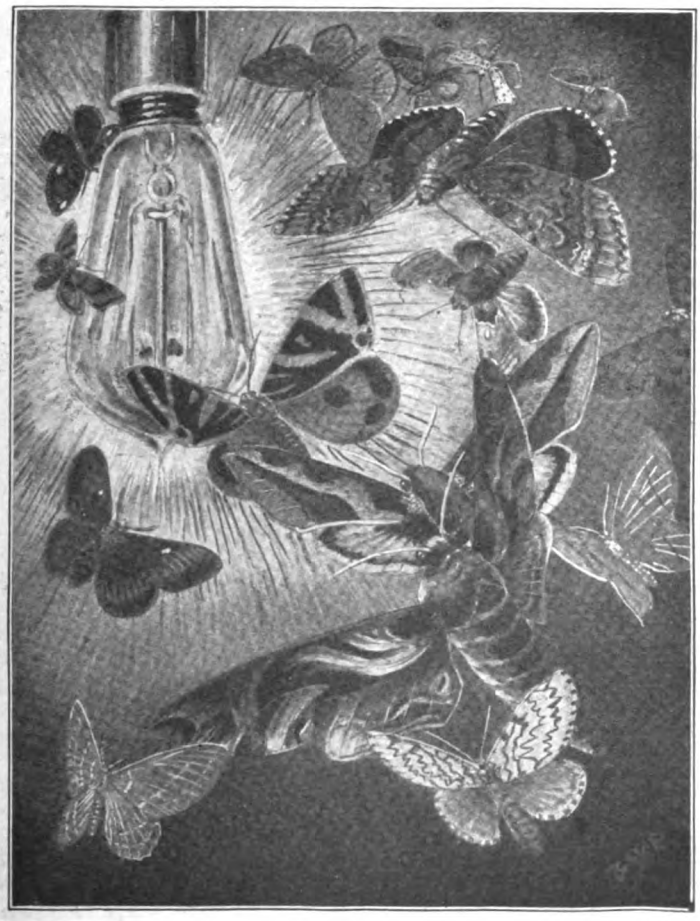
Colors can be distinguished without difficulty, and some of them seem to react more favorably than others, but here again the colors preferred by some are shunned by other species. By means of sight, and not by the odor, the honey bee seeks the flower in order to remove the nectar.

Many of our insects, and especially the moths, are nocturnal in habit. They are much more lively at night than during the day. The same is true of many beetles. Others with similar habits are the locusts, crickets, mosquitoes, May flies, caddis flies, etc. All these insects are lured by bright lights to which they fly as if intoxicated. And they remain as if held by some invisible bond, and if one of them is grasped in the hand, and thrown into the darkness where the light does not penetrate, they will return the next instant.

The eye, which is stimulated thru the light, transforms the wave motion of light into *nerve motions*. This optical stimulus of the nerve end organs makes the insect fly towards the light. Since the compound eyes are only slightly sensitive to light, these, in all probability, do not cause the animal to deviate from its course and fly into the magic circle of artificial light. This is accomplished by the simple eyes or ocelli. These simple eyes undoubtedly also influence the direction of flight besides keeping the body in an upright horizontal position.

When the body is in its normal position, each of the simple eyes receive equal illumination. Where there are three ocelli present, as is usually the case, one of the ocelli, when the body is tilted, will receive less light than the other two which are looking up-

(*Continued on page* 195)

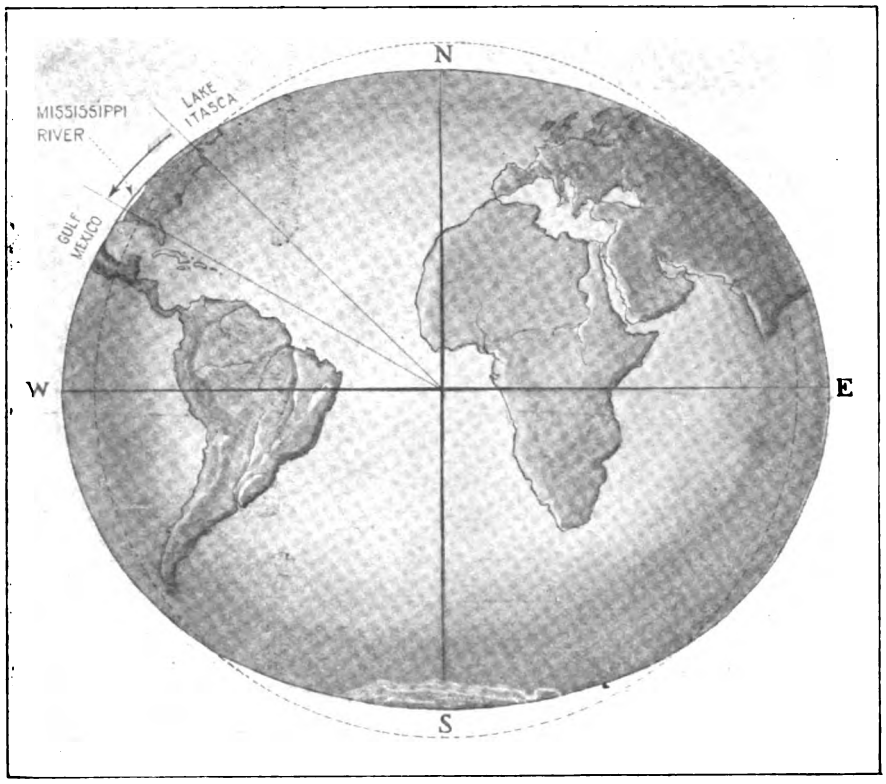


**It Is Difficult to Realize the Beauty of the Original Water Color Painting Reproduced at the Right, Showing Numerous Specimens of Moths and Other Insects Flying Toward an Electric Light Bulb at Night. Science Has a New Explanation of Why It Is That These Insects Fly Helplessly into Open Flames or Toward Other Sources of Light.**

**As Dr. Bade Points Out, It is Hardly Conceivable in View of the Present Knowledge of the Compound Eyes of Insects, that there Is Any Co-Action Between These Eyes and the Brain of an Insect Which Causes It to Fly Helplessly Toward a Flame or Light. Since the Compound Eyes are Only Slightly Sensitive to Light It Is Hardly Possible That These Cause the Insect to Fly Toward a Light, This Being Accomplisht by the Simple Eyes or Ocelli Shown in Fig. 1.**

# Why the Mississippi River Runs Up Hill

NOT all of our readers realize what a penchant water has for going up hill. All the stems and tree trunks of the vegetable kingdom draw water up from the earth to the extremities of their branches and leaves whence it evaporates into the air. The forest, or the field of grain represents great quantities of water flowing vertically upward. It is safe to say that any river flowing towards the equator flows up hill, because its mouth will be more distant from the center of the earth than is its source. If this does not hold, then the river is practically a cataract, so great must be the rate of descent of its water.




"The Sun Do Move" and the Mississippi River Runs Up Hill. As the Equatorial Diameter of the Earth Exceeds the Polar Diameter the Mouth of the Mississippi is Several Thousand Feet Further From the Center of the Earth Than Is Its Source. Therefore in a Strict Sense the River Runs Up Hill and the Same Applies in General to Rivers Which Flow Towards the Equator. On the Other Hand Rivers Flowing Toward the Poles May be Taken as Running Down a Relatively Steep Descent.

The Mississippi, counting its course from Lake Itasca in Minnesota flows to the south thru about 15 degrees of latitude, which is about one-fourth of the distance from the pole to the equator. Now the equator is six and a half miles approximately further distant from the center of the earth than is the pole. It follows that were the Mississippi credited with a perfectly level bed so that it did not flow at all, then its mouth would be about one-fourth of the six and a quarter miles, more distant from the center of the earth than its source would be. To get the real distance, we must subtract the height of its source above sea level, which is about 1400 feet, leaving a little over a mile for the excess distance of the mouth from the center of the earth. In this way we determine that the Mississippi really runs about a mile up hill.

If a ship started from the Arctic regions and sailed to the equator, it would rise some six and a half miles; an elevation which is a greater space than the height of the tallest mountain in the world. It would require no energy on its part to effect this vertical change in position, because that would be attended to by the centrifugal force, due to the earth's rotation.

Conversely the Nile flowing to the North, on the basis we have used for the Mississippi, is only saved by centrifugal force from being a tremendous cascade as high as many Niagaras. It possesses this elevation but centrifugal force saves the great stream from being a raging torrent, which would resist the best efforts of our English friends to construct their famous barrage.

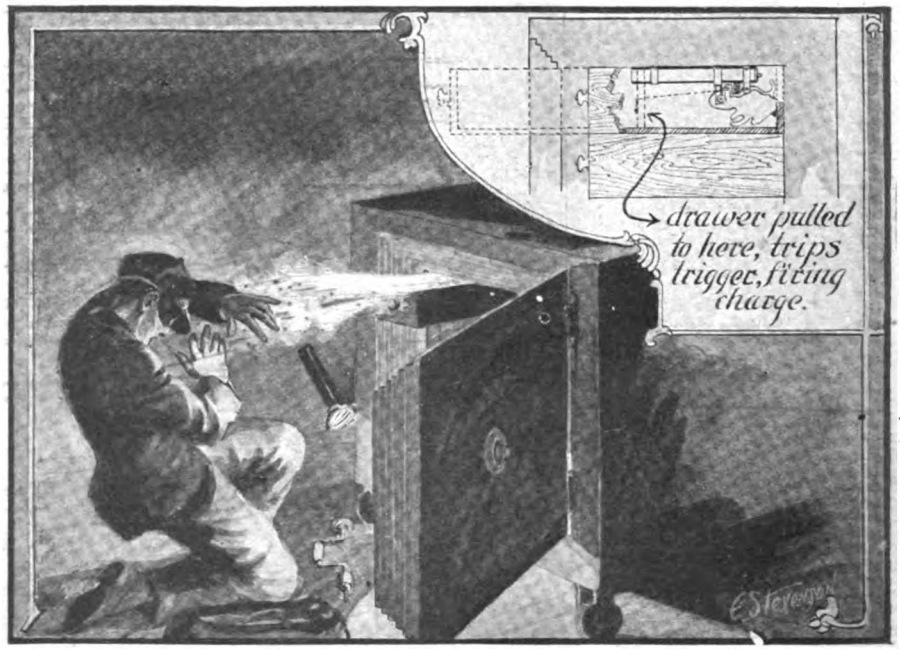
# Shot-Gun Trap Foils a Safe Robber

There is at least one safe robber in New York City who will be mighty careful in the future as to what safe he attempts to open, for recently he had the surprise of his young life. The safe had been rigged up with a miniature shot-gun, so that when the door was opened and the cash drawer pulled out, the shot and powder charge was fired almost into the face of the robber. The man in this case landed in a hospital, and becoming suspicious of his buckshot wounds, police detectives managed to check up his whereabouts prior to his being shot, and found that he was the party who had opened the safe provided with the protective device here shown.

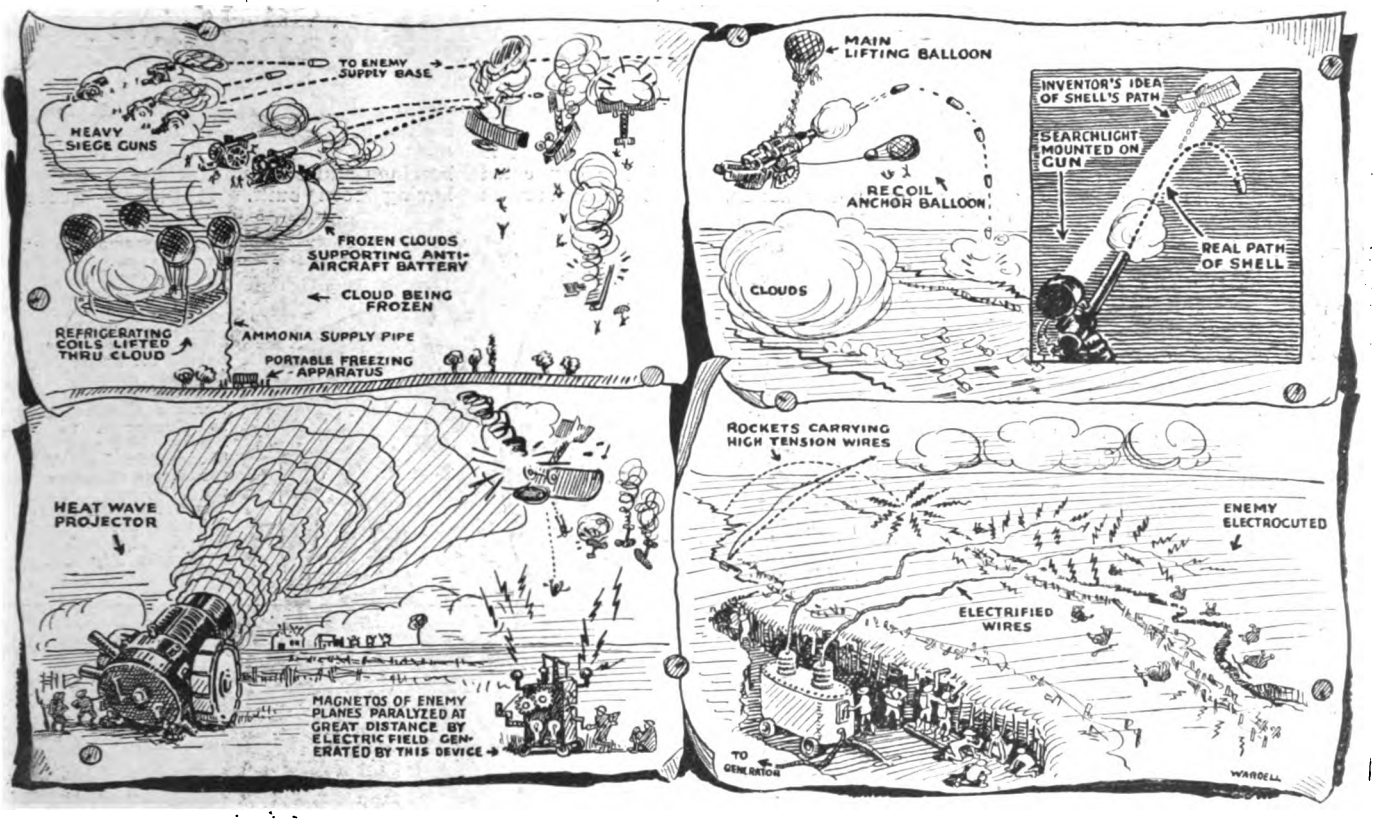
This thief trap was designed somewhat on the order of the hand grenades used during the war. The device comprises a 4" length of iron pipe, ½" in diameter, which pipe was fastened in the top of the money drawer. This piece of pipe was provided with a strong iron plug or cap at one end and was then loaded with buckshot and black powder. At the rear of the improvised gun, a hole was drilled to take a standard percussion cap, which cap was fired by a trigger connected with a cord to be pulled and which operated a hammer to strike and detonate the cap when the drawer was drawn open a certain distance.

These devices, while they may prove efficacious, are always possest of a strong element of danger to the owner of the safe, for he may in opening the safe in the morning forget about the shot-gun attachment, and be shot himself.

Speaking of burglar alarms or other protective devices to be fitted on or in safes, there are many other devices which can be worked out and which would prove more desirable undoubtedly, in view of the aforementioned objections. Dr. T. O'Conor Sloane, has made a very good suggestion, viz., to fill the safe with comprest air and when any drilling is done or the door tampered with, the air escaping will cause a noise and also serve to act on a diafram relay, which in turn may ring a bell or alarm.




The Improvised Shot-Gun Illustrated Above Was Fitted Inside the Cash Drawer of a Safe in a New York City Concern's Office Recently, with the Result that the Safe-Breaker Landed in the Hospital with Severe Buck-Shot Wounds. The Unusual Nature of These Wounds Aroused the Suspicions of the Police, with the Result That the "Patient" Was Found to be the Party Who Had Opened the Safe the Night Before.




# Mounting Great Guns on Frozen Clouds

A wild English inventor as we at least believe, suggests freezing clouds into solid ice and using them as gun platforms. This invention has, it seems, actually been submitted to the British war authorities. The statement of said authorities says little of his reception, but it appears that he was kindly but firmly led to the door, yet before he left managed to explain a scheme he had for suspending heavy guns from captive balloons.

One inventor wished to project heat waves against airplanes and so destroy them. Part of his plan was to set up electric fields that would paralyze the magnetos of enemy airplanes when they attempted an attack. None of these enthusiasts seemed to realize the limitations of their suggestions. A man planned to attach searchlights to anti-aircraft guns, and so fire along the beam of light. He neglected the fact that the path of a shell and the path of a ray of light are somewhat different.

Among other weird inventions was one for throwing live wire cables against the enemy, using rockets to get the cables across No Man's Land. It was suggested that a tunnel be built all the way into Germany, and also that trained cormorants be sent to pick the mortar out of the chimneys of the Krupp factories at Essen.

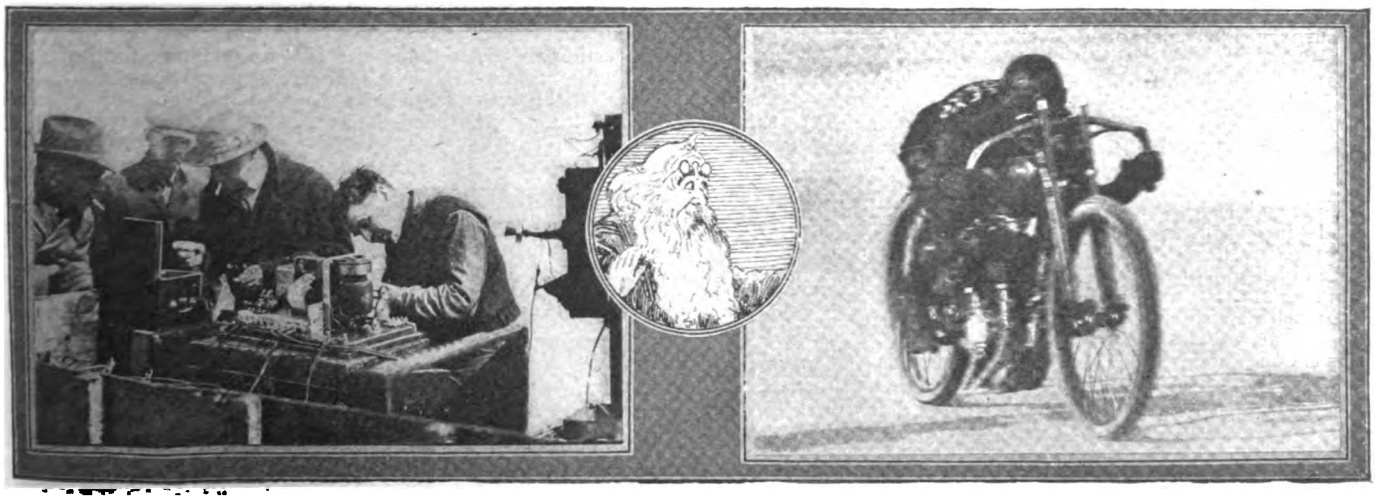
There is little doubt that Baron Munchausen would fade away before some of these wild-eyed projectors, and the Keeley motor yields in absurdity to such ideas as are detailed above.

# Timing Motorcycles Electrically

The beach at Florida has long been used as a speeding course for motor propelled and even wind propelled vehicles. It is of course almost level and the slight incline towards the water is so little that it furnishes an ideal course for exhaustive experimentation with high speed vehicles. We reproduce a rather remarkable photograph of a motorcycle at Daytona Beach, making over 100 miles an hour. While this speed has been greatly exceeded, it is rarely that such a good photograph is obtained, of a machine at any such speed.

As many of these speed tests are made over rather short distances, the period required to cover the course must be accurately determined, and to give a scientific touch to this determining, an electric timing and recording apparatus is used.

The recording apparatus we illustrate in the left-hand photo. The machine runs over a contact strip and thus operates the electrical device. It is so delicate that it records one one-hundredth of a second and in order to impart authoritative accuracy to its record, a government chronometer is used for the time.



**How Science Accurately Measures the Speed At Which Racing Cars and Motorcycles Travel, By Means of the "Electric Chronograph."**

**A Remarkable Photograph Showing Motorcycle Driver Traveling At a Speed of 112 Miles An Hour, or One Mile in 32 Seconds.**

# Electric Effects in "Welcome Stranger."

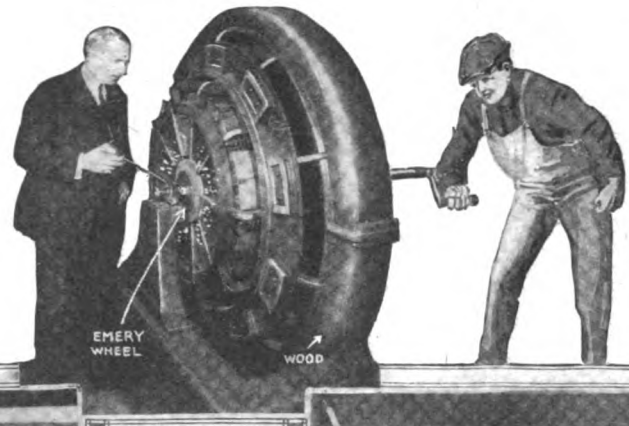
A theatrical production which has delighted the audiences of New York for many a month and which has still a tremendous pulling power with the theatre-goers, is the play at the Cohan and Harris Theatre, "Welcome Stranger." Not only is this play captivating because of its mirth and light comedy, but it will also appeal to the scientifically inclined individuals.

Many clever models are introduced into the play at very appropriate moments. In one scene in the play, a photo of which is reproduced, a model of the city as it will appear when fully electrified is given; the lights in the city streets are seen to automatically flash on, the miniature houses have their lights intermittently thrown into or out of circuit, and even tiny, miniature street cars fully illuminated, are seen to pass up and down over the hills and thru the valleys. The contrivance is operated by switches, which can be readily seen in the photograph, and the supply from dry batteries is connected into the circuit.

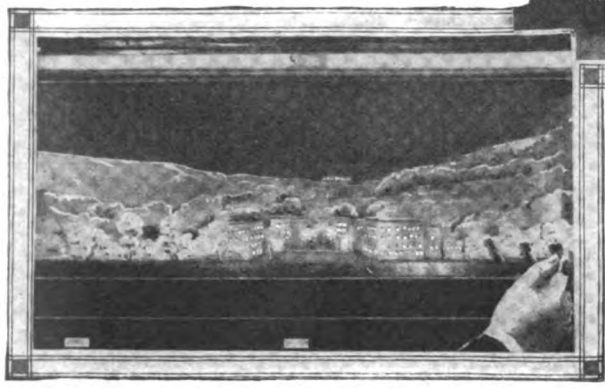
In another scene an office desk is fitted with electrical contrivances of peculiar nature. Thus, upon pressing a button, a cigar lighter pops up thru the desk top. On releasing a second button, a phonograph horn enters upward thru another part of the desk and acts as a dictaphone.

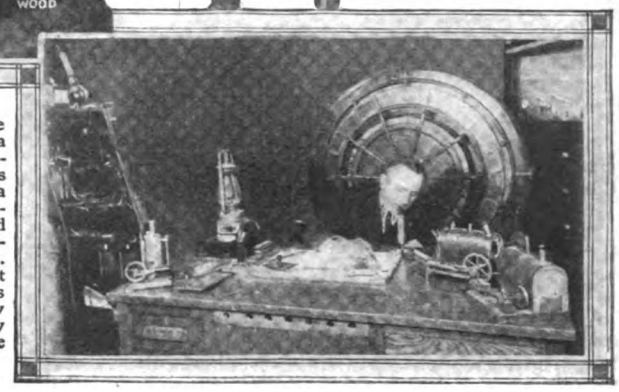
Strange as it may seem, both the cigar lighter and the phonograph horn are very simply made. Each device is attached to an arm which is connected by rubber bands, to the under surface of the top of the desk. These rubber bands are now in a stretched condition. When the button on top of the desk is pushed, a catch releases the cigar lighter or phonograph horn which is impelled upward thru the desk via the rubber band stimulus.

When the door to the dynamo room is opened, the dynamo is shown in full operation. Sparks are flying from the brushes and the entire device seems to be real. On closer inspection from behind the scenes, one can see how cleverly this generator has been made for the performance,—entirely composed of wood, with the exception of the bearings and only half of the generator having been built. It became necessary to simulate the sparks sometimes seen on the generator between the commutator and brushes. This was cleverly done by having four iron nails rest against an emery wheel, which emery wheel constitutes part of the rotor, and an attendant in back of the dynamo turns the crank furiously to spin this "armature wheel" and thus we have sparks to order. The delusion created by this contrivance is perfect, and both the plot of the play and the actors are well deserving of praise.




The Dynamo Shown At the Left Provides Much of the Realism of "Welcome Stranger"; It Is Made Out of "Solid Wood." A Stage Attaché Stands Behind the Scene Drop, Against Which the Dynamo Stands, and Turns a Crank Which Is Connected to An Emery Wheel As Shown. In Line With the Brush Holders of the Dynamo Are a Number of Iron Spikes. When the Emery Wheel Is Turned Sparks Fly Off.





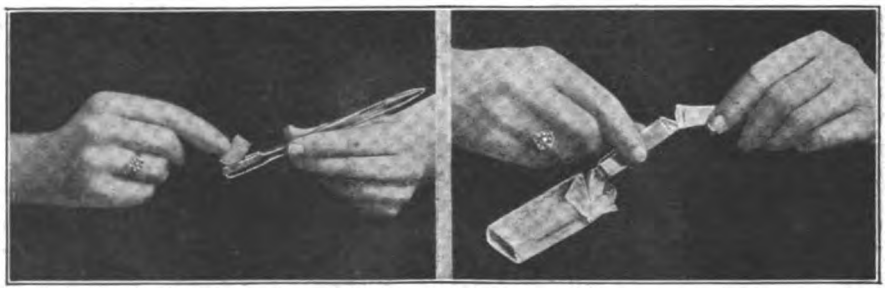
"Welcome Stranger," a New York Theatrical Success Contains a Number of Ingenious and Effective Electrical Effects. The Photo At the Left Shows a Miniature City With Trolley Car in the Background.

# A Hygienic Tooth Brush

The tooth-brush we illustrate is conducive to health. We are now living in an age of, what we may venture to call, cleanliness. The surgeon Lister was one of the great originators of antiseptic surgery, but much of his work when investigated, resolves itself into cleanliness. A tooth-brush once used is dirty for the rest of its life, so we illustrate in the present photos a tooth-brush which is used only once and then thrown away. A slotted handle is provided into whose slot the brush portion is placed. This is of special shape so as to reach all parts of the dental process. This is done by having it rather short so that it will not bridge across the arch of the teeth, leaving portions untouched.

After one use, the brush portion is thrown away, so that the tooth-toilet operation is always started with an unused brush, which is of course supplied carefully wrapt and absolutely germ free. The handle is of impervious material. The wrapping of the brush portion is so cleverly managed, that when a brush is removed for insertion in the handle, the operation leaves the remaining ones sealed up. Thus, those employing this brush, have the luxury of a new brush every day. In general it may be compared to the system of supplying soap in restaurants, hotels, boats and Pullman cars, where a new cake of soap in its individual wrapper appears every day on the washstand.

It is said that an ordinary tooth-brush after a few weeks use, usually contains from one to two millions of germs. There is no need of getting frightened, as such brushes have been used for many years, but in and among nations we are inclined to consider semi-civilized a stick with the end chewed takes the place of a tooth-brush, and if thrown away day by day really puts the semi-civilized person, as we are prone to call him, on a better hygienic standpoint than we are wont to occupy ourselves, when we really come to think it over.



Inserting a New Element of the Latest Hygienic Toothbrush, the Cleaning Member Being Removed and Discarded Aftes One Usage.

The Toothbrush Brush Elements Come Wrapt in Sanitary Paper and One Is Broken Off and Used Each Time the Teeth Are Cleaned.

# Geometric Basis of the New Typography

THE illustration shows various sizes and styles of display letters, typal borders and rulings all photographically reproduced from originals made on one 84-character writing machine in which the outlineals displace an equal number of unessential types. All of these new geometricals are so adjusted as to connect at the ends with underscore marks if so desired. Straight marks are so long and have such slant that connected lines can be struck up and down or slanting across a sheet. Otherwise the keyboard is normal. Outlineals are unpatented. They can be made for all machines.

A black-record ribbon is used. Intricate florets, interlacings and intersections are typed by striking one or more outlineals over an equal number of different ones, as: W, if typed on the same point, will produce ⊠. Here the printing is necessarily all in black, but striking chromatic effects are produced in originals by using a two-color ribbon. Excellent card signs for advertising purposes can be made.

Various sizes of type are made by scientifically grading the degree of photographic reduction.

About twenty years ago a development of this technic which did not include displayed characters was called callitypy by Jacob Backes of New York, who prepared these data and illustrationa; the stated name for this art is now in all unabridged dictionaries. The corresponding terms in German and Frenoh are, respectively: Kallitypie, callitypie.

SCIENCE AND INVENTION

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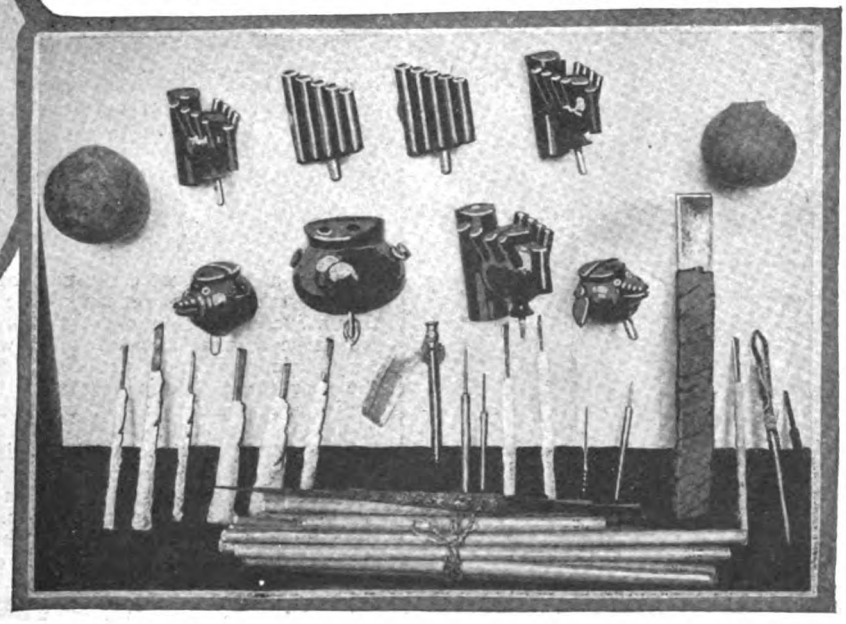
# Chinese Pigeon Whistles

Chinese pigeon whistles are fastened on the pigeon's tail and when he flies the music starts.

AMONG the unique and novel musical devices of China, not generally known in this country are their ingenious pigeon whistles. These whistles are very light, weighing only a few grams and they are attached to the tails of young pigeons soon after their birth, by means of fine copper wire; so that when the birds fly, the wind blowing through the whistles sets them vibrating, and thus produces a melodious open-air concert, for the instruments in one and the same flock are all tuned differently. On a serene day in Peking where these instruments are manufactured, with great cleverness and ingenuity, it is even possible to enjoy this aerial music while sitting in one's room.

There are two distinct types of whistles, those consisting of oblong bamboo tubes placed side by side, and a type based on the principle of tubes attached to a gourd body or wind-chest. They are lacquered in yellow, brown, red and black, to protect the material from the

(*Continued on page* 191)



# Can We Obtain Electricity Directly from Coal?

By PROF. T. O'CONOR SLOANE, Ph.D., LL.D.

THE heat engine of the steam or of the internal combustion type is subject to the fundamental second law of thermo-dynamics, under which it is impossible for it to utilize all the potential energy of the fuel.

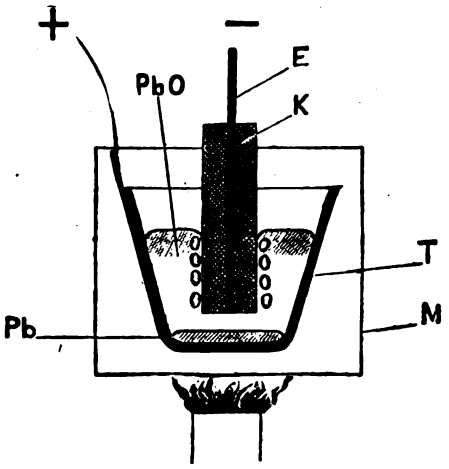



Fig. 1. Carbon-Iron Couple, the Iron Container Being the Cathode, and Lead Oxide the Electrolyte; Melted Lead Is Formed and Sinks to the Bottom.

Besides this fundamental law defining loss and limiting efficiency, there are other sources of waste—radiation of heat from the machine itself, imperfect operation, and defective cycles which reduce efficiency to a small percentage of the heat value of fuel.

In the case of the steam-engine, if there were no friction and no losses with the best practical conditions, over half of the potential energy of the fuel would be lost under the action of this law. The amount lost is determined by the range of temperature utilized in the engine. This begins at 212 degrees F. or over, according to the operation of the condenser and extends to the maximum temperature of the steam. The latter is limited by considerations of lubrication, packing and other practical factors of operation. The heat extending from 212 degrees F. or whatever the condenser temperature may be, down to the absolute zero, 459.4° F. is lost under this law.

In the internal combustion engine a much higher temperature is reached, with a far greater range and with much higher efficiency compared with the steam engine, but the fuel used is more expensive than coal and this neutralizes the advantage. The second law may be reduced in effect, but with the use of fuel of increased cost per thermal unit.

The energy in 2/10 lb. of coal represents about one horse-power hour—in the best steam engineering practice it may take two pounds of coal to develop one horse-power hour.

The primary battery is not a heat engine and if in a primary battery, carbon could replace zinc and be economically oxidized as zinc is, a prima facie basis would be established for utilizing nearly all the energy of the carbon which may be considered as fuel.

The proposition is sometimes not quite correctly called the "direct conversion of heat into electricity" and has proved a tempting subject for inventors altho their efforts so far have failed. Even the principles on which their inventions operate in some cases, are open to discussion.

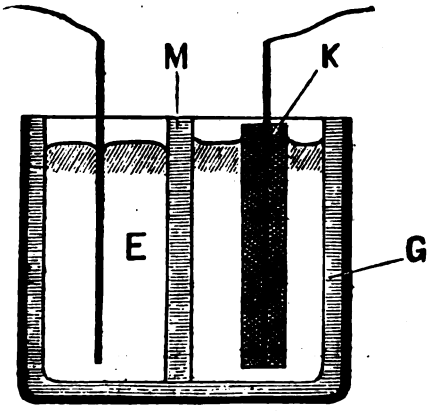



Fig. 3. Porous Diafram Iron Carbon Cell: This Is an Approach to the Principle of the Daniel Cell: Construction.

Again, leaving the primary battery, it would seem that in the thermo-electric effect, there would be some possibility of high efficiency, but altho thermo-electric batteries have been constructed which were really useful, the heat in some small ones of a Bunsen burner being enough to give a laboratory current for electro-deposition of metals and the like, attempts to build up large and efficient thermo-electric batteries have also failed.

We believe it will interest our readers to have described to them, a few of these attempts at the direct conversion of heat into electricity, and we can assure them that a successful solution of the problem would be a great advance, altho we see very little chance of its being done in the near future. It is even a matter of conjecture whether it will ever be successfully accomplisht.

If a voltaic couple could be devised in which the cheap element, carbon, would be oxidized by an inexpensive method, the problem would be near solution. For here there is no second law of thermo-dynamics overhanging the reaction of the battery, there is no heat to be lost, there is no reason why a very large percentage of efficiency should not be reached, but it has never been done.

The Jablokoff couple is based on an attempt to carry out the above principles. Carbon is the element consumed; it represents a substitute for the zinc of the ordinary battery. The other electrode is

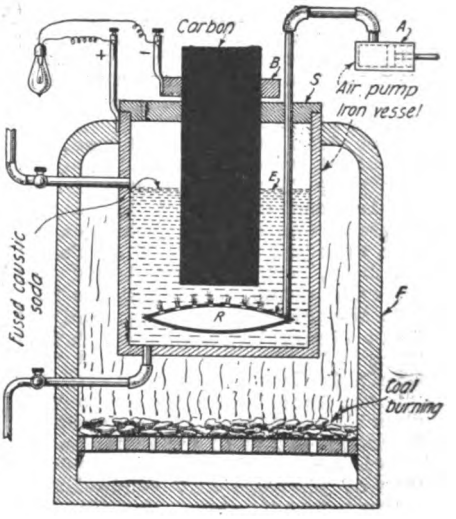



Fig. 4. Jacques Cell; Much Discussion Has Been Excited by This Cell. It Is Even Suspected That It May Act by Thermo-Electricity.

a bar of iron which undergoes no change. Instead of sulphuric acid, copper sulphate solution or ammonium chloride solution of the various typical primary batteries, fused potassium nitrate or sodium nitrate is employed. This is supposed to be electrolyzed and to attack and oxidize the carbon, the evolution of carbon monoxide gas representing such oxidation. An electromotive force of 1 to 2 volts is claimed for this couple.

But the nitrate is expensive, the heat required to keep it fused is an item of expense and common cheap coal cannot be used as the positive electrode, so while carbon is being burned, it is not cheap carbon, but a very expensive kind, somewhat similar to arc-light carbon.

Another combination is carbon, lead oxide (litharge), iron. In the cut, Fig. 1, the central electrode is carbon, the iron crucible (at once battery jar and nega-

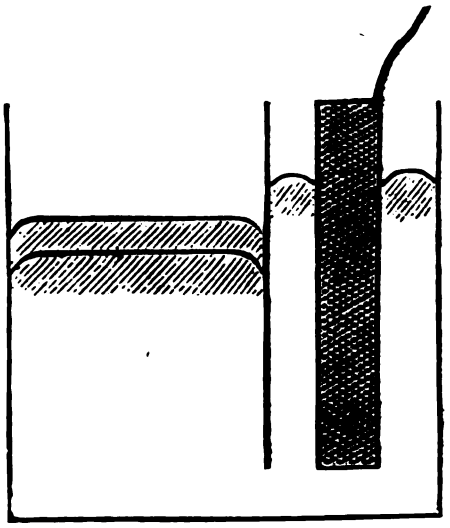


Fig. 2. Iron-Carbon Cell with Septum. The Right Hand Division Contains Fused Litharge; the Reduced Lead Sinks to the Bottom and Enters the Left Hand Division.

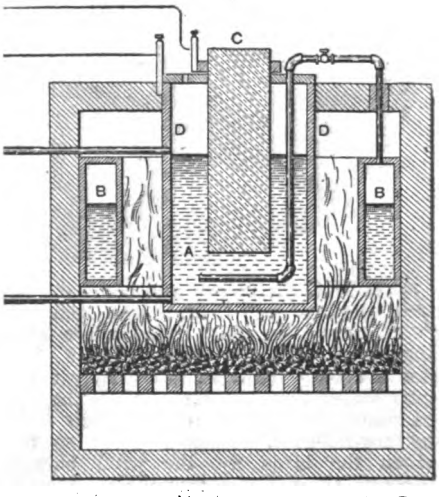



Fig. 5. Blumenberg's Cell; an Annular Boiler B, B Supplies Steam to be Blown Thru the Electrolyte.

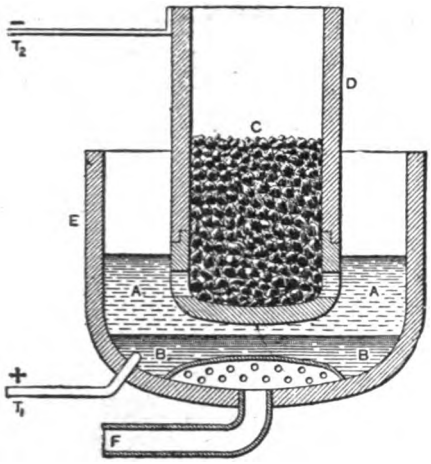



**Fig. 6. Short's Cell; the Lower Terminal Is in Connection with the Outer Iron Container and with Melted Lead in the Bottom.**

tive element) is charged with lead oxide which is maintained in fusion. An electromotive force is generated, metallic lead sinks to the bottom and carbon dioxide gas is evolved. The metallic lead is quickly oxidized by melting in the open air and is ready for use again as the electrolyte. It is even possible to have this regeneration take place almost automatically so that the lead would be what is known as a carrier of oxygen.

One of the cuts, Fig. 2, shows a variation on the above arrangement. The carbon electrode is in the right hand division; the heavy metallic lead flows to the left hand division and is oxidized there, the oxide accumulating and floating on the lead surface and being transferred to the left hand division. But this combination gives low results.

The next cut, Fig. 3, shows what was thought to be a step in advance. The iron battery jar is lined with an insulating material and a porous diafram divides it into two parts. In the left hand division an iron electrode is surrounded with melted lead oxide; in the right hand division is the carbon electrode surrounded by melted sodium nitrate and potassium nitrate. Here the regeneration of the electrolyte is impossible. Again where lead oxide is used, it soon becomes contaminated by the ash of the carbon.

We next illustrate the Jacques cell, Fig. 4, one which has excited a great deal of interest within a recent period, and whose action is not yet certain. In all the carbon consuming cells the question arises as to whether it is a true electrolytic generation of potential or how far it is a thermo-electric generation. Referring to the cut, we have the carbon in the center, surrounded by fused caustic soda in an iron vessel. The vessel acts as a negative or unattacked plate. An air pump blows air thru the soda, the current of air being divided into small jets by a rose. The carbon under these conditions burns up; sodium carbonate curiously enough, forms only in part, but the electrolyte continually experiences deterioration from impurities in the carbon.

Blumenberg's cell illustrated in our next cut, Fig. 5, is a sort of development of the Jacques cell. The carbon in the center is surrounded by a fused so-called "electrolyte" containing lime, cryolite and caustic soda, which is kept in fusion by a fire, and is contained in an iron or copper vessel which forms one of the plates of the battery. Superheated steam, generated in the annular boiler is blown thru the mixture. This does the work of the air in the Jacques battery.

An excellent example of a litharge battery is the Short cell shown in the cut, Fig. 6. In the outer vessel the lowest layer to be seen is melted lead with which a conductor $T_1$ is connected. This lead is surmounted by a layer of melted litharge in which is immersed the bottom of an iron vessel containing granulated carbon. Arrangements are made for blowing air thru the metallic lead to form litharge and the carbon in granulated form is contained in the iron vessel which is perforated at the bottom to admit the fused litharge. The couple really is a carbon lead battery excited by melted litharge.

As the carbon becomes oxidized under the action of the battery more and more metallic lead is formed, but as the battery runs out of litharge, more is supplied by the air blast oxidizing the lead.

Altho the efficiency of thermo-electric batteries is low, they are exceedingly convenient and have a more or less extensive use. They are based on the following principles: If a closed circuit, Fig. 7, is made up of two conductors of different material, and if the junctions are maintained at different temperatures, a current of electricity will be generated owing to the production of potential difference. Two dissimilar pieces of metal connected at the ends constitute what is known as a thermo-couple corresponding to the single couple of a primary battery. The voltage is very slight and usually the current may be taken as relatively very large owing to the low resistance.

To get any available voltage, a great number of the couples are connected in series, zig-zag fashion, Fig. 8, so that the circuit is not closed by each pair, but is only closed when the free ends of the entire zig-zag set are brought into electric contact. A thermo-electric battery is interesting as it perfectly represents the direct conversion of heat energy into electric energy. But up to date, it has proved very uneconomical and only of use in exceptional cases. In the illustrations we show a few typical thermo-electric batteries which have proved of some practical value.

The effort to directly convert the potential energy of fuel into electrical energy with any reasonable degree of efficiency has failed up to date, yet it is hard to believe that it will not be accomplisht eventually.

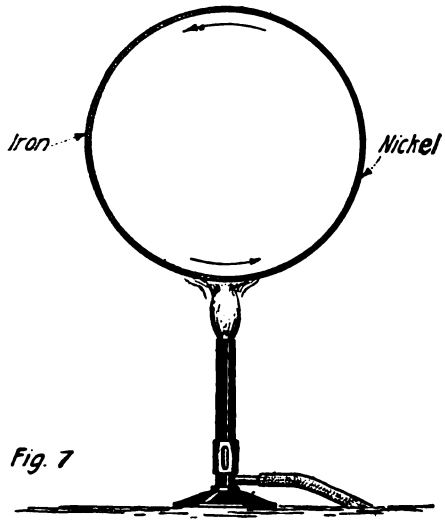



**Fig. 7. Single Thermo-Electric Couple; a Number of Such Couples Constitute a Battery.**

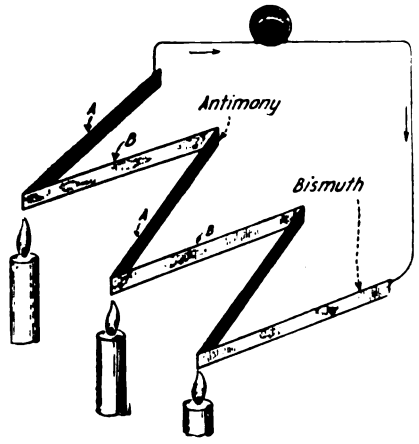



**Fig. 8. Multiple Thermo-Electric Couples; This Illustrates the Series Connections of Thermo-Electric Couples.**

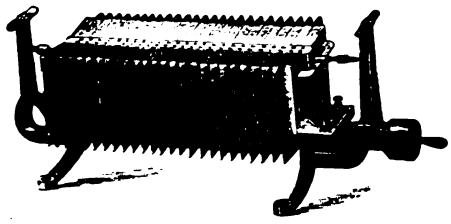


**Fig. 10. Gas-Fired Thermo-Electric Battery; Useful for Small Currents.**

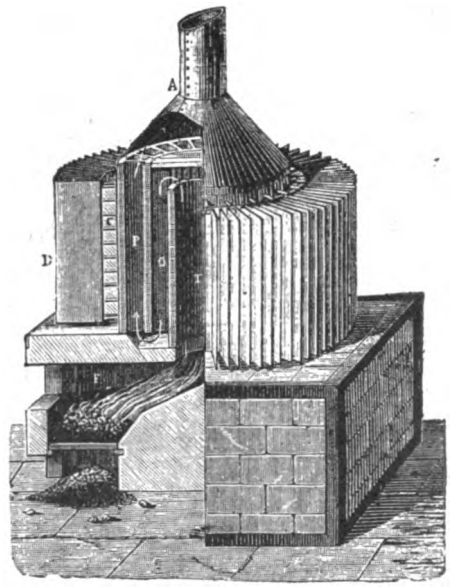



**Fig. 9. Coal-Fired Thermo-Electric Battery; an Attempt to Produce Electricity Directly on the Commercial Scale.**

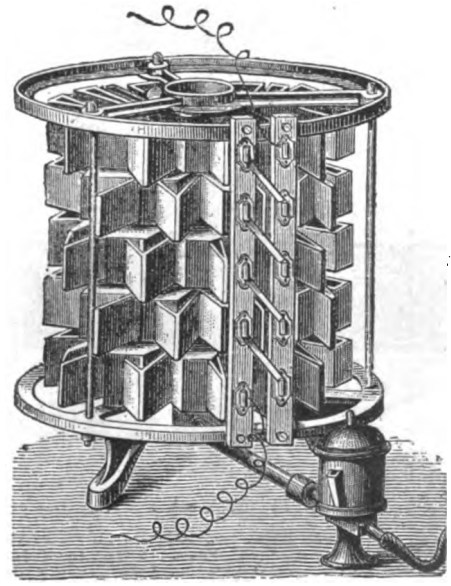


**Fig. 11. Gas-Fired Thermo-Electric Battery; Adapted Especially for the Laboratory.**

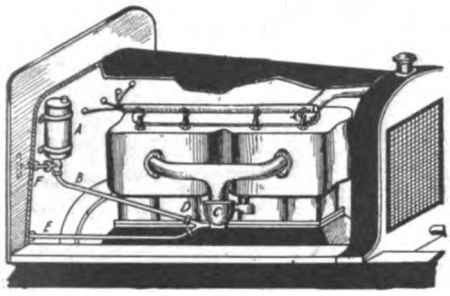
# MOTOR HINTS

First Prize $25.00

## HIGH LEVEL AND RESERVE GASOLINE TANK

The following described device has given satisfactory service for some time on a Ford one ton truck so I will attempt to describe same for the benefit of your readers.

Some cars that do not have the vacuum gasoline system are apt to become stalled on a steep grade of considerable length. After having this happen once, I constructed the device described here and have had no more such trouble.



A- Emergency gasoline supply.- B- Line to carburetor C D- Y connection. F- Extension on stop cock thru hole in dash.

**A Reserve Gasoline Tank Such As This Will Be Found a "Friend Indeed" When Stuck On a Grade With Low Gas in Your Tank.**

I secured a small brass container with a capacity of about one pint and mounted it on the dash immediately behind the engine as shown in the sketch. It should be located as high above carburetor as possible. A "Y" connection for attaching to the carburetor where the gasoline line connects was then secured and put in place instead of the regular connection. Then re-connect the regular line and another to the new container on dash. A small stopcock was soldered into this container and was provided with an extension handle thru dash so that it could be operated from seat.

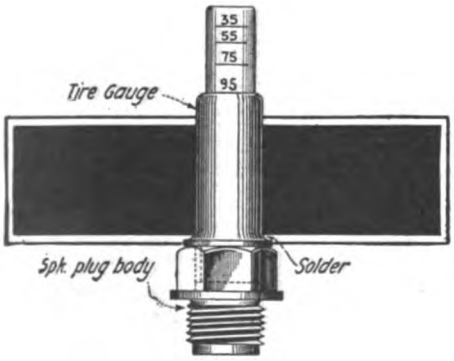
Contributed by THOMAS C. MOFFET

Second Prize $25.00

## MOTOR-CYLINDER COMPRESSION GAGE

Are you over-hauling your car or motorcycle? If so, you want to be sure that you do not lose compression. You may have to put your machine back into the garage and find out where the trouble lies. I had the same thing happen to me but I am making sure this spring with a little tire gage and an old spark plug base. Here's how:

Take out the porcelain or mica insulator and in place fit the tubular tire gage like in the sketch. It can easily be removed again and used for its original purpose, as a tire




**How a Tire Gage Was Used to Measure the Compression in the Engine Cylinder.**

gage. All you have to do is put it in the place of spark plug, turn over your motor, and it will register the amount of pounds pressure in the cylinder. After trying it in each, you can easily see which is the weakest cylinder.

This little trick will save you a lot of unnecessary time and cuss words, and is well worth the trouble of making.

Contributed by O. J. THIELHART.

## $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 |

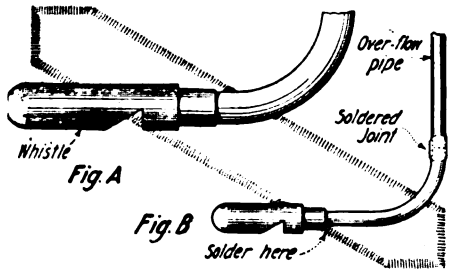
**All other accepted articles, which win no prizes, will be paid for at the rate of $2.00. Articles submitted should not be long ones. About one hundred to two hundred words will suffice. Address all manuscripts to Editor, "Motor Hints," care of this publication.**

Third Prize $10.00

## LOW WATER ALARM

### "A Warning for Low Water in the Radiator"

Some people find it hard to keep enough




**When the Water Gets Too Low in the Radiator the Whistle Blows, If You Adopt This "Alarm" Scheme.**

water in the radiator. And when the water gets low the radiator begins to steam and as the over-flow pipe carries the steam back under the car, it is not noticed until the pressure gets great enough to leak out under the radiator cap. So why not solder a little ten cent whistle to the bottom of the overflow pipe so when the steam begins to rise it will whistle like a peanut roaster.

To make a warning signal like this is not a hard job for anybody that can solder and is handy with tools.

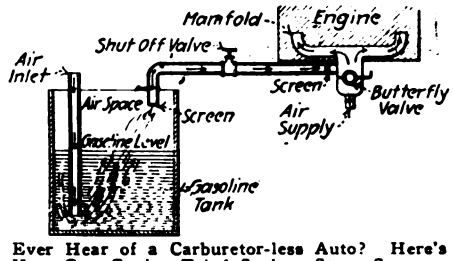
First get a piece of copper tubing the same size or a little smaller than the overflow pipe and about six inches long and bend it as in fig. A. Then solder it on as in fig. B.

This signal will never fail to warn you when the water is low and needs attention before it damages the radiator or the car.

Contributed by HARRY M. BROCKWAY

## A "CARBURETOR-LESS" CAR.

Once upon a time, I played a trick on my "Ford." The carburetor had been bothering me for some time. An idea presented itself to me, and I went to work on it. Briefly, the idea was this: To do away with the carburetor and draw the gas (*not* gasoline) from the gasoline tank directly into the cylinders. To accomplish this, I removed the gasoline chamber from the carburetor, leaving the butterfly valve intact, so that the flow of air could be regulated, and so fastened the gas pipe from the gasoline tank to the carburetor that the gas from the tank was drawn into the cylinders *by the suction of the engine;* and the mixture of gas and air was regulated by the butterfly valve, to which was fastened the throttle. There was one air inlet to the




**Ever Hear of a Carburetor-less Auto? Here's How One Genius Tried Such a Stunt Successfully.**

gasoline tank and this was extended to the bottom of the tank below the level of the gasoline, so that the suction from the cylinders drew the air from the inlet pipe *thru* the gasoline in the tank, making a very strong mixture of gas which was drawn into the cylinders. There was a valve in the gas line to shut off the supply of gas in order to stop the engine.

How that Ford did run! My only trouble was that I could not control the speed of the engine very well when it was running free. One would naturally think that if the engine should backfire, it would ignite the gas in the tank, but that however, did not happen owing to the fact that a rather small gas line was employed. It would, however, happen with a large gas line, but this can easily be remedied by inserting screens at various places in the gas line. I ran my Ford with this arrangement for several weeks and it caused a great deal of curiosity. The sketch shows the arrangement.

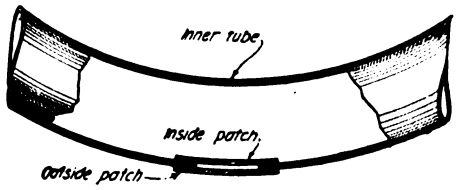
Contributed by B. F. WING.

## REPAIRING INNER TUBES.

The following stunt is one that we use considerably in the garage, and is as good, if not better, than a vulcanized job.

Sometimes a customer brings in a tube that has a long rip or hole in it, and so large that an ordinary patch would not hold.

Clean the inside of the tube where the hole is as well as the outside with gasoline. When it has dried coat the inside (for about one-half an inch where the hole is) with rubber cement and let it get rea tacky. As soon as it is put on the patch




**Superior Method of Repairing Inner Tubes With Two Patches Instead of One.**

and let dry. Do the same on the outside. This makes a double patch where the hole is. One on the outside and one on the inside.

Contributed by

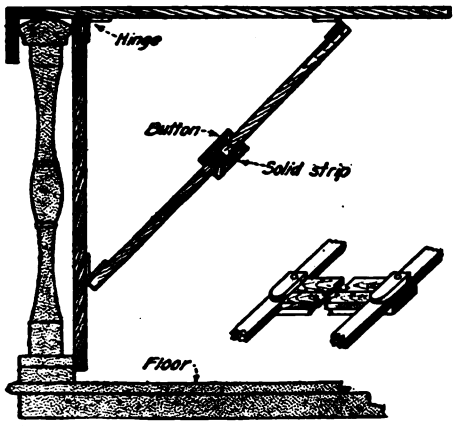
M. P. LITTLEFIELD.

# Home Mechanics

## Conducted by WILLIAM M. BUTTERFIELD

### ADJUSTABLE PORCH TABLE

A table is shown in Fig. 2 that can be hooked over the top of the porch rails at any place for the moment desired, and without preparation removed or replaced. The table can be manufactured from a large

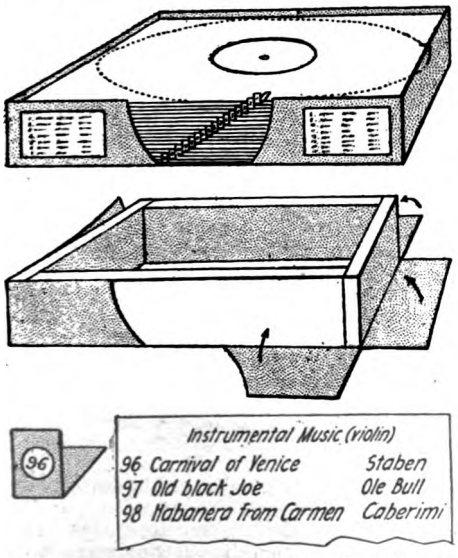



A Home-Made Porch Table Which Can Be Constructed From Odds and Ends Found About the House. It Can Be of Any Width Desired and Is Readily Removed When You Are Thru Using It.

bread board, commonly sold in hardware stores, the various pieces of the frame are made from ordinary lumber. The drawings show its construction. To keep the bracing frames in position a stop piece is secured with screws to the underside of the table in front of the upper frame as illustrated—this prevents the frame from falling. To hold the lower bracing frame in line with the upper one, a cleat is secured to the latter as shown. The table is hinged and can be let down, after folding the bracing frames, and then can be stored in a restricted space along the porch rail. The apparatus should be painted to make it waterproof.

### METAL RECORD TRAYS

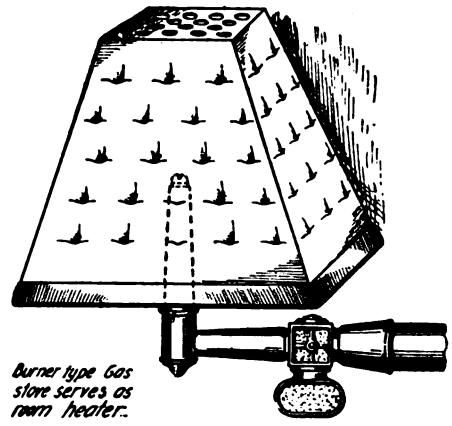
Many phonograph record filing cabinets and racks are known, but all are costly both in price and they often take up valuable storage space. The tray, made of thin metal (tin, copper or iron), shown clearly above—has the advantage of cheapness and of providing ample room for a good number of records. Besides the paper envelope, with its label, coming with each record, is also preserved as a part of a cataloging scheme. To bend, and solder the corners of the trays (there is a tray for each shelf in the cabinet), it is advisable to make a wood frame, such as is illustrated in a partly formed tray in the drawing. All of the trays are made on the one frame, thus insuring a uniform shape or size. The metal is shaped with shears as shown, then bent and soldered at the corners on the frame. Index slips are attached to the trays, and a number tag of cloth is glued to each paper record cover. The object of these individual tags is two-fold; first to number each record for identification as indicated by the index slip, and to enable anyone to lift the pile so that any particular cover with its record can be pulled out above the edge of the tray.




Phonograph Record Trays Are Welcome to Every User of Records—Here Is a Simple Indexed Tray Made of Tin. It Can Also Be Made of Wood. The Tin Is Bent Into Shape Over a Wooden Form or Pattern As Shown.

### A CHEAP GAS HEATER

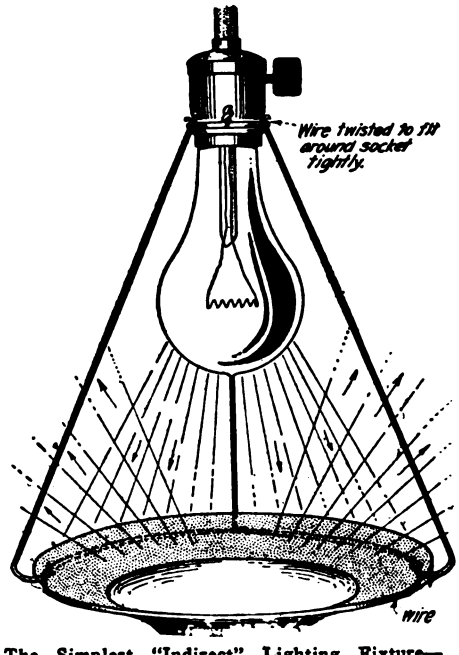
The home mechanic has only to invest the small sum of ten cents, and a few minutes time, to obtain a good durable gas-heater. This device consists of a metal toasting frame, which is provided with four ledges bent outwards and upwards, for holding toast, and the ordinary brass ring used for holding the glass globe on the gas fixture. The toaster is obtained at any five and ten-cent store, the ring is provided with the fixture as a part of its equipment. In using the toaster, straighten out the angles in the ledges, then bend all down so that they will fit the globe ring in a circular fashion. This will make a drum heater of the toaster, with its round bottom inclosed within and supported by the ring. The toaster, used in its original shape on any variety of gas or oil stove, will be found a most convenient appliance for heating, its shape being particularly suited for disseminating heat.




This Simple Gas Heater or "Stove" As It Is Called in the Department Stores, Will Serve to Heat Up a Room Nicely These Cool Spring Mornings, Says Mr. Butterfield. The Air Seems to Be Heated More Effectively Using One of These "Stoves" On the Burner, Than With Open Tip Flames Alone.

### INVERTED DOME FOR ELECTRIC LIGHT

Some times in working under an electric bulb the light is found too glaring for convenience or safety to the eyes. To give a good degree of light, and at the same time to overcome the glare of the bulb, inverted domes of white porcelain have been made and installed on many large fixtures. It is not possible to fit domes of this character on all fixtures that may need them, particularly many single bulb lights. In the figure herewith we show how the home mechanic can construct an inverted dome from a few pieces of brass or iron wire and a porcelain saucer or thin bowl. This arrangement will be found satisfactory in every way.

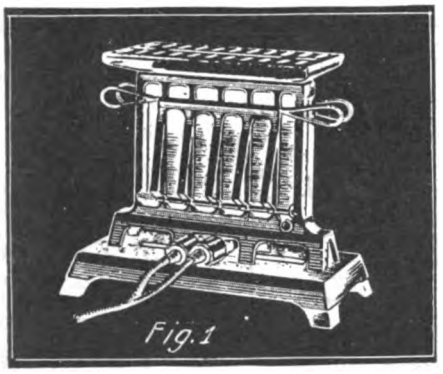



The Simplest "Indirect" Lighting Fixture—Made in An Emergency to Reduce the Painful Glare Given Off By Incandescent Lamps, Especially Noticeable When Drawing or Painting. A Thin China Dish, Painted Preferably, Is Held in a Wire Frame Fitted About the Socket

# Home Electrics

## By G. L. HOADLEY, M. E.

PRACTICALLY every housewife pays for the electricity she uses in kilowatt-hours, which is registered by the electric meter. In the May issue we learned how to compute and check electric light bills. What does this




**Many People Believe That Electric Toasters and Other Devices Are Expensive to Operate, But When the Actual Cost Is Computed, This Is Not Found to Be the Case.**

term kilowatt mean? A kilowatt is 1,000 watts. The watt is too small a unit for practical use, so the larger unit, kilowatt, is used. You pay for the gas you use by the cubic foot; for the water by the gallon; and for electricity by the kilowatt-hour. Your electric iron consumes 550 watts. Suppose you use it for three hours *steadily* without once turning off the current to complete your week's ironing. How much has it cost you at $0.06 per kilowatt-hour to do your ironing? Solution: 3x550 = 1650 watt-hours. 1650 ÷ 1000 = 1.650 kilowatt-hours. 1.65x$0.06 = $0.099 or just about 10 cents for your week's ironing.

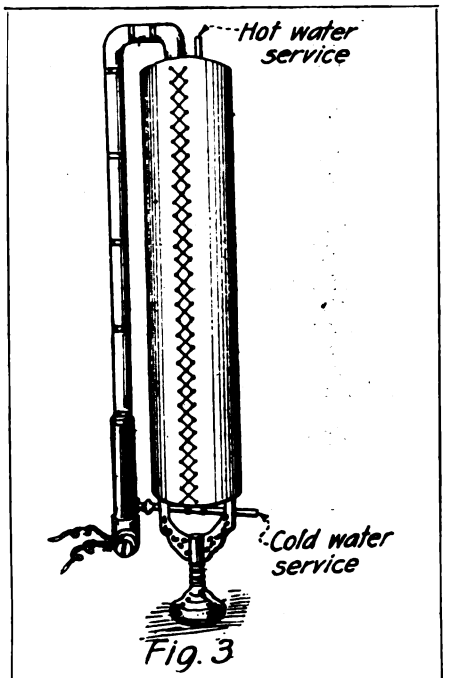
Your washing-machine motor is usually a ⅙ horsepower motor. Let us see what it costs to do the family wash. A good-sized family wash can easily be done in four hours. Since one horsepower equals almost exactly ¾ kilowatt, ⅙x¾ = ⅛ kilowatt or 125 watts, as the full load output of the motor. Since the motor is approximately 70 per cent efficient, 125 watts = 70 per cent of the power supplied to it at full load. Hence, the input = 100 × (125 ÷ 70) or 180 watts, or .180 killowatt. The number of kilowatt-hours registered by the meter then, is .180 kilowatt times 4 = .72, or a trifle less than ¾ of a kilowatt-hour. This costs 0.72x$0.06 = $0.0432. The total cost, then of doing the family washing and ironing is $0.043 + $0.10 or $0.143. This is less than the cost of "doing up" one man's shirt by a laundry. A washing-machine and electric iron will soon pay for themselves, where a family wash is concerned. It should be noted also that the six-cent rate is a medium charge, and a lower rate of three cents is in effect in Chicago and other places after 60 hours use of maximum load. At the lower rate the cost of doing the family *wash and ironing* would be cut in half, or to about $0.07.

A universal toaster, Fig. 1, has stampt on the bottom; volts 115-amperes 2.19. Let us see what it costs to operate it for one week if used for 15 minutes each morning. Total hours per week 15/60x7 = 1.75 hours. Now, power in watts = volts x amperes; hence, 115x2.19 = 252 watts or 0.252 kilowatt of power. In one week, then, the meter would register 0.252x1.75 or 0.441 kilowatt-hour. At the $0.06 rate, the cost of operating it is 0.441x$0.06 = $0.026. Not a very large amount to spend for a week, especially when one thinks of the greater convenience, and how much better fresh hot toast tastes than the usual kitchen product.

## Cost of Operating Electrical Appliances

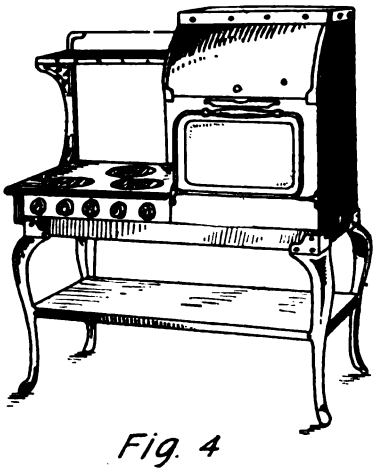
The universal coffee percolator illustrated in Fig. 2, is marked as follows: volts 110-amperes 4.1. What will it cost to operate it every morning for one week, assuming that the percolator is used fifteen minutes each morning? Number of hours used per week is 7x15/60 = 1.75 hours; number of watts consumed is 110x4.1 = 451 watts; number of kilowatt hours registered by meter is 451x1.75 ÷ 1000 = 0.789; cost per week is 0.789x$0.06 = $0.04734. Five cents is a small amount to spend for a week when one considers the better flavor obtained by this method of making coffee.

**Water Heater:** Consider next the cost of heating the water in the kitchen boiler by electricity. A special low rate of ¼ of one cent per kilowatt-hour with the electric range or ½ cent without the range




**An Excellent Electric Heating Attachment of High Efficiency—the Electric Boiler Heater.**

is a typical rate for water-heater service. The reasons are that the heater is off when the oven is used during the day, consequently, the heater load is mostly at night, when the power plant load is light, and also, because of the surplus of cheaply generated power from the hydro-electric power plants of the South and West. Since




**The Electric Range Is Finding More Favor Every Day, Owing to Its Freedom From Ashes, and Dust, Also Because It Does Not Heat Up the Kitchen.**


**The Electric Percolator Is Not Such a Bad Offender in "Watts Consumed" As Prof. Hoadley Points Out.**

the heater is not ON when the oven is in use, a flat rate of $2.50 per month is generally charged instead of metering the heater load.

It figures out about the same if metered, as will be seen by the following: Suppose we have a type of heater as shown in Fig. 3, rated at 115 volts, 6.5 amperes. Such a heater will keep an ordinary 30 gallon tank heated to a temperature of about 180 degrees Fahrenheit, unless an unusual amount of water is used at one time as might be the case at the end of a big washing. Assuming the heater is connected all the time, we have: Number of watts consumed is 115x6.5 = about 750 watts; number of kilowatt hours registered by meter per day is $\frac{24 \times 750}{1000}$ = 18 K. W.H. cost per 24 hours is $0.09 (18x$0.00½); cost per month is 30x$0.09 = $2.70, which is not far from the flat rate.

**Electric Range:** The electric range is in common use thruout the West and its cost of operation will next be considered. Let us consider the Hughes range, model 47, illustrated in Fig. 4, which is suitable for the average family. The right-hand cooking surface burner is rated thus: high—1500, medium—750, low—375 watts. It is a three heat burner, that is, any one of three heats, high, medium or low may be used. The average housewife will require about one hour to cook dinner for an average family using all three surface burners at high heat. The left hand burner is rated 1100—550—275 watts; and the rear burner 440—220—110 watts. Two oven burners are rated at 1100—550—275 each; total kilowatt hours registered by meter for cooking dinner, is 1500 + 1100 + 440 ÷ 1000 = 3.04 kilowatt hours. At the typical cooking rate of $0.03 per kilowatt hours, registered by meter, for cooking a dinner, the cost comes to $0.03x3.04 = $0.091 or approximately 10 cents.

The other two meals each requiring less cooking, combined, will cost about the same as this one meal, making a total of $0.20 per day on the average, or between $5.00 and $6.00 per month. The power companies in the West will usually agree to furnish power to include electric ranges on a flat rate basis of $10.00 per month for the average family. This amount covers cooking, lighting and water heater charges. When one stops to consider the added convenience, the freedom from odor, soot, smoke, etc., which the electric range affords, the slight additional cost of operation above that for coal, gas, etc., is well worth the money so spent.

# Practical Chemical Experiments

## BY PROF. FLOYD L. DARROW

### SOME SIMPLE FOOD TESTS

IN this and one or two succeeding articles we shall take up a series of very interesting chemical experiments on foods and food adulterants. There are three principal kinds of foods: carbohydrates, proteids and fats. The *carbohydrates* comprise the starchy foods and the sugars. Thus vegetables, as the cereals, potatoes, etc., are carbohydrates. These are compounds containing the elements—carbon, hydrogen and oxygen, but having the hydrogen and oxygen in proportion to form water. The *proteids* are nitrogenous compounds. Examples of this class are lean meat, casein of cheese and the white of egg. Butter, olive oil, salad dressings and the fats of meats are the best examples of the third class. The carbohydrates and the fats are energy producers while the proteids are tissue builders. As a foundation for work of this sort it will be necessary to learn the tests for these principal kinds of food constituents.

**Test for Carbohydrates:** To make the general test for carbohydrates a 15 per cent solution of alpha-naphthol will be necessary. This can be prepared by the experimenter himself by dissolving 3 grams of the crystals of alpha-naphthol in 25 cc. of alcohol. Then select some well known carbohydrate as wheat flour, powdered rice or starch. Place some of it in a test tube and fill the latter two-thirds full of water. Boil this mixture thoroly and then filter. To 5 cc. of the filtrate add 2 drops of the solution of alpha-naphthol. Then holding the test tube in an inclined position add slowly 3 cc. of concentrated sulfuric acid so that it will pass to the bottom of the test tube, and form a distinct layer below the other mixture in the tube. Under such circumstances a purple ring will form between the two layers.

This test may be repeated with any number of carbohydrates and any foodstuff may be easily tested for their presence.

**Test for Starch:** First prepare a dilute solution of potassium iodide in water and add to it two or three small crystals of iodine. Shake until the iodine dissolves. Now to a pinch of starch in a test tube add 5 cc. of water and boil the contents until a gelatinous mass has been obtained. Then nearly fill the tube with water and add a drop of the iodine solution. A deep blue color will result.

Starch may be tested for in any food by this method. It will be found interesting work to make such tests on a wide variety of foodstuffs.

**Test for Starch in Ice Cream:** Place a small quantity of the sample in a test tube and boil with 10 cc. of water. When it has cooled add a few drops of the iodine solution and if starch is present the characteristic blue color will at once appear.

**Test for Glucose:** Glucose is one of the most important of the carbohydrates. It is commonly known as grape sugar and is used very largely in the manufacture of confections.

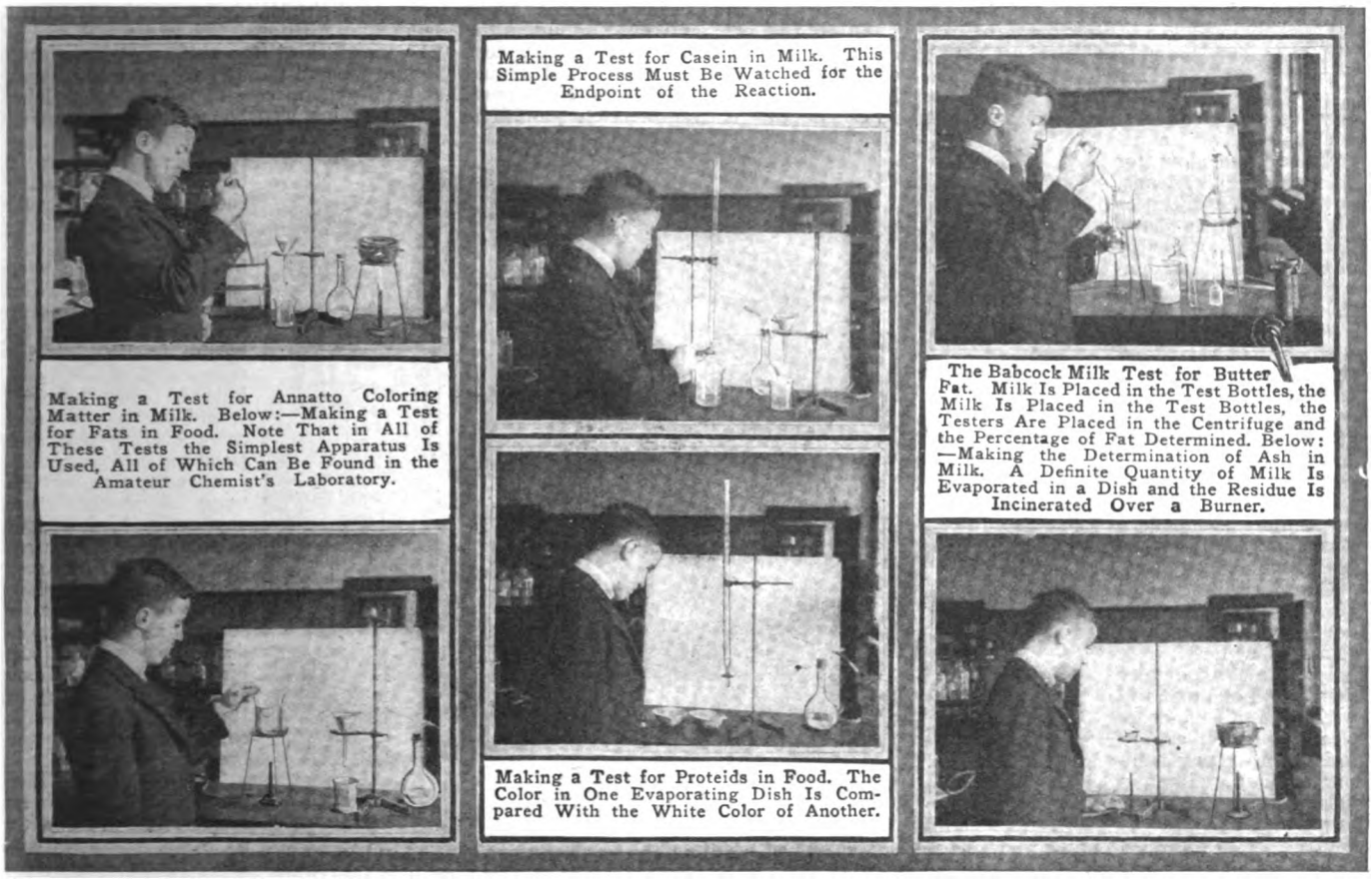
To make this test requires a reagent known as *Fehling's solution* and consisting of two parts, known as solutions numbers 1 and 2.

Solution No. 1: 34.6 g. of copper sulfate in 500 cc. of water.

Solution No. 2: 173 g. Rochelle salts, 50 g. sodium hydroxid in 500 cc. of water.

Dissolve a little glucose in 10 cc. of water. Then add 1 cc. each of solutions numbers 1 and 2. Heat nearly to boiling and note the bright red color that is obtained. This color is characteristic in the presence of glucose.

Various confections may easily be tested for glucose in this way.



Making a Test for Annatto Coloring Matter in Milk. Below:—Making a Test for Fats in Food. Note That in All of These Tests the Simplest Apparatus Is Used, All of Which Can Be Found in the Amateur Chemist's Laboratory.

Making a Test for Casein in Milk. This Simple Process Must Be Watched for the Endpoint of the Reaction.

The Babcock Milk Test for Butter Fat. Milk Is Placed in the Test Bottles, the Milk Is Placed in the Test Bottles, the Testers Are Placed in the Centrifuge and the Percentage of Fat Determined. Below:—Making the Determination of Ash in Milk. A Definite Quantity of Milk Is Evaporated in a Dish and the Residue Is Incinerated Over a Burner.

Making a Test for Proteids in Food. The Color in One Evaporating Dish Is Compared With the White Color of Another.

**Conversion of Starch and Cane Sugar into Glucose:** To a small pinch of starch in the bottom of a test tube add 10 cc. of water and 2 or 3 drops of concentrated hydrochloric acid. Boil this mixture for ten minutes and test the resulting solution for glucose, using Fehling's reagent as before. The bright red color will appear showing that starch has been converted into glucose. The chemical change consists in causing each molecule of starch to unite with one molecule of water.

**Cane Sugar** may similarly be changed into glucose by boiling a solution of it in a test tube vigorously with one drop of concentrated hydrochloric acid. As before the test for glucose is at once obtained. This process is called the "inversion of cane sugar." If a sugar does not at first respond to the test for glucose, but does after having been boiled with hydrochloric acid, you may know that cane sugar is present. If starch is present, however, the test is uncertain, for starch would also be hydrolized into glucose.

**A Test for Fats:** In order to apply this test, place a few drops of olive oil in a test tube and cover with 3 or 4 cc. of benzol. Now place the test tube and contents in a beaker of hot water and allow it to stand for several minutes with occasional shaking.

(*Continued on page* 188)

# THE CONSTRUCTOR

# Cypress Bungalows for the Birds

**By H. JOHNSTONE**

EACH year sees a greater interest manifested by bird lovers in providing better and more attractive houses for their feathered friends. We see but few bird houses in the city, as people do not have the space in which to place an attractive bungalow for their feathered friends, and moreover, city people do not see so many birds nor such a variety of them as do their country cousins. It is hoped that the drawings presented herewith will serve as an incentive and will awaken in the minds of those who love these little creatures, the idea of providing not only comfortable but attractive houses, for the migratory birds who come to us in the northern climes to tell us that Spring is indeed here.

One of the best woods of which to build bird houses, whether large or small, is cypress. Not only is this wood very sturdy and one that will withstand all kinds of weather, but it can be finished up in any manner desired, either a natural finish with oils or varnishes or else by painting with different colors.

**The Joy of Providing Homes for Our Feathered Friends—the Birds—is One That is Felt by Young and Old Especially at This Time of the Year, When the Warblers are Returning from Their Winter Sojourn in the Southland.**

Probably one of the most important things to remember about bird houses, especially if you want to watch and study the birds, which means having the bird house or houses near your dwelling, is the fact that birds are in general very wise little fellows and many of them will not make their home near premises overrun with cats, dogs and English sparrows. One authority in describing this important feature of bird house location mentions that, if these three are eliminated or kept to the minimum, then other birds will come—robins, orioles, king birds, waxwings—these and others will nest in orchard trees or in bird houses placed in or adjacent to such trees, while in the dead limbs and bird houses will be found bluebirds, wrens, swallows, woodpeckers, chicadees, etc.

Whether or not you possess one or more cats, care should always be taken to provide against stray cats climbing the trees or poles on which you have placed bird houses and in one of the accompanying drawings an excellent and approved type of barbed wire *cat-guard* is illustrated. The cat-guard may be built with the lower strand of barbed wire, or better still all of the strands running around the tree may be composed of barbed wire. Where the bird house is placed on top of a pole, a single wire cat-guard will protect it in practically all cases, except when it may be close to a house roof or tree, whence a cat might jump to the pole and descend upon the innocent little tenants. Where such a condition obtains a second cat-guard should be placed a few feet above the bird house. A double cat-guard protection should be used in almost all cases where the bird houses are placed in a tree, and particularly where there are a number of trees close together, for a cat may climb an unprotected tree containing no bird homes, and then jump from that tree to an adjacent one containing bird houses.

The young bird student most probably will want to start by providing small homes for his or her feathered friends, several well-designed styles of which are shown in the accompanying drawings for different birds. Those who are particularly enthusiastic and have the time to devote to cultivating an extensive friendship with birds, will find it interesting to construct one of the larger "apartment houses," which will have a capacity for a dozen or more "bird families."

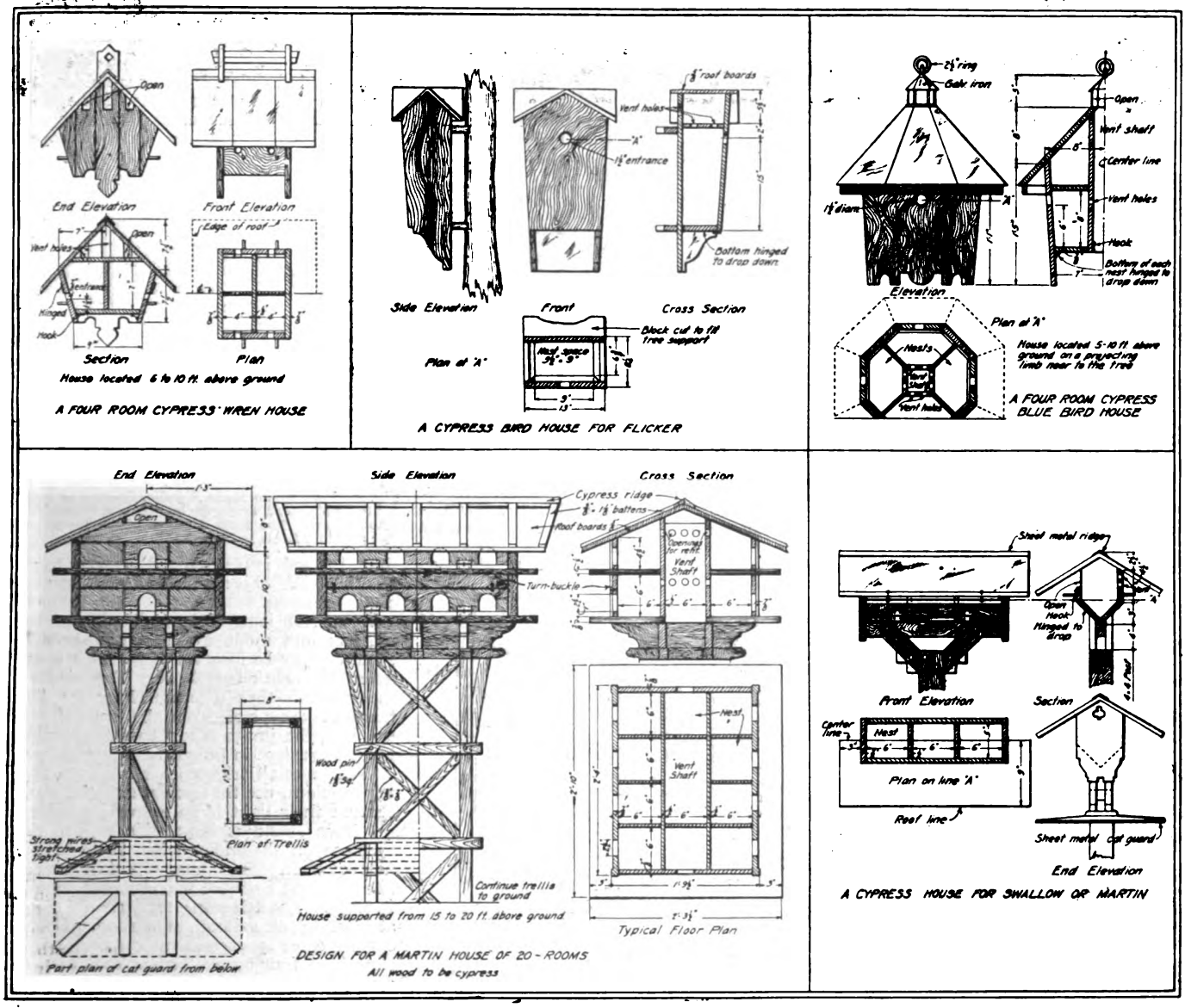
Of course, it is essential that food be placed out every day as well as water to attract the birds, and it is not only a case of building attractive looking domiciles for them, but in not painting them in gaudy colors. For many birds it is well to keep the colors as natural as possible and in Switzerland and Germany, where bird fanciers are legion, the roofs of the bird houses are frequently made of, or at least covered with, rough bark of a dark brown or similar natural color, the bark being obtianed from trees in the forest. Bird houses placed on poles lend themselves harmoniously to the landscape when painted white. A tin or galvanized sheet iron roof can be used and should be well painted to prevent rusting. A good general rule to follow, in building and finishing bird houses, is to remember that birds usually like to place their nests in the crotches of trees and they, therefore, would seem to like the color of natural bark, etc.; therefore, it is well to keep the color scheme of bird houses in sympathy with that followed by nature in dressing the trees. Another good hint in this direction would be to use green as a leading color for painting bird houses.

There are several ways of mounting or supporting bird houses; in some cases they are hung on a nail or may be rigidly supported on a tree or post, but for some birds it is quite desirable to suspend the bird house by a hook and ring in the top of the structure, so that it can swing gently in the breeze.

The St. Louis Bird Club and the National Association of Audubon societies, (1974 Broadway, New York City), offer a $100.00 prize each year for the best types of bird houses built by boys or girls under 14 years of age.

One very important factor in bird houses designing is always before us—that of keeping the bird house or houses clean. This can be done by hinging the floor to the side walls of the house so that the floor can be swung downward and cleaned thoroly. Bird houses mounted at the top of poles, etc., or high up in a tree can be arranged with a rope and pulley, in order to be raised and lowered for proper cleaning, placing food and water therein, etc. The bird tenants should be assured of plenty of fresh air and for this purpose a row of holes is often bored in the sides of the houses, just beneath the eaves, but no ventilating hole should be bored lower than the entrance door, and all joints should be made tight, for drafts of air are dangerous. A small drainage hole should be bored in the middle of the floor if there is the least chance that rain may be driven into the door of the bird house.

The best time of the year to erect bird bungalows is said to be in the Autumn, the birds becoming used to them and sleeping in them. The bluebirds come early and on many a mild day in Winter, one may see them as they are looking for a choice location. Bird houses should, therefore, be left up the year round and if built of cypress



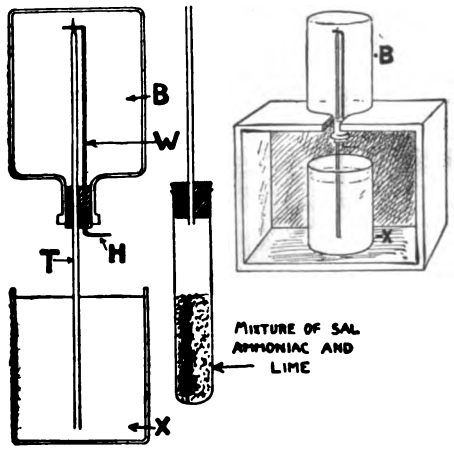

**Above are Illustrated a Goodly Variety of Bird Houses so that One Can Find Among Them a Design Suitable for Their Particular Requirements. One of the Best and Most Durable Woods from Which to Construct Bird Houses is Cypress. Colors for Painting Should be Neutral such as Gray, Brown, Dark Red, etc.**

they will last for many years, for this wood is one that will stand all kinds of weathering, as caused by rain, snow and sleet. As one expert points out, the chief reason that birds migrate to the South in the Winter time is because they cannot get enough food, and also because of the poor accommodations afforded them in the northerly climes to keep them warm and comfortable. There are many enemies of house birds in addition to the pestiferous English sparrow, which must be looked out for; such are snakes and squirrels, red squirrels in particular having a bad reputation in this respect. Therefore suitable guards made of wire or tin should be provided to prevent these enemies from climbing to the nests and houses and frightening or killing their inmates.

# How to Make an Ammonia Fountain

Obtain a wooden packing box about a foot square, turn it on its side and cut a slot large enough to insert the neck of the inverted colorless bottle B. A piece of glass tubing T, fifteen inches long is drawn to a fine point and past thru a perforated rubber stopper which fits B tightly. A stout wire W, is also past thru a fine hole in the stopper and bent at both ends as shown. By turning it at H, the capillary end of the glass tube may be broken off later.

When ready to fill with gas, have the stopper with its fittings removed from the bottle and see that the latter is perfectly dry. Next mix two parts of ammonium chlorid (sal ammoniac) with one part of fresh dry lime and place in a test tube supplied with a stopper and delivery tube. Pass this tube well up into the inverted bottle B, and then gently heat the test tube. The bottle will soon fill with ammonia gas, and when the delivery tube is withdrawn, the prepared stopper with its capillary tube and wire is quickly inserted in place and made tight.




**This Interesting Fountain Stunt Can be Tried by Even the Most Juvenile Chemical Experimenter. If Properly Executed the Change in Color of the Water from a Transparent to a Beautiful Red Tint Becomes Startling.**

If the free end of the tube T, is now lowered into a vessel X, filled with water, the fountain is ready to operate. First cool B with a fan or wet cloth and cause its gaseous contents to shrink. Then slowly turn H to break off the end of T. Instantly the water rises in T from X, and appears as a drop at the end of the capillary. The ammonia dissolves at once in it—causing a vacuum which lowers the pressure to such an extent that the water rushes in and can be heard as well as seen hitting the top of the bottle. This will continue until B is nearly full.

If some phenolphthalein is added to the contents of X, the water will turn red as it discharges into B. If any copper salt be dissolved in X, then the contents of B will be a fine blue color.

A little ingenuity will suggest other modifications of this rather striking experiment.

Contributed by L. H. KIRBY

# Astronomical Photography for the Amateur

## By H. F. CURTIS

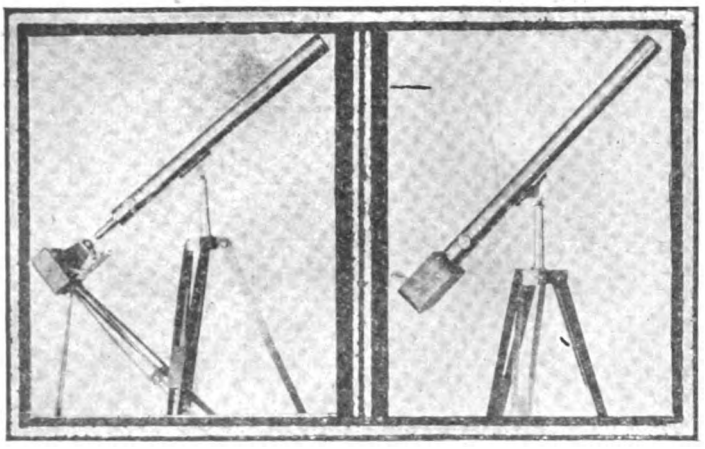


Fig. 1. Extreme Left Hand Photo Shows Ordinary Camera Placed in Line with Telescope for Taking Photographs of the Heavenly Bodies. The Camera Lenses Are Removed and the Shutter Used Only.

Fig. 2. Shows Home-Made Wooden Camera Fitted on the Eye-Piece End of Telescope. Detail of This Camera Is Shown at Right.

THE possessor of a small telescope who has become interested in astronomy and who has followed the articles on the subject which have appeared from time to time in *Science and Invention*, has undoubtedly often wished, if he is a real enthusiast, that he might record some of his impressions by photography. Contrary to the statements made in some of the well-known books on technical astronomy, fairly satisfactory photos of the sun, moon and stars may be made with the small visual telescope of two to three-inch objective, such as the average amateur owns. It is true that such photos possess little or no astronomical value, but they are of considerable interest to the experimenter.

The small telescopes, being intended for visual purposes only, are adjusted to bring to a focus only those rays best suited to the eye, the others being allowed to "wander rather widely." Unfortunately, in this instance, these visual rays are the red-yellow, while the light which affects the photographic plate is the "actinic" light, or that near the blue end of the spectrum.

### USE OF COLOR FILTER.

To get the best results from one of these visual telescopes, a *color filter* transmitting only the yellow or yellow-green light should be placed either over the eyepiece end of the telescope, or over the object glass. Such a filter is not expensive and much better results will be obtained thru its use. They may be obtained at any photo supply house.

The photos may be taken either with or without the eyepiece in place. The eyepiece magnifies the image, but it also reduces its brilliancy, necessitating a longer exposure. The limit of exposure with a stationary telescope is, of course, that during which the image moves a sufficient distance on the plate to cause blurring. It is evident that the higher the magnification used, the shorter the exposure must be to prevent blurring.

When taking photos without the eyepiece, the photo plate in a plate-holder, is placed accurately at the focus of the objective of the telescope, and the proper exposure made. The size of the image thus formed is determined by the focal length of the objective, and is fixt in any given telescope.

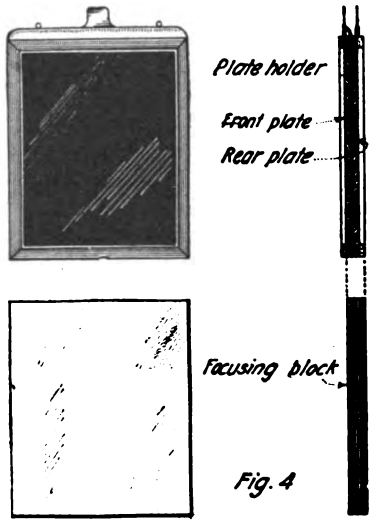



Fig. 4. Shows Detail of Plate-Holder and Wooden Focusing Block Used with Home-Made Astronomical Camera.

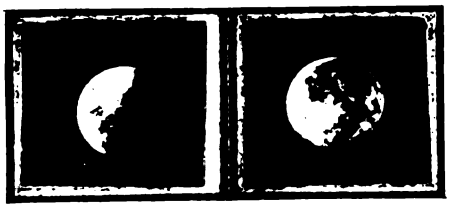


Fig. 5. (At Left) Shows the Moon at Thirteen Days, Taken with a 3" Objective With Exposure of 1½ Seconds.

Fig. 6. (At Right) Shows Full Moon Photograph Taken with 3" Objective.

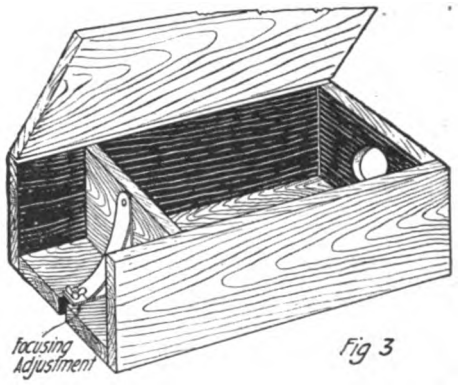



Fig. 3. How Home-Made Wooden Camera Is Built for Use with Small Telescope in Taking Astronomical Photographs. The Back Against Which the Plate Holder Rests Is Made Movable as Shown.

When sufficiently bright objects such as the sun and moon are to be taken, the eyepiece may be inserted to act as a magnifier, as mentioned above. The size of the image is then determined by the distance of the plate from the end of the eyepiece, the image being focust by moving the eyepiece in or out of the telescope.

With a small telescope, it is practically impossible to use the eyepiece on the stars because their light is so extremely faint.

I have found it impossible to use the eyepiece on the moon when it is in the first quarter. In taking the full moon, however, the eyepiece may be used to advantage. The telescope used should have at least an alt-azimuth mounting. If the experimenter possesses a camera of a size about four by five inches, mounted on a tripod, it may be used as the telescope camera in the manner shown in Figure 1. The camera lenses should be removed entirely, only the shutter remaining. This arrangement is the only one which I have found that would take a satisfactory picture of the sun, because of the difficulty in getting a short enough exposure without a high-grade shutter.

### A HOME-MADE TELESCOPE CAMERA.

Where such a camera is not available, moon and star pictures may be taken with an improvised wooden "camera," Figure 2, which should be constructed to fit snugly over the end of the telescope. It may be open on the upper side, if used in a dark place at night, or may be fitted with a hinged cover, Figure 3. An adjustment should be provided to secure

(*Continued on page* 106)

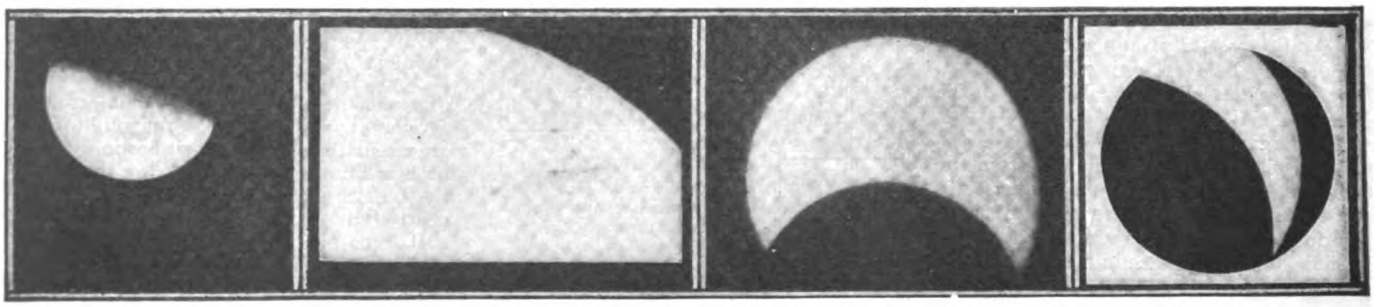


Fig. 7. Excellent Photograph of the Half Moon, Taken with An Exposure of Three Seconds with 3" Objective Illustrated in Fig. 1.

Fig. 8. Sun Spots Photographed, Oct. 3, 1918. Diafram Opening 20 mm. Eye-Piece 75 x, Exposure 1/75th Second.

Fig. 9. Commencement of Annular Eclipse of Sun, Nov. 22, 1919. Eye-Piece 45 x. Distance of Eye-Piece from Plate 3". Exp. 1/100th Second.

Fig. 10. Partial Eclipse of Sun, June 8, 1918. Diafram Opening 20 mm. Eye-Piece 75 x; Distance of Eye-Piece from Plate 4". Exposure 1/75th Second.

# 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.

## An Electric Gas Extinguisher

**FIRST PRIZE, $5.00**

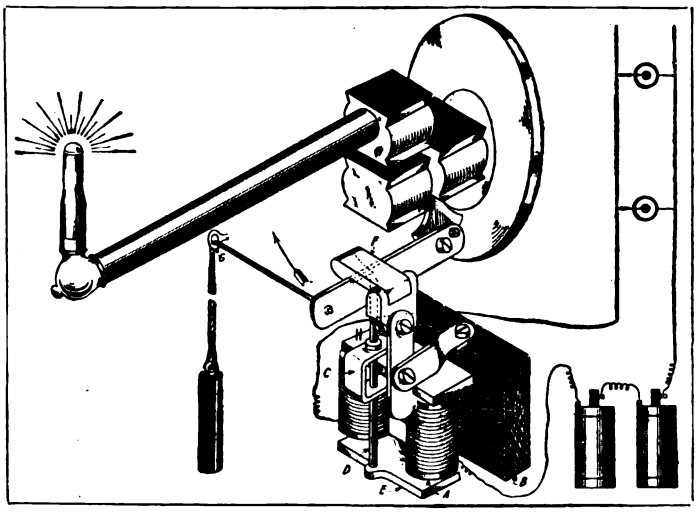
This is a simple little device made from odds and ends usually found about any experimenter's work-shop. It consists of an electro-magnet "A" taken from an old bell which is firmly fixt to a base "B."

The top of the magnet is arranged to take the bent strip "C" thru which the spindle is run, the spindle has a collar to prevent it going right thru. At the bottom end of the spindle is fixt the armature E. This may be conveniently made of old safety razor blades. The spindle ends just under the catch F which is arranged to hold a strip fastened to the gas valve.

A piece of weighted string is run thru an eyelet "G" which pulls the gas valve to "off" when the catch is released. A bell push is arranged near the bed, one near the door and the pocket lamp battery completes the "gadget."

When the circuit is closed thru either push button the armature jumps up pushing the spindle up with it; the catch is thus lifted allowing the weight to pull the gas cock to an "off" position. This device has been operating for three years now without a hitch, and only an occasional change of batteries is necessary. Most of the strips are from a toy "constructor outfit."

Contributed by
J. R. HOULT.



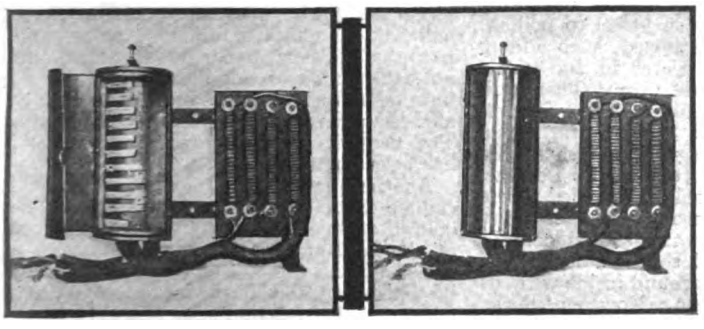
**Any Number of Push Buttons Can Be Used, Any One of Which, When Closed, Will Actuate the Magnetic Release and Shut Off the Gas. An improvement Would Be an Attachment for Turning On the Gas and Lighting It.**

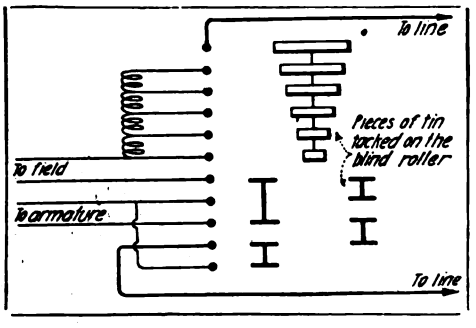
## A Miniature Drum Controller

**SECOND PRIZE, $3.00**

Herewith are presented two pictures of a miniature trolley car controller,—one picture with the case closed, and the other with the case opened to show the construction of the drum and fingers. This controller was modeled from the General Electric Co.'s R.-28 controller, which stands about three feet high—while this model is only 7½ inches high. This controller was made from a cigar-box, a piece of blind-roller, while a piece of blind-roller spring composed the resistance. This little controller works like a charm and had been in use quite a while without a hitch. I made this for use under an electric Christmas tree.

Contributed by
GEORGE P. KRAFT.





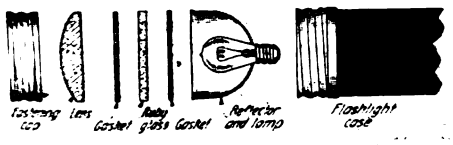

**A Miniature Drum Controller Such as Used on Trolley Cars, Cranes, and Locomotives Is Here Described and Illustrated. It Is Useful for Controlling Miniature Trains and Other Devices**

## A "Dark-Room" Flashlight for Photographers

**THIRD PRIZE, $2.00**

In these days of tank development, a dark-room ruby lamp is not necessary except with the dry-plate tank. The ordinary lamp is bulky and takes up considerable room in the traveling bag. To overcome this difficulty I simply cut out a disc of ruby glass and two rubber washers and of a size to fit my tubular flashlight. How the ruby glass and washers should be assembled in the flashlight so that no white light can escape is shown in the sketch. Since a flashlight is a necessary equipment of most traveling kits this attachment will be welcomed by all who load their own plate-holders, and those who do their own developing. I cut the gaskets from an old automobile inner tube.

Contributed by J. H. SCHALEK.




**This "Dark-Room" Flashlight Is Easily Made in the Ingenious Manner Here Shown**

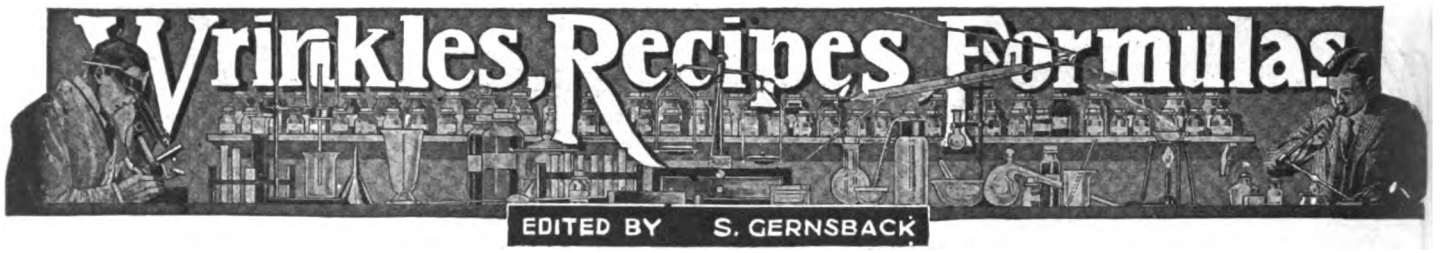
### CLEANING PASTE FOR HANDS.

Any hand cleaning paste for the shop worker should contain a satisfactory cleaner of enough strength to attack grease, ink or dyes, as well as more soluble dirt and at the same time should not contain any excess of alkali, as this will injure the skin. Herewith is a formula which I have used for some time:

Soft soap, 90 oz.
Ammonia water, six ounces.
Turpentine, sufficient to form a stiff paste.
Powdered pumice stone, 30 oz.
Oil of wintergreen, 3 oz.

Mix the soap and ammonia water and add the turpentine. Heat the mixture by using a double kettle, to secure a water bath. Allow the mixture to heat until a jelly like mass is formed, and while still heated, add the pumice stone and stir well while adding, so that no lumps are formed in the soap. Continue to stir five minutes after all the pumice stone has been added, drop in the oil of wintergreen. Set aside to cool for about ten minutes, and while still syrupy pour into the containers.

Contributed by H. J. RUNDT.




# Interesting Chemical Experiments

## By O. IVAN LEE, B. Sc.

(*Continued from May Issue*)

### A Violet Color from Iodine

Place some of the tincture of iodine in a thin glass and put the glass in a warm place. The alcohol, water and iodine will evaporate in succession; and when the alcohol and water are gone and the iodine is coming off, the glass will be filled with reddish-violet fumes of iodine. The same color can be shown in another way. Dilute some of the tincture of iodine with water until a yellow brown color is reached, and then pour in a little carbona. On stirring the mixture a while, the brown color will leave the water and pass into the carbona which will be colored purple.

### Proof That Potash Iodid Contains Iodine

After the alcohol, water and iodine in the preceding experiment have all been driven off by heating, the potash iodid will be found remaining as a yellowish white crystalline powder. Add a spoonful of water to this to dissolve it, and then some chlorid of lime such as is used for disinfecting purposes. Iodine will at once be set free from the potash iodid and will manifest itself by a yellowish brown color.

### The Gold Dust Snow-Storm

To a solution of some potash iodid obtained by evaporation of tincture of iodine, add a solution of sugar of lead in water. This is used for poultices. If you don't find some around the house, five cents' worth from the druggist will be more than enough. (Deadly poison!) A deep orange-yellow powder will be formed. Stop adding the sugar of lead when no more yellow powder comes down. Let it settle and pour off or draw off the water solution above. Then add just enough boiling water to dissolve the yellow powder and let the hot solution cool. As it cools, glittering golden yellow crystals of iodid of lead will separate which give a beautiful "silky" appearance to the solution when stirred up and make it resemble a miniature snow-storm of gold dust.

### Some Simple Experiments in Electrochemistry

As a result of many experiments, the chemical elements (which include all metals) have been arranged in a list called the electrochemical series. In general this list represents the power of an element (under proper conditions) of replacing or displacing those elements following it on the list. Usually, too, an electric current is generated in the process. In this series, zinc, iron, tin, lead, copper, silver and gold occur in the order stated, altho other metals are sandwiched in between. The further any two metals are apart on the list, the more pronounced their differences. For instance, place a penny well scoured with sand-soap under the tongue tip and a silver dime also cleaned bright on top of the tongue-tip, in such a manner that the coins can be touched to each other. The instant they touch, a pronounced metallic taste will be noted which ceases as soon as the coins no longer touch. Some people say, too, that they can see a flash of light when the coins touch if the eyes are closed, but you will have to find this out for yourself. It is certain that an electric current is generated which can easily be noticed by the tongue; and it is not impossible that the optic nerve may also be stimulated in such a way as to give a sensation of light. A piece of zinc or iron will give much stronger results than the copper penny because these metals are much further from silver on the list; and you will remember that in the crow-foot telegraph battery, zinc and copper are used and not iron, tin or lead and copper.

Dissolve some blue stone (copper sulfate) crystals in a glass of water and hang a half a dozen nails in the solution with a piece of string. In about ten minutes, remove the nails and wash them, when they will be found completely plated with copper. If a piece of zinc is similarly treated, the copper is deposited so fast that it looks like a slimy black mud. On the other hand, a piece of (pure) silver or gold will remain unaffected.

### The fireless Hot Water Bottle

Procure a thin-walled glass bottle (a baby's nursing bottle will do very well) and half a pound of photographer's "hypo" (sodium hyposulfite). Fill the bottle about half full of water, place it in another vessel of water which can be heated and bring the water in the outside vessel to boiling. As the temperature is raised, keep adding hypo-crystals to the water in the bottle until no more will dissolve. Then add just enough water to dissolve the few remaining crystals and remove the whole from the fire, plugging the mouth of the bottle with a little cotton wool. Let the bottle and contents cool undisturbed to the temperature of the room. If everything has gone well, the bottle should contain only a colorless, cold solution of "hypo" which can be shaken around inside without having anything happen. Now remove the cotton plug and drop in a tiny crystal of "hypo." In a twinkling the liquid freezes to a mass of crystals and becomes so hot that it can scarcely be held in the hand, remaining warm for a long time. The experiment may be repeated indefinitely merely by heating and cooling as described. Make sure that no crystals remain in the hot solution and that no dust gets into the cold one.

The patent hot-water bottles which only need to have the stopper loosened a bit to make them become hot, work on the above principle.

### Bleaching

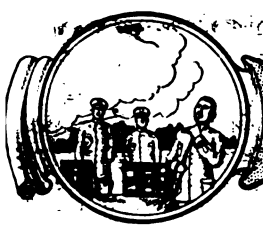
Most of the coloring materials used in coloring cloth, paper, feathers, etc., are dyes as distinguished from pigments. Pigments are employed for paints and potteries and other purposes where the conditions of manufacture or the wear and tear of using would soon destroy or change the colors imparted by dyes. Dyes are very complicated chemically and a slight change in the chemical make-up of one will either entirely change the color or more probably cause it to disappear altogether. Pigments, on the other hand, are fairly simple in their nature and consequently will stand rough treatment. The great majority of dyes are notably sensitive to exposure to strong light. Paper written upon with the so-called "indelible" pencil or typed with the carbon paper of the typewriter, will show the character much lighter after even a week in a window open to sunlight. The chemical change wrought by light may be hastened by resort to certain chemical agents.

Burn some sulfur in a small earthenware dish placed at the bottom of a larger vessel with a close-fitting cover. Some trouble may be experienced in getting the sulfur to burn at first, but once started it will continue with a blue flame and choking gas until it goes out for lack of air. Now slip a letter with a stamp on it and a strip of newspaper under the edge of the cover for a minute or so and then withdraw them. Neither should show any change. Moisten the stamp and newspaper strip and return them for the same length of time. Upon examining them again you will find the newspaper strip quite unchanged, but the pattern on the stamp will scarcely be discernible except for the cancellation mark. It is very interesting and instructive to experiment in this manner with colored pictures cut from magazines, cotton, wool and silk remnants of different colors and patterns, feathers, paper flowers, etc., and note the action of this bleaching gas from burning sulfur. Some colors will be hardly affected while others will vanish completely. The necessity of moisture being present, has been pointed out.

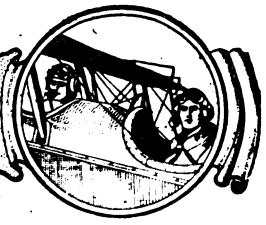
Another valuable decolorizing chemical can be made from chlorid of lime. The chlorid of lime may be conveniently placed at the bottom of a glass fruit jar with a screw cap and the moistened material to be bleached suspended in the jar for some time. Or some chlorid of lime may be rubbed to a paste with a little water, using a stick and a glass vessel, half the amount taken of soda added and more water, and the whole mixture filtered thru several thicknesses of muslin. This solution is very powerful, and if a handkerchief stained with a few drops of red ink is immersed in it, the red spots will vanish almost instantly. It may injure the fabric permanently.

Finally, the third of the common bleaching chemicals is peroxid, that is, hydrogen peroxid. Its action is much milder than that of the other two chemicals previously described, but it is less injurious to the material treated, not being of an acid nature. It is slower, however, and its practical application therefore, somewhat limited.

Dilute some hydrogen peroxid with about five times as much water, place in a bottle, add a little ammonia, and then some black hair, or, better, a black wing feather from a chicken. Shake the bottle occasionally and renew the solution about once a day. The color will gradually lighten and in the end generally becomes some shade of yellow.



# RADIO DEPARTMENT

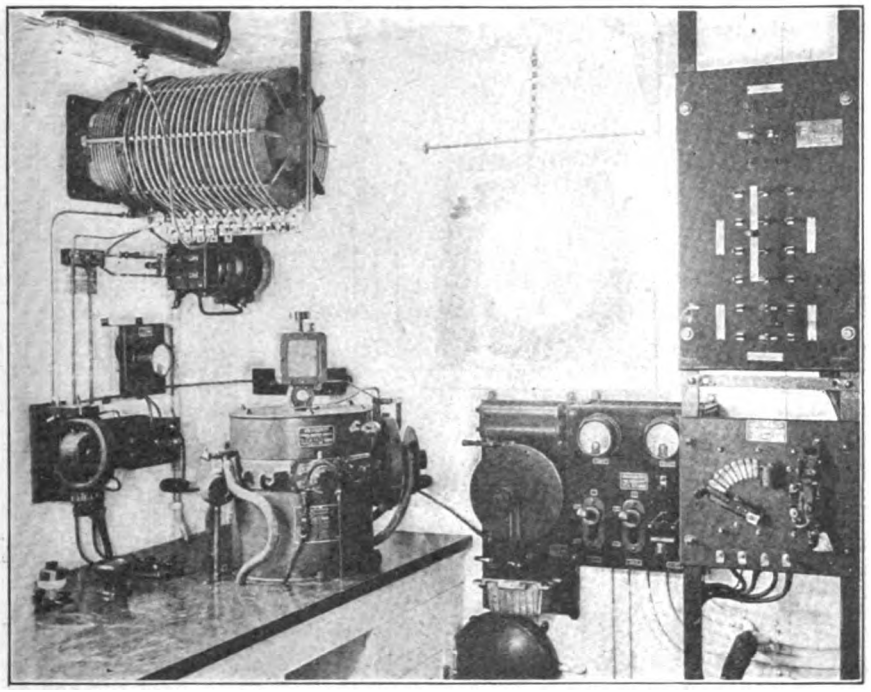


# S. S. "Aeolus" Works 3,013 Miles with 2 K. W. Arc Set

**By ARTHUR H. LYNCH**

UP to a few short years ago, in fact until about the time America joined forces with the Allies, the arc system for radio transmission was meeting with but little approval for marine installations, except in a few scattered instances. Many radio engineers were of the belief that it was all right for long-range, long-wave communication but that it was practically useless for ship to shore use, especially on commercial wave lengths.

One of the greatest difficulties experienced after an arc equipment of suitable and efficient design had been made, was found to be the lack of room for its installation in the ordinary ship radio rooms.



**The Steamship "Aeolus" is Equipt with a Radio Transmitter of the Arc Type and Recently Surprised Even the Heartiest Believers in the "Arc" for Wireless Telephone and Telegraph Transmission, by Transmitting a Message 3,013 Miles in Broad Daylight. Just Prior to This Surprising Record Made With Its Two Kilowatt Arc Transmitter, the "Aeolus" Had Established a Daylight Transmission Record of 2,500 Miles.**

For many years the Navy has been using arc systems for communication with very satisfactory results, tho they have, as a rule, operated on waves considerably longer than those met with in general commercial radio. On the Pacific, arc stations on commercial vessels have been in use for a number of years and have demonstrated quite well that they are capable of more efficient traffic handling than is possible with spark sets of similar power consumption.

During the war many of the Shipping Board vessels were to have been fitted with arc transmitters, but it was not until after the signing of the Armistice that any quantity of the equipment was ready for delivery, so the results obtained with arc by these vessels are more or less a post-bellum affair.

Within the past few months the U. S. Shipping Board has turned over the maintenance of all its sea-going arc equipment to the *Ship Owners' Radio Service, Inc.* Since that time, according to an official of the company, the service which has been derived from the use of the arc has been much more satisfactory. Confining the arc equipment to a single service company has resulted in necessitating spare parts being carried by a single service station in a given port. It has tended to make the employees of the service company more or less specialists on arc maintenance and it has resulted in a selection of the best operators, who are more than anxious to demonstrate just what the system is capable of.

### S.S. "Aeolus" Works Otter Cliffs 2,500 Miles Daylight

From the time the S.S. *Aeolus*, of the Munson Line, left New York, on her last trip to South America, she maintained communication with Otter Cliffs up to 2,500 miles, in daylight. Such operation, on the East Coast may well be considered a record. The *Aeolus* carries a standard 2 K.W. Federal arc transmitter, using either the back-shunt or chopper method of signaling, according to the character of the station with which she is working. In the instance cited, the back-shunt method was used.

The following report from the radio men, on the S.S. *Martha Washington*, is of interest. "Coming north we were surprised to hear the S.S. *Aeolus* coming after us with an arc set, which was working to perfection. We heard them handling traffic and reports up to 2,200 miles daylight."

There is no question at all about the passing of the spark equipment—it is merely a matter of time. The work being done by the *Aeolus* would seem to indicate that, for continuous wave telegraphy, bulb transmitters will have some little stepping to do before they can demonstrate that they are more consistently efficient than the comparatively low-powered arc, even recognizing the fact that bulb communication has been heard more than six thousand miles with an antenna power of less than 100 watts. Among other things, there is the matter of bulb renewal, which is quite an expensive item. All systems have certain, inherent faults, but everything seems to indicate a battle between the arc and the bulb for transmitter supremacy, in the ship to shore field, which will be greatly enjoyed by those on the side lines.

Comparison of the arc and spark methods, rated at the same power may be summarized by saying that the arc is capable of much greater range; causes less interference, because of the sharp wave it emits; has a much greater wave length range, permitting communication to be carried on with less congestion and interference to and from other stations; and is more simple in the matter of its circuits, admitting of the propagation of a most effective wave with a minimum of adjustment.

### The Arc System

Essentially, the arc system, is made up of the following component parts, which are of various designs for different conditions and powers.

A source of direct current of suitable voltage, which in the case of the *Aeolus*, is a direct current motor-generator operated from the ships D.C. supply and delivering a voltage to the arc of from 250 to 400 volts, and an amperage not to exceed 10. The motor-generator unit is supplied with the customary field rheostats, starter, etc., allowing for its operation at a power suitable for the desired transmission.

An arc converter unit, which, in the present instance, is composed of an arc chamber, wherein free hydrogen gas is maintained for the sustaining of the arc under the best conditions. The anode, of

(*Continued on page* 184)

## Articles to Appear in June "Radio News"

*Short Wave Tuning System*
*By Stanley Brown*
*Construction of Ball and Cup Type Variometers By Edmund S. Smith*
*The Mental Telegraf*
*By Maurice Buchbinder*
*The Washington Air Mail Radio Station By S. R. Winters*
*Give Yourself a Radio Vacation*
*By Armstrong Perry*
*The Thirteenth Tap*
*By B. S. Greensfelder*

# The "Loop Aerial" and Its Applications


## By ROBERT E. LACAULT

LATE LIEUTENANT IN THE FRENCH ARMY SIGNAL CORPS

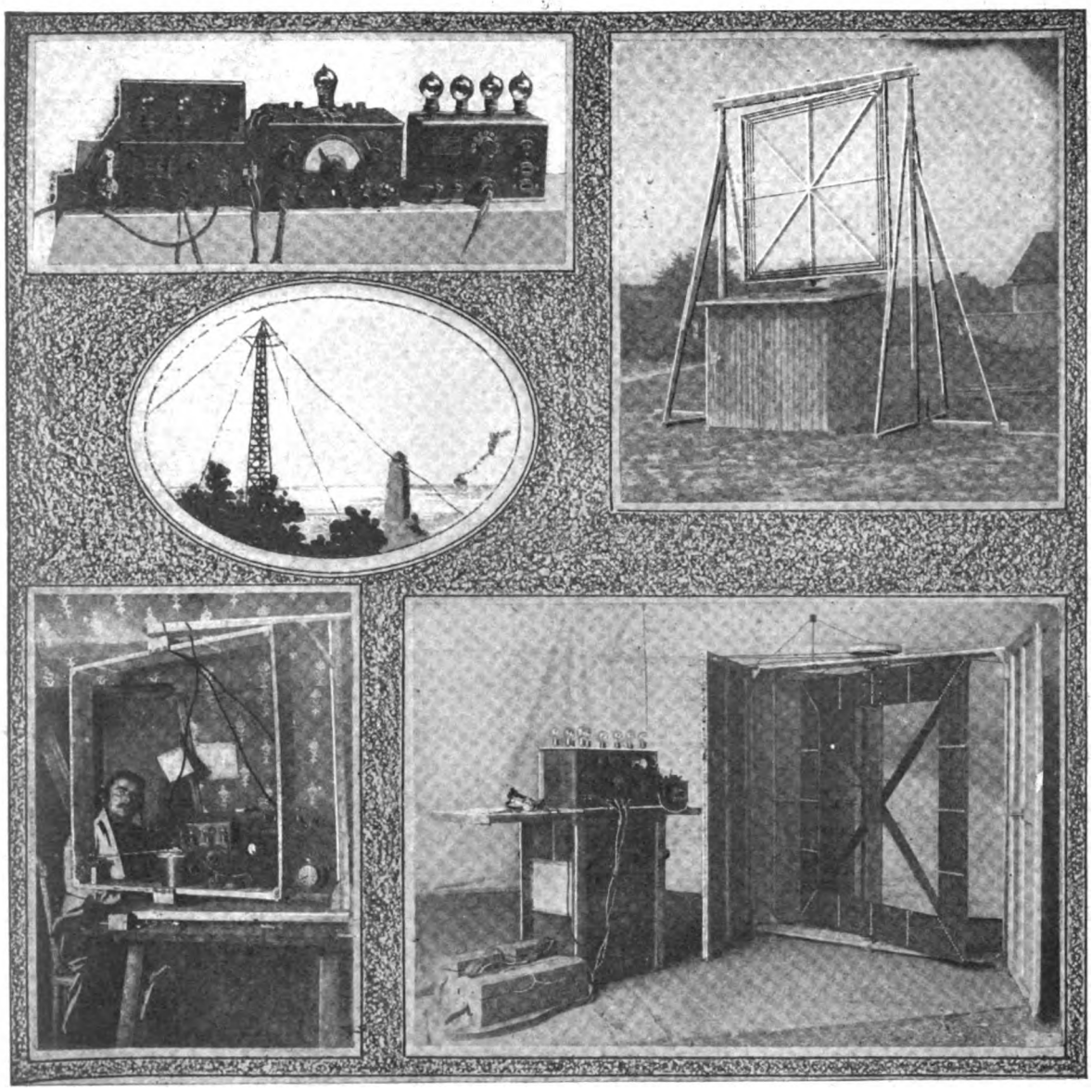



Fig. 3. (Upper Left Photo) Shows Vacuum Tube Receiver in the Center and Audio Frequency V. T. Amplifier on the Left. This Receiver Has a Wave Length Range of 125 to 2,000 Meters When Connected to the 3-Turn 7-Foot Loop Aerial Shown in Fig. 4 (Upper Right Photo). The Operator's Receiving Hut is Shown Beneath the Aerial. Hundreds of These Were Erected as Shown on the Battle-Fields During the War.

Fig. 6. Loop Aerial and V. T. Receiver Located in a French Chateau Which Saw Actual War Service. The Loop Is 40" Square with 120 Turns of Wire. American Stations Were Frequently Copied on This Set.

Fig. 8. Perfected Type of French Loop Aerial in Cabinet Together with Nine-Step Audion Amplifier. (Right)

THE *loop aerial* is not new. Back in 1904, Mr. Blondel, a French radio engineer, started some experiments in directional radio. It had been found by experiment that when using a one-wire inverted L-aerial, a greater transmitting range was obtained in the direction of the lead-in. This led Mr. Blondel to try two L-aerials arranged as shown in Fig. 1, in order to obtain a directional effect in a certain plane only. The two wires were fixt on a large frame supported on a mast and could be turned at any angle.

The results were satisfactory but this system could be used only for small power, owing to the installation necessitated by this type of antenna; but the chief reason the directional aerial was not developed at that time, was the inefficiency of the receivers used in 1904. Even the electrolytic detector, which at that time was "the" thing, did not give good results.

A little later Messrs. Bellini and Tosi made interesting and successful experiments in directional radio but they used fixt loops of large size and a different system, which is not exactly what we intend to explain in this article.

The real loop aerial was efficiently developed during the war for the needs of the Signal Corps at the front; the following paragraphs explain the developments in this work as carried out by the French Army.

The German army used a great number of low-powered sets in the trenches and it was necessary for the allies to catch every message sent by these small sets for some of them were very important. However, the number of these transmitters working on the same wave-length, was so great that much difficulty was experienced in copying the messages owing to the interference. Another reason the loop aerial was so useful, was that by its use the Allies knew where the enemy's set was located. This gave even greater value to the information received.

In 1916, thanks to the amplifiers which had just been developed, wonderful results were obtained with a one-turn 10-foot loop. These encouraging results called the attention of the Signal Corps officers to the importance of this kind of receivers and the set shown in Fig. 2, was developed after much experimenting. As may be seen, a V. T. was used as a radio frequency amplifier, the oscillations being rectified by a crystal detector hooked up to a three-step amplifier. The photograph, Fig. 3, shows the receiver in the center and the audio frequency amplifier on the left. This receiver had a wave-length range of from 125 to 2,000 meters when connected to the three turn seven-foot loop shown in Fig. 4.

Later, a combined radio audio-frequency amplifier was used with these loop aerials, giving a greater sensibility to the set. In these amplifiers, radio and audio frequency transformers were used and the same vacuum tubes amplified simultaneously the two frequencies. It was a four-tube five-step amplifier.

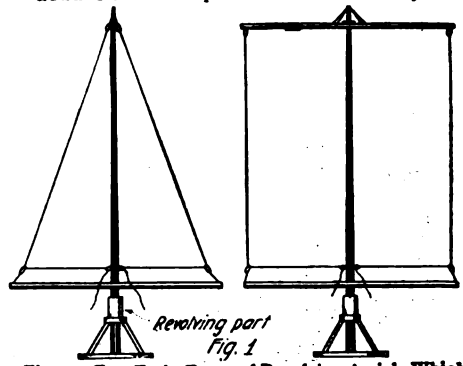



Fig. 1. Two Early Types of Revolving Aerials Which Were the Forerunners of the Modern "Loop Aerial" in Which Several Turns of Wire Form a Closed Coil. In These Early Directive Aerials the Single Wire Formed Either a Triangle or a Rectangle as Shown.

The first three tubes amplified at radio frequency, the fourth was a detector, and again the second and third amplified at audio frequency. See Fig. 5.

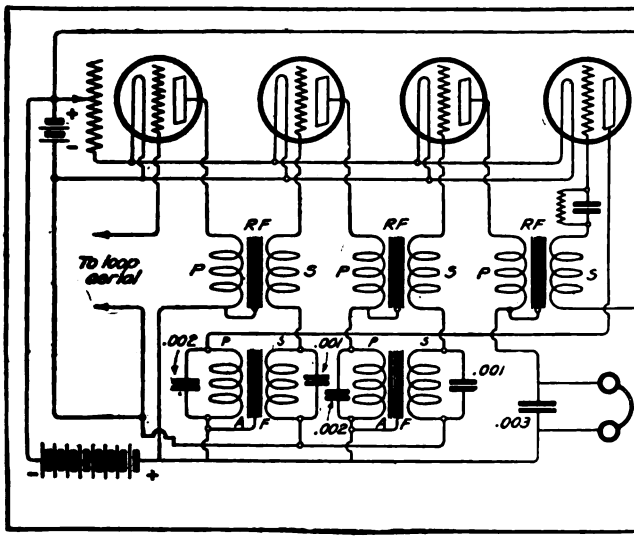



Fig. 5. Shows a Very Interesting 4-Tube 5-Step Amplifier Which Was Used in the French Signal Corps with a Loop Aerial Very Successfully. The First Three Tubes Amplify at Radio Frequency, the Fourth Tube Acts as a Detector, and the Second and Third Amplify at Audio Frequency.

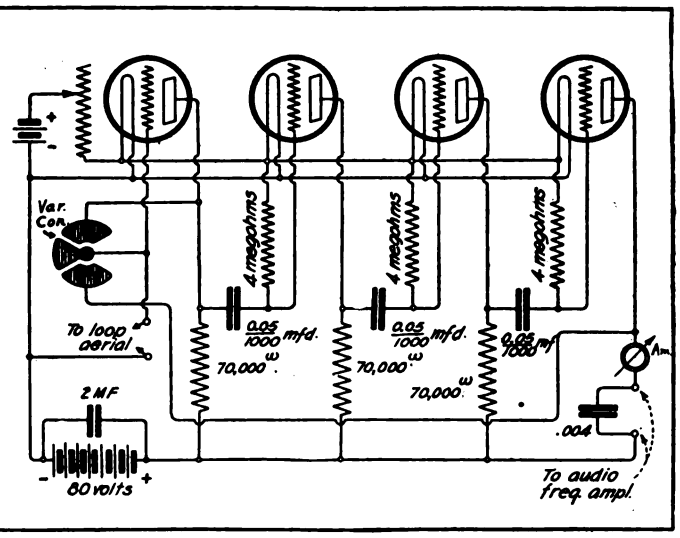



Fig. 7. Shows a Very Interesting Type of V. T. Amplifier Now Gaining in Popularity. It is of the "Resistance Coupled" Type. The Various Resistances are of the Non-Inductive Type. Details of This Amplifier are Given in the Text, While a Number of Them are Indicated in the Diagram.

The radio frequency transformers were wound with a small number of turns and the iron core made of extra thin laminated steel; they were designed to give maximum amplification on short waves (under 1,000 meters).

As the loop aerials gave such excellent results for short waves, it was decided to use them for the reception of long waves, as well, but the range of wave-lengths in this case being much greater, experiments were made with a new type of amplifier, which was found to give, on all waves, much better amplification than the transformer coupled radio audio-frequency amplifier.

In Fig. 6 is shown a receiver for all wave-lengths above 1,000 meters, using a loop aerial 40 inches square wound with 120 turns of litzendraht wire in conjunction with a resistance coupled amplifier, the signals amplified by the radio frequency apparatus were boosted again by a three-stage audio frequency amplifier. With such a receiver American stations were copied in France and of course all the European stations came in loud.

The diagram of the resistance coupled amplifier is shown in Fig. 7. This apparatus is fitted with a small variable condenser by means of which the plate of the fourth V. T. may be coupled to the receiving circuit, setting up oscillations in the circuit and thus

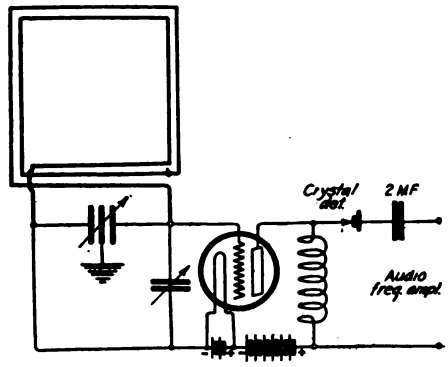



Fig. 2. Showing Audion Hooked up in Connection with a Loop Aerial. The Oscillations are Here Rectified by a Crystal Detector, Which is Connected in Turn to a 3-Step Amplifier.

acting with the well-known regenerative effect.

The various resistances are of the non-inductive type and made with a special enamel. The capacity of the small condensers coupling the grid to the plates of the various tubes must be chosen so that its reactance $\frac{1}{cw}$ remains small in regard to the four megohms' resistance. The amplifier gives good results for all frequencies greater than the one for wh ch this condition is filled.

For instance, a capacity of .00005 mf., is suitable for frequencies greater than 100,000 (= 3,000 meters) and a value of .004 mf., for audio frequencies. This type of amplifier is the most sensitive actually built and reception may be made on small loops 10 inches square, when radio and audio frequency amplification is used.

The last instrument built on this principle for reception on five-foot loops is shown in Fig. 8. It has nine steps of amplification and gives wonderful results. The loop used in this receiving set has 15 turns of insulated wire wound in three sections which may be used separately or connected in series, according to the wave-length which is to be received. The turns being wound on the same plane, this indoor receiver has remarkable direction-finding properties and it is this type of receiver which is used aboard the large dirigible balloons.

In a word, the loop aerial is really efficient now, thanks to the amplifiers which make possible the reception of signals which were inaudible before. It is to be hoped that the C. W. (continuous wave) transmitter will make possible its use for transmission, rendering the old form of aerial obsolete and reducing *interference* to the lowest minimum.

# Measuring the Motion of a Telephone Receiver Diafram

## By PROF. LINDLEY PYLE

THE writer had occasion recently to measure the magnitude of the to-and-fro motion of the vibrating diafram of a telephone receiver which was being excited by an alternating current of such strength that the sound emitted by the telephone receiver could be clearly heard at a distance of a hundred feet. The diafram was therefore in much more violent motion than when used in regular telephone practise when the receiver was held against the ear,—and yet it was found to be moving to-and-fro thru only one ten-thousandth of an inch of space.

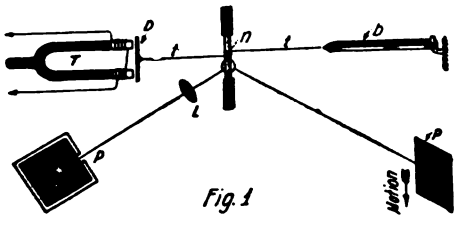



Fig. 1. Arrangement of Light Beam Reflection Apparatus Used in Measuring and Recording the Motion of a Telephone Receiver Diafram, as Described by Prof. Pyle.
T—Telephone Receiver D—Diafram N—Needle t—Silk Thread B—Rubber Band P—Pin Hole A—Enclosed Source of Light L—Lens P—Photo Plate.

In making the measurements use was made of the device termed by Prof. D. C. Miller "the phonodeik" as described in his book on "The Science of Musical Sounds." The end of a piece of fine silk thread was attached by sealing wax to the center of the face of the diafram. The thread was then led out to and wrapt four or five times around a fine needle mounted to rotate freely in bearings with its axis parallel to the face of the diafram (see *n* Fig 1). The thread was then tied to a rubber band, *b*, under tension, which band was in turn attached to a fixt point. A strong beam of light from a pin-hole fell upon a tiny mirror attached to the needle and was focust upon a photographic plate, *P*, which could be moved rapidly across the beam of light in a direction parallel to the axis of the needle. Development of the photographic plate showed a record of the vibrations of the receiver diafram. The experiment is performed in a dark room.

The principle of the method is very simple. As the diafram moves to-and-fro the rubber band keeps the silk thread taut. The needle is thus caused to rotate to-and-fro

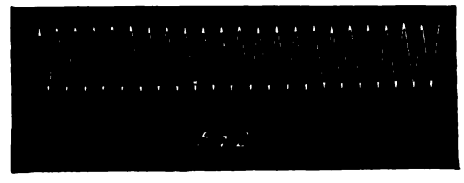


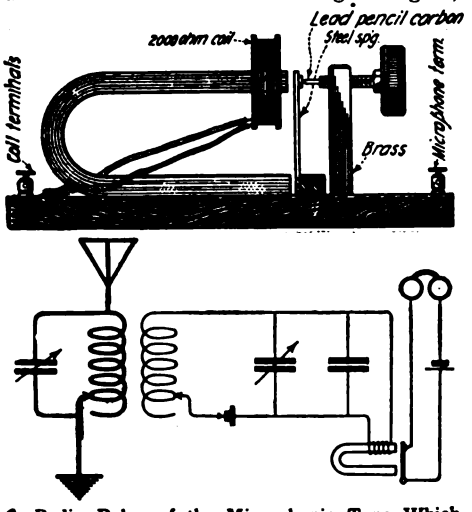
Fig. 2. Above is a Copy of a Chart Showing Vibrations of a Telephone Receiver Diafram, as Recorded by the Apparatus Shown in Fig. 1.

in its bearings carrying the mirror with it. The beam of light reflected from the mirror then wags to-and-fro and faithfully writes upon the moving sensitized photo-plate the story of the motion of the dia-

(*Continued on page* 195)

## A "FUNNY-TONE" RADIO RECEIVER

The "funny-tone" is made by winding two thousand turns of No. 38 B. & S. on a bobbin on the end of a ringer magnet,




**A Radio Relay of the Microphonic Type Which "Radio-Bugs" Will Undoubtedly Like to Experiment With, As It Requires no Expensive Vacuum Tubes or Other Paraphernalia. It Moreover Acts As An Amplifier and Several of Them Can Be Connected in Cascade As in the Telefunken System.**

the magnet being mounted on the base with the wound pole uppermost. A thin piece of spring steel long enough to cover both poles of the magnet is next fastened to a brass block as shown, so as to be held against the lower side of the magnet, free to vibrate immediately in front of the upper pole.

This spring or vibrating reed and an adjacent thumb screw are each grooved to hold a bridging pencil of grafite. Now we have a form of microphone in which the tension on the carbon pencil may be adjusted by means of the thumb screw, and in which the vibrations in the diafram are produced by corresponding fluctuations in the magnet. For efficiency and neatness it is well to bring out the connections to convenient binding posts; then the terminals of the coil would be one pair of posts and the microphone would make the other.

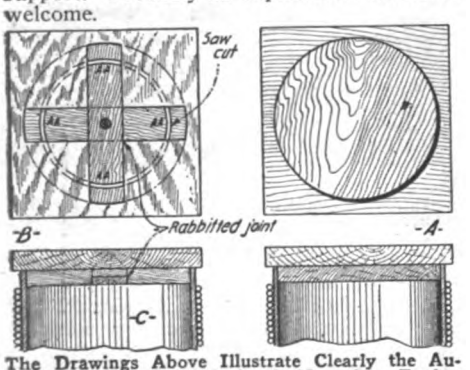
It is evident that with such an arrangement, fairly large currents can be modulated by a small current in the electro-magnet and striking results can be had by connecting the magnet winding of the "funny-tone" into your radio circuit in place of your 'phones, and connecting the 'phones in series with the microphone and a dry cell. If it is desired to use very large currents in the microphone a one or two microfarad condenser should be shunted across it.

Many other uses for the instrument will suggest themselves, such as amplifying ordinary telephone conversation.

Contributed by E. W. START.

## IMPROVED TUNING COIL SUPPORT

Enclosed drawings of an improved coil support. Probably an explanation would be welcome.




**The Drawings Above Illustrate Clearly the Author's Improved Method of Mounting Tuning Coil and Loose Coupler Tubes.**

Amateurs often mount their coupler or load coils as shown at (A). To saw out this round wooden block is a tedius job, and is often a serious drawback, and, as some amateurs cannot afford a lathe, they are up against it. I did the same myself for several months, until I thought this idea up. The joint is arranged as shown at B.

A shows amateur's way.
B my way.
C method of mounting coil.
AA method of strengthening.

If the amateur prefers a stronger joint he should cut each of the four arms as shown at (AA). The saw cuts are then filled with glue or shellac and the tube forced in. It is then left to dry.

Contributed by STEVE MIRANDE.

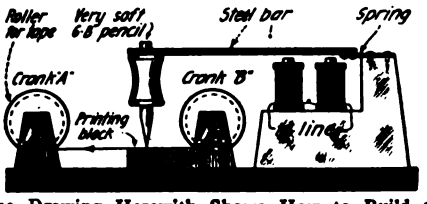
## SHELLACKING COILS

In magnet winding construction it is the general rule to thoroly shellac the turns of wire, and then to permit the winding to thoroly dry for about 24 hours or else to place it in an oven and bake it, so that the shellac permeates all the turns. While this is excellent and approved practice in general classes of electric construction, it is not the best practice in radio work. Authorities differ somewhat on the pro and con of shellacking or varnishing of radio coils, but it is generally contended that shellacking or varnishing such windings tends to increase their distributed capacity.

## TELEGRAPH TAPE RECORDER

Enclosed find drawing and explanation of a simple omnigraph and sounder which I made and which I want you to enter in the Radio Department. The explanation may be seen from the diagram. Hitch a battery motor or clockwork to the tape drum and you have an automatic telegraph tape register, excellent for experimental work.

Contributed by F. WILLIAM JUNG.




**The Drawing Herewith Shows How to Build a Simple Telegraph Tape Recorder. Of Course the Details May Be Considerably Improved As By Using a Motor or Other Mechanism to Pull the Tape Under the Pencil, Et cetera.**

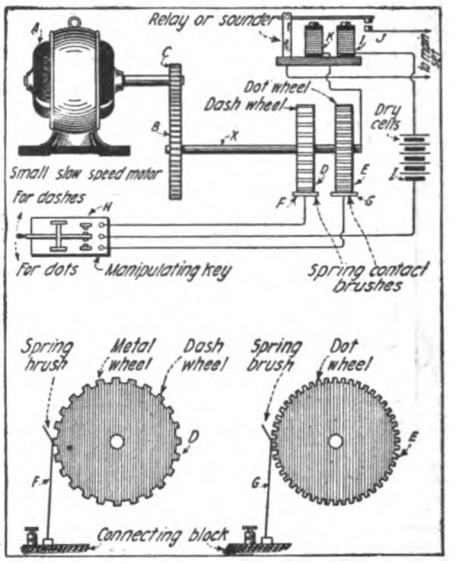
## A MOTOR-DRIVEN "BUG" KEY.

I was a one-time Radio Amateur myself and know the joys of Ford coils and raiding door bells, etc., for platinum contacts, binding posts and such like "junk." While tapping the key the other day an idea struck me for an automatic key, which I think will prove O. K. A little criticism, however, won't hurt it any.

It happened thru my taking stock of prospective parts for making a "bug" key. On the "bugs" now used, as far as I know, you have to tap the key once for each dash; with my key, however, you tap only once for as many dashes as you desire.

Perhaps the diagram will explain the operation. A is a small motor, 1/32 H.P. sufficient, slow speed, which drives shaft X thru reduction gears B. A rheostat or governor for varying speed of rotation should be inserted. Shaft X rotates wheels D and E for dots and dashes. F and G are contact brushes which press against D and E. H is manipulating key and I the primary circuit cells. K and L are electro-magnets of sounder or relay J. When key H is moved to right it forms a circuit thru batteries, relay, shaft, brush and dash wheel, automatically making and breaking current for "dashes" as long as key is prest to *right*. Pressing key to *left* makes "dots." Thus any speed may be obtained by regulating speed of shaft. Another diagram shows the construction of dot and dash wheels.

Contributed by NORMAN H. ALLEN.




**Talking of Speed in Transmitting, Here Is a Nifty Idea—Two Toothed Wheels Make the Dots and Dashes Automatically, and All You Have to Do Is to Swing the "Key" to Right or Left, as the Diagram Clearly Shows.**

## UTILIZING MORSE RELAY AS COIL INTERRUPTER.

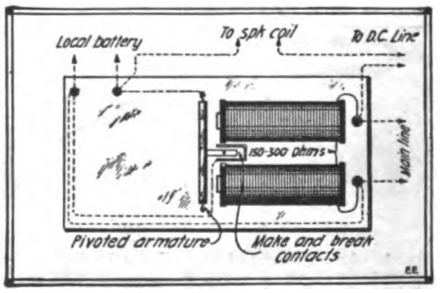
A Morse telegraph relay should prove much more efficient than the spring interrupter and more easily adjustable as the armature cannot only be adjusted laterally, but the spring tension can be set to a nicety. If the coils of the relay are of at least three hundred ohms resistance, little or no resistance will be required in series for medium sized coils, tho for the smaller coils some outside resistance will have to be inserted. (This refers to 110 volt circuits.)

A second idea for those who have alternating current of at least 125 cycles. (Tho 60 will do fairly good work on proper adjustment.)

This idea is to leave the connections of the relay as first indicated, (main line and local circuits separate) and substitute a second platinum tipt contact for the one insulating back stop.

In this circuit (the local or secondary circuit) are connected the coil to be operated in series with the proper battery. The armature contacts are set until there is a space of about one sixty-fourth of an inch between them, that is on either side. It will be seen that by passing an A. C. current of high frequency thru the coils, the armature will be alternately attracted and repelled, thus interrupting the battery circuit at a very high rate. The two contact points give double the interruption of one and the back-stop alone.

Contributed by PENUEL E. BALLARD.



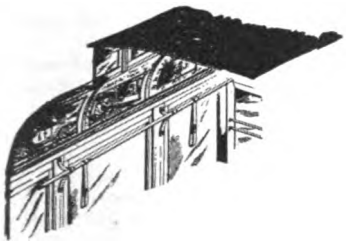

**For 110 Volts D. C. the Relay Magnets Are in Series With the D. C. Service and the Spark Coil Primary, the Usual "Main Line" and "Local Battery" Terminals Remaining Dead.**

# LATEST PATENTS

## Advertising Cards

(No. 1,365,451. Issued to Albert E. Bradley.)

This is something radically new in advertising cards, specially adapted to



be used in street car advertising, and is bound to attract the attention of passengers riding upon the car in a very novel manner. For instance an automobile is pasted upon a mirror and on another picture the photo of a traveling man sitting within a car, the mirro being placed back of the windows thereof in such a manner, that, when the street car is in motion, scenery outside will be reflected into the mirror arranged in the windows of the picture, so as to make it appear that the train in which the photographed man sits, moves. In employing a representation of an automobile, when scenery is reflected into the mirror upon which the design is pasted, the automobile will appear to be in motion.

## Life-Saving Apparatus

(No. 1,365,244. Issued to Victor Holmgren.)

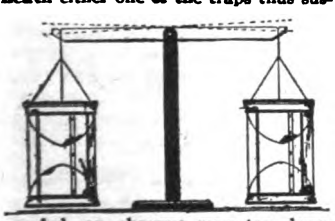
Life-saving apparatus is a necessity. The inventor of this one, however, makes his device either adaptable to life-saving, or to form part of the amusement devices employed at beach resorts. Essentially it consists of a flat cork float covered by canvas and somewhat pointed at the bow. Two vertical cork floats are found at the sides and

the propelling mechanism is suspended from these by means of a wooden frame; shoulder braces and straps hold the rider so that he will not roll off the float. When not in use the device is collapsible at least as far as the propelling mechanism is concerned. This mechanism consists of a gear which communicates with another connected directly to a propeller.

## Flytrap

(No. 1,369,242. Issued to Cal P. Hasselgren.)

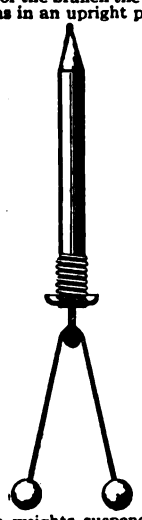
This flytrap may be easily cleaned but depends on intermittent manual attention to realize the full efficiency of the device. It represents a thin flat platform of heavy paper which has mounted upon it near the center an upright. This upright carries a cross-arm or walking-beam from which are hung the two individual flytraps. Bait is placed under both traps. When a number of flies have congregated underneath either one of the traps thus suspended, an observer may tap downwardly upon the end of the cross-arm which supports the trap under which the greater number of flies are seen, when the trap will be instantly deprest by gravity to surround the flies, and will remain there while the flies thus imprisoned soon force their way upward into the trap.



## Candle-Holder

(No. 1,369,000. Issued to Dominik Benkovic.)

By placing this patent before our readers we desire to call their attention to a simple contrivance easily constructed, which, if properly exploited, promises to be a very successful device. It is a simply constructed candle-holder for Christmas trees which is both ornamental and practical. The obvious disadvantages which are incident to the use of ordinary candle-holders are obviated by this invention, as regardless of the inclination of the branch the candle on a tree remains in an upright position due

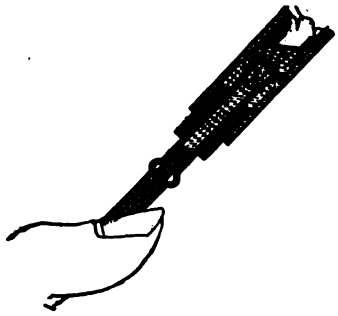


to the two weights suspended from a fork-like member. It will thus be seen that this pendulum arrangement of legs will straddle a branch of a tree, and in that the contrivance is made almost entirely of wire with the exception of the weights, it could be manufactured cheaply enough for public use.

## Manicuring Implement

(No. 1,362,601. Issued to Harry H. Chandler.)

With manicuring so popular amongst both men and women, an instrument of this nature fills a much needed want.

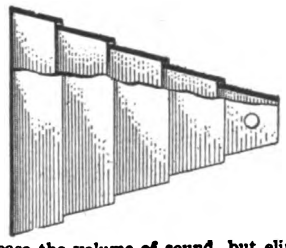


The device consists of a tubular glass container fitted at one end with a rubber cork and sealed at the other. Into the rubber cork is inserted a small tubular shank made of either rubber, glass or wood, which is closed at the inner conical end but which has drilled into this end a tiny opening. Into the other end the operating portion may be inserted, which is also provided with a tubular passage-way and the face of which is inclined so as to form a flattened point. The liquid contained within the handle is guided and distributed to the area under treatment, and extra tips may be inserted as desired. The device is leak-proof when carried in the pocket or in milady's handbag.

## Phonograph Horn

(No. 1,365,249. Issued to Edward H. Koehler.)

A phonograph horn which is claimed to improve the tone-quality and increase the volume of sound, but eliminating at the same time the metallic character of such sound issuing from the mouth of the horn, is the subject of this recent letters patent. This horn is made up of a number of panels, all of which are the same width and which are varied according to the size of the machine. These panels overlap each other for a distance of one-half to one inch, but between them an open space is left. This space is produced by plugs which separate the panels and, therefore, the inventor believes that each panel is free to vibrate independently of the other.



## Airship

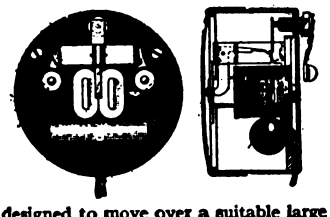
(No. 1,365,474. Issued to Kanute Arvid Enlind.)

This airship has the car suspended from its long cylindrical body. The tank or gas envelope is rigid in its nature, and at either end is provided with an opening, thru which a long axle or shaft passes. At either end another buoyant tank is mounted, the surface of which is encircled by spiral veins or ribs which form the propelling air-screws, so as to propel the ship when the motor shaft and consequently the tanks at either end are rotated. The spiral vein or fin of the rotating tank may be slightly and gradually increased in width from the front to the rear of the tank. These latter tanks are mounted upon roller bearings. The main stationary tank has at one end an intake and at the other an outlet, both closed by plugs and the rotating tanks are provided with similar openings. In this way the tanks may be readily charged when it is desired.

## Massage Apparatus

(No. 1,365,416. Issued to Joseph S. Leach.)

This massage apparatus is to be employed for the treatment of certain affections of the ear. It consists of a make-and-break mechanism whereby current to the electric magnets will set up a vibration of the diafram. A means of regulation of the pitch and intensity or amplitude of vibration is provided, whereby any desired sound may be easily obtained by simply adjusting the contrivance; thus to vary the rate of vibration and thereby the pitch of the sound, a contact screw is threaded to the casing and a handle is secured to it which has a pointer fitted thereto and

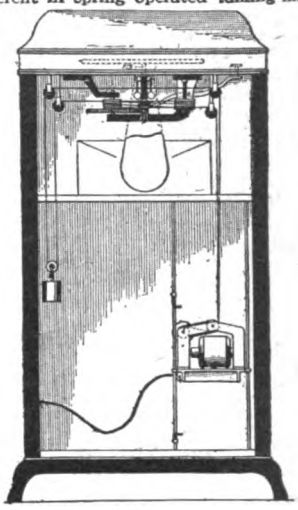


designed to move over a suitable large scale. A condenser is shunted across the make and break contact.

## Weight-Motor Talking-Machine

(No. 1,366,508. Issued to Edward E. Taliferro.)

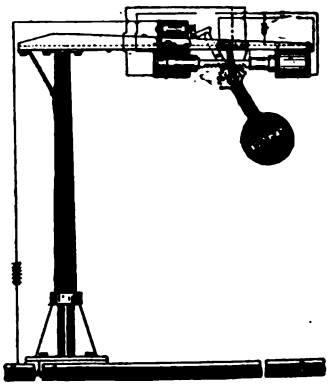
In order to provide for silent movements on the part of an electrically operated talking-machine, the inventor employs an electric motor mounted upon a platform which raises itself and also acts as the weight for operating the turn-table of the phonograph. Another weight is also found within the phonograph. It is claimed that with this contrivance a perfect uniformity of motion is imparted to the disk carrier, without any variation of any kind during the playing of the record, without regard to its length, and therefore, there are no annoying changes of pitch of the sounds produced, and this defect, which is inherent in spring operated talking-machines, is overcome. The falling weight is automatically returned to the upper limit of its travel, by means of a pair of trip switches. The motor slides in four guide ways.



## Railway Crossing Signal

(No. 15,023. Issued to Robert E. Driscall.)

This railroad-crossing signal, which



may be placed alongside a track is intended for warning occupants of vehicles or others passing on a highway of the near proximity of railway trains. It consists of a metallic post having a transverse arm of sufficient length to be disposed above the crossing; mounted upon this arm are two solenoids and an electro-magnet which holds a danger signal toward one side. When the metallic parts of a train cross an insulated section of track, the danger signal is released and due to the solenoids and the ratchet-like armature operating between them, a vibratory motion or a swinging movement on the part of the danger signal results. The signal itself communicates by means of a toothed sector with teeth upon the bar communicating with the two solenoids.

# Fortunes From Little Things

## By CHARLES FREDERICK CARTER

IF you should decide to get rich quick would you undertake to found your fortune on a manufactured article to be sold at less than a fifth of a cent each? Before spurning the thought with the scorn it may seem to deserve—— Let me tell you about William Painter.

William Painter was the son of a poor but honest Quaker farmer in Montgomery County, Maryland, whose ancestors came over in 1669 and whose pedigree reached back to the thirteenth century. These facts are mentioned to prove once more, that breeding counts for as much in human beings as in cattle. If you would get on in the world choose your ancestors with care.

William probably would have taken the old farm for better or for worse, only the old farm couldn't support him in the style to which he wished to become accustomed. So he married a charming Quaker girl and moved to Baltimore. For a number of years the Painter family played the game familiar to so many millions of other young couples; that is, the game of trying to make a dollar bill provide five dollars worth of necessities.

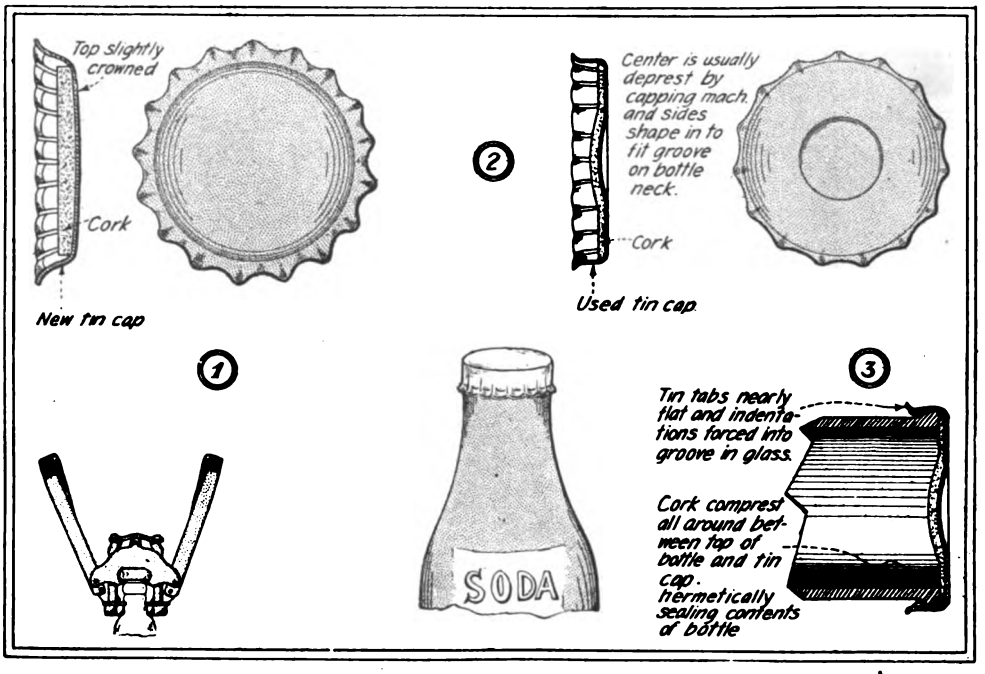
Along in 1882, when William was 43 years old, he observed that ordinary corks were a most unsatisfactory means of sealing beer bottles. Beer, by the way, is said to have been a beverage very popular among those who liked it in former days. Any way, vast quantities of it were retailed in bottles. Numberless other liquids were also sold in quantities and corks, the only things available as stoppers, were as unsatisfactory for these as for beer.

Painter thought if he could devise something better than a cork for closing bottles he might make some money. First, though, he did what few other would-be inventors do: he investigated the prior art in bottle stoppers. Patent office records showed that for forty years near-inventors had been trying to produce an improved stopper but had failed.

With knowledge thus fortified Painter brought out his first bottle seal in 1885. At that time wire was used to hold corks in beer and carbonated beverage bottles. Painter's seal was an affair of rubber and cloth with a wire staple which was to be forced into an annular groove in the neck of the bottle. It was fairly satisfactory for beer but a failure for carbonated stuff. He organized a company to manufacture the seal and sold more or less of them for five years.

At the end of that time the company had sunk fifty thousand dollars and was obliged to recognize that the seal was a failure. Painter then patented his famous Crown bottling cap consisting of a tin disc with corrugated edges and lined with cork, "on in a jiffy, off in a flash," to quote the advertising agent, who for once told the truth. All this was not so simple as it sounds; for it required two years of experiments before the right idea was hit upon.

### No. 1 ROMANCE OF A BOTTLE CAP




**Above we see how the little tin cap with its cork lining is fitted on to a glass bottle, as well as the appearance of the cap before it is snapt into place on the bottle. In the lower left hand corner of the figure is shown a small, yet very efficient hand-operated capping machine for placing these remarkably simple substitutes for the old-time corks used in bottles of soda water and other beverages.**

In 1892 a new company was formed called the Crown Cork and Seal Company to manufacture and sell the new device. Painter was President, Managing Director and Secretary of the new concern at a salary of $20,000 a year and a royalty of one cent a gross on the new cap. Yes, the company had to sell 144 of these caps before Painter could draw one copper cent in royalties.

But then it was such a simple, cheap and necessary thing, and so many things are sold in bottles and in such immense quantities, that even at this rate an inventor should be able to keep the wolf from the door. And Painter certainly did have the right idea. If you would know what it was, go into the nearest grocery store and look at the bottles. The Crown seal, or a very close imitation of it, for the patent has run out, is on practically every small packed bottle containing beverages or foods sold anywhere in the world.

Having produced this necessary article, Painter found that his troubles had just begun. First, he had to invent a machine to make the things, for of course an article retailing at 25 cents a gross could never be made by hand. When the caps were made, there was literally no market for them. They could only be used on bottles having a ring at the top and no such bottles were made. Furthermore, the bottle makers wouldn't produce any such crazy thing. No such bottles had ever been made, and a bottle that was good enough for Julius Caesar ought to be good enough for a plain citizen. Why change?

By nearly talking himself to death Painter finally induced two of the largest breweries in America to adopt the new style seal. The brewery money talked a language that bottle makers understand.

Still Painter was not out of the woods. The bottles and the caps were now available and customers loomed in the offing; but how could he get the caps on the bottles? Painter had to sit down and invent a machine, totally unlike anything ever seen, to fill the bottles and cap them automatically. But he did his task well. The new automatic bottling machine was a marvel. It completely revolutionized the whole bottling industry, not of America alone, but of the entire world.

Two immense factories were built in Baltimore, and they had to be kept going day and night. Other factories followed rapidly in Toronto, London, Paris, Hamburg, Yokohama, and the City of Mexico. It wasn't long until Painter's royalties at 1 cent a gross amounted to $365,000 a year.

As usual, just as soon as Painter had achieved a success a host of others tried to beat him out of his money. Infringements were numerous and the usual litigation followed until the courts had fully established Painter's claims and the company was strong enough to protect itself from pirates—that is, most of the time.

Painter was a most excellent business man, which cannot be said of most inventors. But a certain tobacco man put something over on him once. The tobacco man bought the patent for a worthless bottle cap, an infringement on Painter's device, courted litigation, and won. Painter's company settled the matter by buying out the tobacco man for $1,100,000.

Painter took out more than a hundred patents on bottle caps and machinery for making and using them, and had applications for still other patents pending at the time of his death. He became one of the foremost citizens of Baltimore. He died in 1906 at the age of 67, leaving a fortune estimated at ten million dollars, built on bottle caps. The Crown Cork and Seal Company, of Baltimore, with J. M. Hood, Jr., a son-in-law of Painter, President, is still extant. The Company has 70 warehouses in the United States and Canada and pays 20 per cent. dividends regularly.

From such little and extremely simple things as this, have fortunes been made. It is not only the idea that the inventor must have, however, but the brains to make a good business deal with the commercial world.

# Scientific Humor

**Not in U. S. A.**—"I'm going to get tanked tomorrow," said the Gasoline tank.

"Think I'll get full myself in a few days," answered the Moon.

—*J. F. Harnage.*

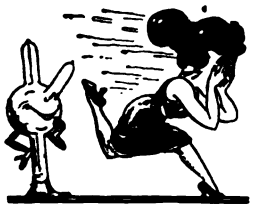
**A Study in Einstein's Relativity.**—LADY, TO CONDUCTOR: "Which end of the car do I get off?"

CONDUCTOR: "Makes no difference, lady, both ends stop."—*Edward J. Rife.*

**Must Have Had It in Her Head.**—Ad. in Oakland, Cal. newspaper:

MUST sell my vacuum; sacrifice for cash. Box 7368, Tribune.

—*Julius Fredericks.*



**Impossible! X-rays Could Not Pierce Here.**—FLASHER: "They are now able to detect imitation paintings. The X-rays pierce the paint and show the age of the canvas beneath."

DASHER: "Why not try the rays on the women's faces?"

—*Edward L. Friedman.*

**No Dead Ones Need Apply.**—This advertisement recently appeared in a daily paper:

WANTED—"A live wire to undertake the sale of our new electro-medical apparatus. The advertiser guarantees that it will be profitable to the undertaker."

—*H. D. Collins.*

**The Tolling of the Bell.**—Over the button on the front door of a house in a little town near Gettysburg is affixed a card reading:

"Button doesn't bell. Bump."

—*F. L. H.*


**Pity the Ancient Newsboys.**—BOY—"Father, was writing done on tablets of stone in the old days?"

FATHER—"Yes, my son."

BOY—"Gee!" mused the boy. "Then it must have taken a crowbar to break the news."

—*Russell Hansen.*

**"Don't Get Hot," Said the Stove.**—"What's the secret of success?" asked the Sphinx.

"Don't be shocked," said the Battery.

"Talk some more," said the Telephone.

"Never lose your head," said the Barrel.

"Make light of everything," said the Lamp.

"Don't monkey around," said the Monkey.

"Be up to Date," said the Calendar.

"Don't be a knocker," said the Hammer.

"Take Pains," said the Window.

"Look out for the time," said the Clock.

"Always keep cool," said the Ice.

"Find a good thing and stick to it," said the Glue.—*Bernard K. Tormey.*

## First Prize $3.00

**It Wasn't So Dry, Tho.**—EXPERIMENTER—"Have you any good scientific stories?"

LIBRARIAN—"Here's 'Twenty Thousand Leagues Under the Sea,' by Jules Verne. It's very interesting."

EXPERIMENTER—"I'm afraid that's too deep for me."—*Earl A. Rohlf.*

**Ship Ahoy.**—"Say parson, can you marry us in a hurry?"

"Certainly sir, I have a reputation for making twenty knots an hour in a pinch!"

—*L. A. Taylor.*

**Professional Pride.**—"My little baby girl," proudly proclaimed the young dentist, "is only eight months old and is getting a tooth!"

"Huh!" sneered the young chiropodist, "my little baby boy is only seven months old and is getting a corn!"

—*Adolph F. Lonk.*

*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.*

**Horse Sense.**—PHYSIOLOGY TEACHER—"How many senses are there?"

STUDENT—"Six."

PHYSIOLOGY TEACHER—"How is that? I only have five."

STUDENT—"I know it. The other is common sense."—*R. Cleveland.*

**He Forgot Himself.**—DIG:. "But didn't you feel the thief's hand going into your pocket?"

ABSENT-MINDED PROF.: "Yes, but I thought it was my own."—*Juan B. Riera.*

**Soon He'll Get the Air, Too.**—"Has he been a telegrapher long?"

"Not very. He gives his key plenty of ventilation."

"What do you mean?"

"He has it open most of the time."

—*Leslie Van Every.*

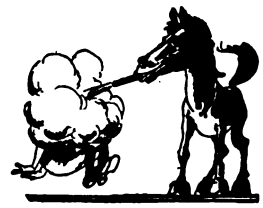
**Oh Mamma!**—PROF. IN NATURAL HISTORY: "Mr. Smith, can you name a mammal without any teeth?"

SMITH: "Yes, sir, my grandmamma."

—*Juan B. Riera.*

**Not a Wireless Phone Co.?**—"That athlete is wiry, all right."

"Yes; he used to be lineman for the 'phone Company."—*Leslie Van Every.*



**The Horse Blew "Himself."**—Veterinary, to new assistant: "Take this tube, fill it with that powder, put it in the horse's mouth, and blow hard."

Assistant, returning after a few minutes with eyes watering and appearing in great agony: "All r-right s-sir."

VET.: "What on earth is the matter?"

ASSISTANT: "The horse blew first."

—*Juan B. Riera.*

**He'll Be En-lightened Soon.**—LITTLE MABEL: "Mamma, can our maid see in the dark?"

MAMMA: "Why dear, what makes you ask such a question?"

LITTLE MABEL: "I heard her talking to papa in the dark hall, and she said that he needed a shave."—*John Novak.*

**Maybe Auntie Made Him.**—HENRY: (to druggist, "Give me a box of Dr. Green's pills."

DRUGGIST: "Anti-bilious?"

HENRY: "No, Uncle's sick."

—*Harold A. King.*

**The Task Supreme.**—CHEMIST: "Name a substance difficult to analyze."

STUDENT: "Boarding house hash."

—*Smith C. McGregor.*

Hamburger Steak is now called Liberty Hash. (*Printer's Devil.*)

**And Then It Went to Its GOal.**—"This is *my* car," exploded the irate tourist to the garageman, "and what I say about it, goes—see?"

Just then a dirty-faced machinist crawled out from under the dead machine and said pleading, "Say 'engine' mister!"—*G. M. Hitchcock.*

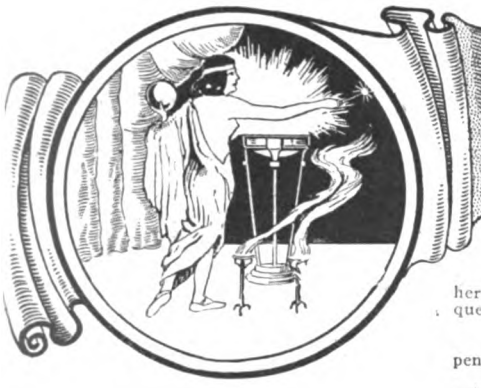
**Why Not Feed 'Em On Swiss Cheese.**—PROF.: "What insect requires the least nourishment?"

BRIGHT PUPIL: "The moth. It eats holes!"—*Gladys Kattelman.*

**And Sea-Sickness.**—TEACHER (to class in chemistry)—"What does sea water contain besides the sodium chloride, that we have mentioned?"

SMALL BOY—"Fish, sir."

—*Mrs. T. D. Newman.*



# THE ORACLE

The "Oracle" is for the sole benefit of all scientific experimenters. Questions will be answered here for the benefit of all, but only matter of sufficient interest will be publisht. Rules under which 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, no penciled matter considered.
3. Sketches, diagrams, etc., must be on separate sheets. Questions addrest to this department cannot 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 research work or intricate calculations a special rate will be charged. Correspondents will be informed as to the fee before such questions are answered.

## Rewinding Magnet Coils for Different Voltages

(1103) B. H. Chatfield, Los Angeles, Cal., writes:

Q. 1. What size and amount of wire should be used for winding magnet coils in the loud talking reproducer as described in *Radio News* for October, 1920, for use with a six-volt storage battery?

A. 1. If the two magnetizing coils in the Magnavox instrument there described, are to be used on a six-volt battery, the coils may be wound with the same amount or 3 pounds of No. 17 B & S gage, single cotton covered magnet wire. The rule for rewinding magnet coils or re-designing them for any voltage, is stated thus:

The cross sectional area of the magnet wire in circular mils is increased for a lower voltage and decreased for a higher voltage in direct proportion to the voltage ratios. For example, if you have a design specifying a certain size of wire, or a wire having a cross-sectional area of 10,000 circular mils, as given in any wire table found in text books or catalogs, then for operating on voltage, one-half the designed voltage, the wire size should be doubled and the size of wire chosen from the table having a cross-section of 20,000 circular mils and the nearest B. & S. gauge number selected. This will cause the current to be double and with the potential at one-half the designed potential, the resultant watts will be kept the same. Thus, you can redesign any magnet coil for any potential desired, once you have the fundamental or original design,—the amount or weight of the magnet wire or in other words, the depth of the winding remaining the same.

With the magnet coils wound with No. 17 S. C. C. magnet wire, the two coils should be connected in parallel for the six-volt service and the current should be twice 1.88 amperes, that consumed at 12 volts, or 3.7 amperes.

## How Magnet Strength is Tested

(1104) M. B. Aufderheide, Springfield, Ohio, writes the Oracle:

Q. 1. Data for a 2 kilowatt radio transformer.

Q. 2. How is the strength of magnets measured?

A. 1. Data on one and two kilowatt radio transformers has been given so often in the Oracle that we would advise you to peruse a copy of our Index, price of which is 15c.

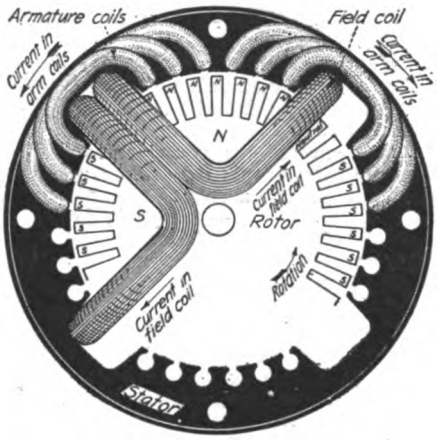
A. 2. The strength of the magnet is tested in the following way. It is seldom that the precise measurement of the actual flux density in the bar magnet is required. A method for determining the flux density is as follows: If the magnet is a straight bar, the intensity of the magnetization may be derived from magnetometer readings. If in the form of the letter "U," the magnet should be provided with smooth end faces, across which a small iron armature is placed. A coil of a known number of turns is slipt over the middle of this iron armature. This coil is connected to a ballistic galvanometer. The quick removal or replacement of the armature gives a throw on the galvanometer, which is then compared with that taken, in the same way with a standard magnet. The magnetic flux may also be computed from a calibrated ballistic galvanometer. There is also available for measuring the magnetic flux in maxwells, the *Grassot Fluxmeter*.

## Commutator-less D.C. Machine

(1005) Charles Long, Coffeyville, Kansas, asks:

Q. 1. I am enclosing three sketches of a direct current generator or motor having no moving coils or sliding contacts. I can see no reason why it will not work. If you can discover something I may have overlooked, I would be greatly pleased to have it pointed out. Note that the stator resembles an induction motor stator quite closely. It is built up of thin soft iron in the same way. The large slots are for the field coils, the small ones for the armature coils. The rotor punching is very similar to a D. C. armature punching, and in fact the one might be used for the other. The rotor is about the same thickness as the stator. It is toothed as shown and is perfectly bare, being like a D. C. armature core without windings or commutator or insulation.

The field coils are dropt over the rotor and then the group is to be inserted in the stator. It is scarcely worth while to mention that part of the coils and rotor are left out for the sake of clearness. Since there are no moving coils or sliding contacts, commutator, etc., it would be quite easy to build this machine for an extremely high voltage, or for a very high speed for special work. Suppose a tooth of the rotor to be right under one of the field coil slots to be utilized. It would be neutral. As the rotor turns, it passes from under the slot and coil and becomes, we'll say, north. As an individual north pole it sweeps past the armature coils, till it reaches the next field coil slot, where its polarity is reduced and reversed so that it emerges as a south pole. In sweeping across the armature coils it induces the current the machine is supposed to produce.




**Showing Arrangement of Coils in Proposed Commutator-less D.C. Machine.**

A. 1. We have referred this matter to an expert on dynamo design. The gentleman to whom we have referred your inquiry is professor of electrical engineering at one of the leading universities.

Briefly explained, the result of the investigations on your design is as follows: The commutator-less direct current generator, proposed by you, will not produce direct current at all, but alternating current; as the authority referred to has stated,—"This machine will operate as an alternator, for the reason that periodically increasing and decreasing magnetic flux, even if unidirectional, will produce an alternating pressure and current."

We have been flooded during the past year or two with a great many designs similar to the one you propose for a commutator-less D. C. machine to be used as a dynamo or motor, but owing to the action of Lentz's law, none of these succeeded in producing direct current. Lentz's law states that the direction of an induced current is always of such a nature that it opposes the current by which it was induced,—and as you will see from this fact, the rising and falling flux, even if unidirectional, will cause a current, first in one direction and then in the other direction, to pass thru the armature coil or coils of any machine of this type.

## Siphon Query

(1106) Martin Hussey, Detroit, Mich., writes:

Q. 1. Referring to our article in the February, 1920, issue on "Electrifying the Holy Land," suggests a siphon carried up and down over the surface of the land to carry the water from the Mediterranean to the Dead Sea.

A. 1. It is quite obvious that you did not get the essential feature in our article "Electrifying the Holy Land."

It is quite true that a siphon would work, but the country is very hilly and for that reason pumps would have to be set into operation to start the siphons, an added expense.

In the second place, the siphon would obstruct traffic, and in the third place, the velocity head which is obtained by means of a tunnel slightly on an incline would never be as great in a siphon as in the method outlined, because the friction in the siphon would presumably exceed that in the straight tunnel of comparatively even pitch; not to mention the chances of the long siphon breaking up due to air pockets forming alongthe line.

## Resilvering Mirrors

(1107) A. R. Beekman, P. O. Box 406, Miami, Fla., asks:

Q. 1. How can I resilver mirrors?

A. 1. A very good formula for the resilvering of mirrors consists of the following two solutions.

When ready for use they are mixed in equal parts and poured upon the glass which has first been levelled. The glass must first be cleaned carefully with ammonia and then distilled water and when spotlessly clean, a very good firm coating will be deposited.

A coating of ordinary varnish is subsequently applied to the back to prevent oxidation of the silver.

Solution one—Four ounces distilled water brought to a boil, 6 grains of silver nitrate and 6 grains of Rochelle Salts are added. It is boiled for six or seven minutes and filtered.

Solution two—Four ounces of distilled water, a small quantity of which is poured into a tumbler; 19 grains of silver nitrate added and stirred until dissolved. 26% ammonia is then added until the precipitate which is first formed is re-dissolved. 16 grains more of silver nitrate is again added and then the balance of the water. Filter and proceed as previously directed.

This will result in a very successful coating.

## Perpetual Motion Again

(1108) Oscar Chader, Montwerde, Fla., asks:

Q. 1. If a motor and dynamo are connected together and the current from the generator is allowed to pass thru a step-up transformer and thence to the motor why won't we obtain perpetual motion?

A. 1. It would be impossible for you to step up energy (watts) as you have suggested, because the efficiency of a transformer is only 90% and if you put 100 watts into the primary side, you only obtain about 90 watts on the secondary side, and the difference or 10 watts is lost already in the action of the transformer.

A motor is only 80% efficient ordinarily; a generator likewise 80%. The combined efficiency of the two is 64%. Now when the transformer is thrown in, a gross efficiency of 57% is obtained; in other words, thru the changes one-half the current is lost, hence your perpetual motion scheme is absolutely worthless.

## Frosting Bulbs

(1109) Edgar A. Castellini, San Francisco, Calif., wants to know how to frost electric light bulbs:

A. 1. The following matte varnish will frost globes, for commercial use, by dipping the bulb into it.

Mastic, ½ oz. avd., sandarac, 2 oz., benzol, 20 oz., and ether, 10 oz. A solution of gutta percha in chloroform may be used in a similar manner.

Nitrogen lamps will not remain colored long if the color is applied superficially, due to the high heat developed in the lamp. The glass may be roughed with sand.

## Chemical Queries

(1110) Joe Cronan, Rose Creek, Minn., asks:

Q. 1. The name of a good metallic conductor of heat.

Q. 2. An easily fusible alloy.

Q. 3. Chemical fire extinguisher.

A. 1. Probably the best conductor of heat which is comparatively cheap, is silver.

A. 2. An easily fusible alloy which melts at a very low temperature is composed of

Bismuth 2 parts,
Lead 1 part,
Tin 1 part,
Melting point being 200° F.

If about one-sixteenth part of mercury is added, its melting point is reduced to about 155° F. It will be understood, that 212° F. is the heat of boiling water.

A. 3. The chemicals used in various fire extinguishers are not very well known. However, it has been found that carbon tetrachloride does not freeze readily, and at the same time, serves as an excellent extinguisher for fires. In some extinguishers a solution of sodium sulphate is formed by the reaction giving the operating pressure and this solution is to some extent efficacious in reducing combustibility.

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# Astronomical Photography for the Amateur

By H. F. CURTIS

(*Continued from page* 148)

proper focussing when the eyepiece is being used. As a substitute for a shutter, a piece of cardboard with a hole or slit cut in it, may be flipt across the eyepiece by the use of a rubber-binder arrangement. The telescope may be counter-balanced, if necessary, by fixing weights firmly to the opposite end of the telescope.

It is highly essential in all work of this nature to secure an extremely accurate focus. To facilitate proper focussing, a block of wood should be made the same size as the plate-holder and of a thickness equal to the exact distance from the back to the active surface of the photo plate in the holder to be used. This is probably more clearly shown in Figure 4. A piece of thin, smooth, white paper should then be fastened to the surface of the block with thumb-tacks. If this focussing block is then placed in the "camera" first, and the image properly focust on it, the plate-holder may be substituted for it with the assurance that the image will be sharply focust on the plate. I have found a paper surface superior to ground glass for the focussing of such weakly lighted images, where fineness of detail is important. It should be remembered, however, that a focus which seems to be perfect to the eye, may not produce a sharp photograph. The focussing should be done with the filter in place. The proper focus may also be experimentally found by making successive exposures on a single plate, each slightly nearer the eyepiece than that position which appears perfect to the eye. One photo will be found which is much sharper than the others.

### KIND OF PLATES TO USE.

The best plate to use is a *Cramer isochromatic plate*, sensitive to the light transmitted by the filter used. Ordinary plates produce good photos, however. For taking the sun, use the slowest plate that can be found. On the other hand the fastest plates obtainable should be used for the moon and planets.

The length of exposure will have to be determined by experiment. An exposure of from one-half to two seconds will be about right for the moon, when the eyepiece is not used. With the eyepiece in place, the exposure will vary more or less as the square of the distance of the plate from the end of the telescope, and no definite instructions can be given. The length of exposures for the sun will be discust below. The telescope should be used without the eyepiece for the stars, and the exposure should be as long as possible without blurring.

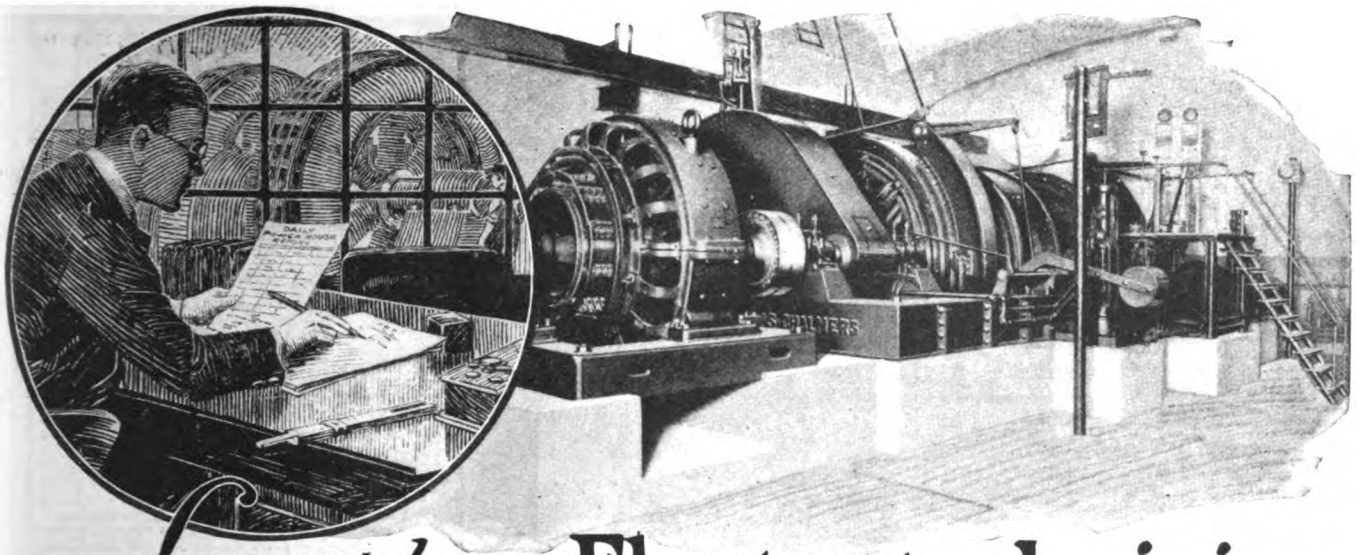
### DEVELOPING THE PLATES.

The plates should be developed to their full depth in any ordinary developing solution. Prints made on glossy paper are much superior to any other. They should be developed until the sky shows perfectly black, and the detail, if any, is clearly seen. Where good detail and sharpness are obtained, the pictures will often bear enlarging up to several diameters.

Contrary to expectation, the sun is quite a difficult object to photograph, due chiefly to its great brilliancy. If a diafram of some opaque material such as black cardboard, having a small hole about one-fourth to one-third the diameter of the object lens cut in it, is placed in front of the object lens, the light is cut down a great deal, at the same time producing a somewhat sharper image due to the reduction in spherical abberation of the lens.

The eyepiece may be used to advantage on the sun because of the loss of brilliancy with magnification, the added ease of focussing the larger image and the greater detail shown on the plate. The exposure should be as short as the shutter will take. Even with these precautions the plate is apt to be over-exposed, and it will have to be watched during development to prevent its getting too dark to show detail.

In the photos accompanying this article, Fig. 6, the full moon was made with the three-inch instrument shown in Figures 1 and 2. The eyepiece was not used, the exposure being about one second. Figure 5 is a similar photo of the moon at first quarter, the exposure being two seconds. Figure 7 is a portion of the moon's limb taken with the eyepiece as a magnifier. Figure 8 is a highly magnified section of the sun's limb, showing, tho not in great detail, the presence of several sun spots. The partial eclipse of the sun of November 22, 1919, is seen in Figure 9. The sun was barely 10 degrees above the horizon at the time of exposure, and the outlines are poorly defined due to the "boiling" of the atmosphere. Figure 10 is a "corner" of the partial eclipse of June 8, 1918.



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## Dynamite Boosts Plant and Tree Growth

(*Continued from page* 122)

into a reservoir by making it porous, so that it absorbs water and holds it like a sponge. Why not use explosives and make the reservoirs two and three times as great and secure absolute instead of partial insurance against drouth?

It is admitted that much of the rainfall is lost by running off, and consequent damage is done by erosion. Why not check this by the use of explosives before the rainy season, storing the rainfall in porous soil, instead of letting it run to waste? It is admitted that some of the soils called "worn-out," or "poisoned" and "worthless" may be reclaimed *if the soil is thoroly stirred up from the depths*. What can do this so efficiently as explosives? It is admitted that much of the plant food in the soil is unavailable because it is unweathered. Why not make it available by opening the ground to weathering agencies by explosives?

A single cartridge of explosive can easily convert several yards of compact and useless hardpan into half an acre of new feeding ground. Costly, massive, improved machinery enables the farmer to spread out his operations, to move horizontally, and handle more acreage in the same time, and he is ever eager to double and treble his holdings of fertile soil. What is wanted is something that enables him to move vertically down and double his acreage, and double his yield by doubling the fertility of the soil, by doubling the depth of the feeding zone, by doubling the water supply, by cultivating the ground to double and treble the former depths.

### Depths to Which Roots Go

The natural tendency of most roots is to go deep into the soil. Many, who have not investigated this subject, believe that roots do not go deeper than one or two feet and cultivate accordingly. On the contrary, they go to much greater depths *if the soil conditions permit*. Corn roots that have been confined and have occupied all the soil to a depth of 2 feet, will go to a depth of 8 feet if the restriction is removed. Wheat, oats, and barley will penetrate from 8 to 10 feet, grass roots will go down 6 and 8 feet, while alfalfa has been known to go down over 30 feet. Grapevine roots have been found 22 feet below the surface, while some root systems of trees correspond in extent and branching to the parts above ground. The roots of clover weigh as much as the total weight of the year's crops, while the roots of an oat crop are nearly 50 per cent. of the weight of the seed and straw. The total length of all the roots of a single wheat plant was found to be about 268 feet, of one rye plant 385 feet, and of one corn plant 1,452 feet.

Such facts show that the size and depth of the root systems are generally not realized, and are generally underestimated. It is evident that the roots need a far deeper feeding zone than is ordinarily given them. The feeding zone has been shallow and meager, largely because the farmer could formerly find no suitable means for the deep cultivation. No practical machinery can till the soil as deep as two feet, and even that limit is not sufficient for the needs of crops. Such deep cultivation is possible only with high explosives.

The benefits of deep-rooting of a crop do not pass away when the crop is harvested, for the roots are left down where they grew, and on decaying, form humus at a depth where it would be impossible to place it by artificial means; down where it will help to perpetuate the granulated condition of the

(*Continued on page* 164)

# Dynamite Boosts Plant and Tree Growth

(*Continued from page* 162)

subsoil, and keep alive the deep feeding and working bacteria, helping the farmer to gain thereby the full return from all of his field rather than from the top only.

### Trees in Central Park, N. Y. Helped by Dynamiting Soil

Some time ago a special investigation was made as to the cause of so many trees dying in Central Park, New York City's famous recreation and scenic grounds. Discarding all of the older theories as to why the trees had shown such a high mortality rate, and refusing to believe that the trees succumbed due to the onslaughts of various bugs, worms, birds or fungous growths, the experts in charge of the maintenance of this famous park, finally came to the conclusion that the teachings of Professor Gilbert Ellis Bailey were correct and that what the trees really needed was a loosening up of the deeper soil strata, so that their roots could reach downward and thus absorb the needed additional water, not to mention benefits accruing from the excellent food supplies stored in this sub-strata, as shown in the accompanying table in the illustration, where the various percentages of chemicals are given for the different depths. The Central Park experts came to the conclusion that some localities are far more in need of blasting of the soil in the vicinity of the tree roots than are others. The method of shattering the hard subsoil is shown in one of the accompanying diagrams. Owing to the fact that the sub-strata are composed of clay or a high percentage of it, or else some other form of hardpan, the nature of which is well-known to be that of packing solidly and thus preventing plant and tree roots from finding their way down thru it to the natural water and food stores which they crave, blasting will do good where no other means can be applied.—*Data courtesy E. I. du Pont de Nemours Powder Co.*

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STATEMENT OF THE OWNERSHIP, MANAGEMENT, CIRCULATION, ETC., REQUIRED BY THE ACT OF CONGRESS OF AUGUST 24, 1912

Of Science and Invention, published monthly, at New York, N. Y., for April 1, 1921. State of New York, County of New York, ss.: Before me, a notary public, in and for the State and county aforesaid, personally appeared Hugo Gernsback, who, having been duly sworn according to law, deposes and says that he is the Editor of the Science and Invention, and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management, etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, embodied in section 443, Postal Laws and Regulations, printed on the reverse of this form, to wit:

1. That the names and addresses of the publisher, editor, managing editor, and business managers are: Publisher, Experimenter Publishing Co., 233 Fulton St., New York City. Editor, Hugo Gernsback 233 Fulton St. New York City. Managing Editor, Harry Winfield Secor, 233 Fulton St., New York City. Business Manager, R. W. DeMott, 233 Fulton St., New York City. 2. That the owners are: Experimenter Publishing Co., 233 Fulton St., New York City; Hugo Gernsback, 233 Fulton St., New York City; Sidney Gernsback, 233 Fulton St., New York City; Harry Winfield Secor, 233 Fulton St., New York City; R. W. DeMott, 233 Fulton St., New York City. 3. That the known bondholders, mortgagees, and other security holders owning or holding 1 per cent. or more of the total amount of bonds, mortgages, or other securities, are: None 4. That the two paragraphs next above, giving the names of the owners, stockholders, and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him. 5. That the average number of copies of each issue of this publication sold or distributed, through the mails or otherwise, to paid subscribers during the six months preceding the date shown above is ——. (This information is required from daily publications only.)

H. GERNSBACK

Sworn to and subscribed before me this 1st day of April, 1921. Beatrice K. Owen, Notary Public, New York County, New York. New York County No. 000, New York Register No. 000. (My commission expires March 30, 1923.)

## The Deflecting Wave

By HERBERT L. MOULTON

(*Continued from page* 124)

tons of American manufactured products. Forty-eight hours passed and the Liverpool office advised the headquarters in New York of the first non-arrival of a trans-Atlantic air liner.

The newspapers circulated their belief that the radio controls of the "Ramapo" had failed and as a consequence that ship had drifted off the course and sped aimlessly on until the fuel for its Diesel engines was exhausted.

DeFoe found it hard to share this belief, for he was aware of the careful examination that the control apparata of each air liner underwent before starting. As a precautionary measure, however, he placed an observer on every air liner leaving port. What followed can best be told by referring to the diary kept by one of these observers —Rutherford Morgan.

The Experiences of Rutherford Morgan, Director of Operations of the Aero Transit Corporation, while on the Air Liner "Atlantide," as Recorded in his Diary.

"On November 5th, 1927, two days after the "Ramapo" had disappeared, I concealed myself on the "Atlantide," Aero-Transit's newest and largest transoceanic air liner, and prepared for one of the most thrilling voyages over the Atlantic that ever befell a man.

At six o'clock in the morning, just as the sun began scattering the heavy banks of fog that clung to the earth, I watched the ground beneath me vanish as the "Atlantide," released from its anchorage, soared skyward. A few moments later the eight electric motors began to whirr, the rudders responded to Liverpool's continuous wave, and we were off. Where? Presumably eastward, for England . . . but wait!

An hour earlier the "Alighieri" had left Long Island with Matthews, one of our passenger pilots, aboard, so I walked into the little cabin of the "Atlantide" where a special radiophone set had been installed and endeavored to get into communication with him.

"Matthews, 'Alighieri,' call Morgan, 'Atlantide,'" I repeated several times and soon the ether brought his firm voice back to me.

"Morgan, 'Atlantide,' this is Matthews, 'Alighieri.'"

"Everything O. K.?" I asked.

"Yes, am about 90 miles off shore and going strong," he replied.

"All right," I said, "I'll call you again this evening at 8 o'clock."

"Good! I'll be waiting for you," and then the ether became silent once more.

All that day I loafed on the starboard deck, reading several of the magazines I had brought along. Now and then I glanced at the compass and its needle quivered to port and verified our eastward course.

It was beautiful, serene and peaceful up there in the sunshine. Ofttimes the cool moisture of a cloud dampened my face; once a startled sea-gull, alarmed at this curious monster that flew so rapidly without wings, darted by and was tossed about in the tumultuous air currents we left behind. Several times, when the wind swung the nose of the giant craft around, I heard the clicking of the magnetic apparatus that controlled the rudders and brought us back on our course.

At 8 o'clock that night I called Matthews on the radiophone and after he had reported that the "Alighieri" was still on her course and that all was well, I pre-

pared to sleep on the small collapsible cot that had been placed in the cabin. In not a great many minutes the smooth hum of the motors had lulled me to sleep; me —in a pilotless giant of the air, speeding eastward thru the night, over 3000 miles of watery expanse!!

I awoke with the dazzling glare of the morning sun in my eyes. My watch informed me that it was just 7:30 o'clock. I sat upon the edge of the cot for a moment or two gazing at the beautiful spectacle of the sun dispersing an army of clouds that had gathered during the night, when I suddenly began to think about the sun itself. Why was it shining in the Port window? Obviously, it should be almost straight ahead of us and here it was streaming in on our left side. We were off our course! We were sailing South!!

After hastily dressing I stepped into the radio room and glanced at the compass, confirming my earlier conviction. We *were* traveling South! I had no means of determining how long we had been on this southward course. I was convinced that the magnetic rudder controls had ceased functioning—an unprecedented occurrence—and that we were drifting hither and thither at the beckoning of the winds. Just then something happened that smashed my theory into tiny bits.

*I heard the sharp, unmistakable "click, click, click" of the magnetic rudder control!!*

No doubt remained in my mind as to the mystery of our deflected course. The instruments were operative and yet we were undisputably out of Liverpool's control. There remained but one answer. *An outside control station was drawing us southward, to a fate unknown as yet, but probably akin to that of the "Ramapo."*

I tried for the next hour to communicate with Matthews, but my time was spent unprofitably. I heard one or two steamships somewhere in the vicinity, but could elicit no response to my radio call of inquiry. Thereafter, I could do nothing but await developments. They were not slow in presenting themselves.

Since I had first rubbed my eyes that morning the "Atlantide" had maintained its normal speed, but now, at 9:08 o'clock, the motors slowed down to a scant 25 miles per hour. At the same time the air liner began a gradual descent from its 3000-feet altitude. I remained in the little cabin and secreted all the equipment I had brought with me, including the cot, blankets and my two grips. Then I peered out of the porthole.

The descent continued for several minutes, but when we came within 250 feet of the surface of the sea, it ceased. I cautiously put my head out of the porthole and looked for'd, and immediately wished I hadn't, for it resulted in unpleasant complications later on.

Several hundred yards ahead, steaming thru the morning swell of the North Atlantic, I discerned a small, white yacht. Upon her bridge a man stood, studying the "Atlantide" thru a pair of binoculars. In that unfortunate minute, he evidently saw my head bob out of the porthole, for he immediately strode into the pilot house and disappeared.

I withdrew my head and prepared to hide myself in among the bales and boxes of merchandise that constituted the "Atlantide's" cargo, for it was my aim to remain in hiding as long as possible. Of course, I could have saved myself this inconvenience by simply stepping into the control room and sending the air liner speeding eastward by manual control, but the explicit instructions given me by DeFoe charged me with non-interference, regardless of the consequences. After all, the object of my journey, as well as that of each of the other men the Chief had

placed on all the liners, was to determine the cause of the "Ramapo's" disappearance, and to run away at this time would probably forever prevent our finding this out. So I hid.

For perhaps twenty minutes nothing happened, but at the end of that period the motors became silent and a moment later I heard the heavy rumble of the liner landing upon a hard substance. This was followed immediately by voices and a few seconds later footsteps sounded on the deck of the "Atlantide."

An hour or more passed and I was becoming tired of hearing nothing but the sound of gruff voices, running footsteps and a dozen or so saws and hammers. It was stuffy back where I lay, surrounded by the cargo, and . . . well, pretty soon I dozed off. . . .

"Here 'e is!"

The bright gleam of a pocket flash blinded me. At the same instant I was roughly jerked to my feet by a pair of muscular arms.

"C'mon, you! We gotta better place fer yer ta sleep! C'mon!!"

I was amazed to find, upon arriving outside, that the "Atlantide" rested on the starboard deck of a large steamer, apparently a tramp. As I glanced astern, I saw the small, white yacht steaming off. My guard pushed me into a cabin just then, thereby preventing my making further observations.

The room in which I stood was small, but well furnished for a tramp ship, and lighted with electricity. In the center of the room rested a large, heavy mahogany table, at which was seated a young, smooth-shaven man, with light blue eyes and ruddy complexion; evidently one of the ship's officers.

"Here 'e is, Captun!" my captor exclaimed. "I found 'im sleepin' along 'o one o' them flivvers yer wanted so bad."

"Leave him here with me, Pud, and keep a watch outside—I don't want to be disturbed," the smooth-faced man ordered, in an equally smooth voice. Pud left the room and I stood facing the Captain, who glanced at me keenly.

"So the Company's puttin' spies on its old tubs now, eh?" he said, a faint smile spreading over his face.

"Not spies," I replied. "Just observers and guards to see what happens to its property and the property of its shippers."

"Lord help the Company if they're all like you," he observed. "A heluva guard you'd make, and as for observin'—what was you lookin' for, rats in the cargo?"

I did not answer him, but asked, instead: "What do you intend to do with me?"

"Dunno; I'll keep you tied up for a couple o' days till I decide. Pud!"

Pud slipped thru the door like something automatic and again stood before his master.

"Take him below, give him something to eat, and tie him up."

Pud, the hairy soundrel, led me out on deck again, where I saw a dozen men engaged in hauling the cargo of the "Atlantide" out on deck and then dropping it down into the hold of the tramp. Some other men busied themselves in dismantling the air liner—tearing it apart—DeFoe's pride and pet!

For two days I was confined below, in irons, but at the end of the second night I was allowed to go up on deck, with specific instructions not to get "snoopy." Nowhere was the "Atlantide" to be seen. In all probability it had been dismantled, its heavier parts thrown overboard, and its cargo and engines stored in the hold of the steamer. I looked about for the little yacht that had led us on, siren-like, to my imprisonment and the "Atlantide's" destruction, but saw nothing of it.

I was given good food, a fair bed and had nothing to do but observe. This I did. I studied every member of the dirty crew, none of whom would speak to me, and who appeared to do nothing but eat, sleep and drink. I drew a mental picture of each one of these modern pirates and vowed to do everything in my power—if I was ever freed—to put each one of them behind prison bars.

Things went on in this way for three long days. The ship seemed to remain in one spot, for we had a period of calm with very light winds and the engines had not turned once during my stay on board.

On the sixth day of my captivity, about three o'clock in the afternoon, I perceived all hands gathering aft and strolled in that direction. At first I saw nothing, but a slight ground swell lifted us up and I saw the little white yacht again, followed by—AN AERO TRANSIT LINER!!

Fifteen minutes later saw the "Ranier" (one of our smaller freight carriers) resting on the deck of the tramp steamer and presently there issued forth from it Arthur Young, last seen by me in New York a week ago! He did not have the opportunity to see me, being taken, as I had been, into the presence of the Chief Pirate, as I now referred mentally to the Captain.

Presently Young came out on deck alone, apparently with the freedom of the deck, for he walked about unconcerned until he saw me, standing by the rail amidships.

"Good Lord! Morgan," were his first words, when he stood before me, "you here too?"

"Look's that way, Young, doesn't it?"

"Why, man, tell me about it! What's happened to the 'Atlantide'?"

I told him, in few words, all that had happened, and asked him whether he had any idea as to just how far we were from the New York-Liverpool airline.

"It can't be more than 50 miles at the most, Morgan," he replied, "for the 'Ranier' did not leave its course until an hour ago."

"That's strange," I said, "it took me over two hours before I landed on this old derelict. We've probably drifted 150 miles North during the last six days."

We continued our conversation for several hours, all the time watching the "Ranier" become robbed of her cargo of manufactured products. For some inexplicable reason the wrecking crew did not appear upon the scene—probably it would await the morrow before beginning its work of destruction.

Supper time came around and Young and I were allowed to remain together. Later, however, we were separated; he was given a bunk at the other end of the ship. Before we separated for the night, though, our plans for escape had been completed. We parted at nine, both turning in for a snooze before our proposed departure at 2:00 A.M.

I did not get my needed sleep, however, for it was warm in the stuffy cabin and my head was filled with thoughts of what the second hour of the coming day would bring. Could we do it? Did the liner have enough "lift"? Would we be detected and perhaps shot down? Pleasant thoughts for a man trying to sleep!

Two o'clock slowly dragged around and I arose noiselessly. A brisk breeze had sprung up from the South and I could hear rising waves lap-lapping against the iron sides of the steamer. Once out on deck I hugged the sides of the cabins and edged my way amidships. As I passed the stern of the "Ranier" I cut several of the ropes that bound it down to the deck, leaving only one thick strand to hold the

liner in place. Then I proceeded silently to the cabin entrance, where I was to meet Young.

For several minutes I stood in the sheltering shadow of the dirigible and presently saw a dark figure slink out of one of the white doors down the deck. He had to pass the prow of the "Ranier" and had instructions to duplicate my feat with the moorings at that end. I saw him stoop and become engaged in sawing away at the thick hawsers with his knife. Behind me I felt the air liner tremble and tug at her last remaining ties. She had the "lift"—one more minute now and we would be off!

Suddenly the "Ranier" gave a mighty lurch; I heard the strand of the hawser at the stern snap and the whole dirigible started upward.

"Hold on! For God's sake, hold on!" I cried to Young as I gripped the deck rail of the air liner and swung myself aboard. I leaned over the rail and looked for'd and saw a pair of legs dangling in the air.

"I'm all right," I heard Young shout, "get those motors started!"

I busied myself with starting the motors which fortunately had not been tampered with and had just received the satisfaction of hearing their welcome hum when a dozen or more .45 bullets tore their way thru the flooring and lodged in the ceiling. Just then Young stepped in through the engine-room door, his face white and forehead beaded with perspiration, and smiled sickly.

"Got away a little sooner than I expected," he said weakly, "too bad we had to wake them up down there."

"Yes, they seem pretty lively and rather excited about our departure," I replied, "and are evidently trying to pump enough lead into our ship to drag it down again," as another volley of the .45s came thru the floor.

"Well, the sooner we get out of this neighborhood the better," Young observed, "let's get at the rudders."

By this time we were under way and the steamer below was a mere blurr of lights in the darkness. Young operated the rudders by manual control and we headed due West, knowing that the wind would carry us far enough North to bring us in the vicinity of Long Island.

* * * *

Twenty-four hours later Young and I saw the blue and red lights of the Airport, Long Island, landing field, after having been in communication with that station for the past three hours. DeFoe had, on hearing from us, sent out a dozen of his own armed patrols and notified the Government Aerial Defense. While I had not been able to give him the exact latitude and longitude of the pirate ship, yet I was convinced it could be located, as Young had said that it had been only 50 miles South of the regular trans-Atlantic route when he had been captured. From our own computations on the return trip, we judged the ship to be about 1800 miles off the United States coast.

The pirate must have made a hasty departure from his stamping ground, however, for the weeks passed by without any reports of his whereabouts from either the Aerial Defense planes or our own scouts. Ocean transit had become safe once more, the freight lost as a result of the thefts of the "Ramapo," "Atlantide" and "Ranier" had been covered by insurance and the shippers satisfied.

The Press, of course, devoted columns to the whole affair and advanced its own theory as to where the pirates had gone. The more sensational sheets invented isolated islands where the pirate crew supposedly had its base, and full pages in the Sunday supplements gave the public a vivid-colored history of the adventure of Young and myself. For a few weeks we

were the heroes of several fantastic tales; the public read, read again, and yawned. After that Young and I were ordinary mortals, going about on our routine duties and thus the matter quietly left the Present and became a part of the Past—something to be remembered and talked about at leisure.

* * * *

One morning, almost three months after the "Ranier" had brought Morgan and Young back to civilization, the New York papers carried a press association dispatch as follows:

**ALLEGED PIRATE SHIP BEING HELD IN RIO DE JANEIRO**

Ship that Captured Air Liners Believed to Be One Held in Southern Port

Rio de Janeiro, Feb. 11—A tramp steamer, believed to be the "pirate ship" that intercepted and looted three trans-Atlantic air liners last November, is being held in this port, pending the outcome of an investigation.

A preliminary inspection by Government officials today revealed a mixed cargo of manufactured products, mostly machinery, and evidently of American origin. A large radio outfit, unlike that usually found on steamships, was found and will be subjected to a thorough examination.

The Captain of the ship, his officers and the crew are being held until their true status can be determined.

The next day Morgan and Young made a rapid trip down the coast to South America and upon their arrival in Rio identified both the ship, the Captain and several members of the crew. Most of the stolen cargo was intact and arrangements were made for its shipment to New York for disposal.

Morgan was keenly interested in the radio room of the tramp and the next day, when DeFoe glided down unexpectedly in his scout cruiser, they examined the complicated apparatus and sensitive instruments.

"Say, Morgan, some of these instruments are those stolen last year from our Liverpool control room!" DeFoe exclaimed, as he examined a multiple relay unit of his own design.

"Yes!" Morgan replied, "and here's that Orientator you searched all over England and most of the States for."

"Well, I'll be . . . well, that clears things up a bit, doesn't it?"

"It certainly does!" Morgan answered. "The whole scheme is fairly simple to understand. This Captain and one of our inside men probably got together and doped the thing out. This inside man systematically stole certain necessary instruments that could not be made outside. Having installed these instruments, together with the auxiliary apparatus, on the steamer, they proceeded to a point in mid-ocean some fifty miles South of the regular air lane. There they deflected the course of our liners."

"That's all very clear, Morgan," his Chief mused, "but I don't quite see where that little white yacht you and Young spoke about comes in. Was it, I wonder, equipped with radio control apparatus too?"

"Probably not," replied Morgan, "I believe that yacht was only a scout. It evidently steamed along under the air lane and when it saw a liner approaching advised the steamer of the fact by radio. The latter then sent its continuous wave out, which, being nearer and stronger than that emitted from Liverpool deflected the course of the oncoming air liner. The yacht was used as a safety measure, too, for its Captain watched the 'Atlantide' while that liner followed the yacht with reduced speed. As it was, he saw my head bob out of the porthole, and doubtless he put the steamer's Captain on the alert, for I was discovered within a few hours after the dirigible's arrival."

"An unforeseen phase in our automatic radio control of air liners, Morgan, and one which shall have to be provided against in the future, especially if we ever intend to get those mail contracts."

"I think, DeFoe, that such provision has already been effected," the Chief of Operations said. "For the past two months I've been working on an instrument that will automatically send a radio report broadcast when a liner leaves the control of one of our master stations. This report will not only give the exact hour that the liner leaves its course, but will also give the direction in which it is traveling while off the course. By equipping each air liner with such a device, it should be a simple matter to follow up any dirigible that has a tendency to rove off the beaten track."

"Congratulations!" DeFoe exclaimed, "You've hit the nail on the head! Let's get these fellows out of the way and then get back to New York and get busy with your scheme. I've been trying to perfect instruments that would prevent the deflection of an air liner while in flight, but I guess I've been on the wrong track."

"Well," said Morgan, as he put on his coat, "I believe the day will arrive when we will have instruments that will absolutely prevent the introduction of a deflecting wave in our system, but for the present we'll have to use whatever we can devise to offset such attempts. And now, let's get back to the hotel—this salt air gives one a remarkable appetite!"

* * * *

Six months later, in an exclusive club just off Fifth Avenue, DeFoe and Morgan were congratulating one another on the securing of the trans-Atlantic mail contracts by the Corporation.

"I won't hesitate about informing the world," DeFoe stated, as he puffed leisurely on his cigar, "that your 'Off Course Signal' was the factor that convinced the Post Office Department of Aero Transit's ability to carry the foreign mails with speed and safety. Your demonstration yesterday practically closed the deal."

"It's bully of you to say it, DeFoe, but after all is said and done, *you* are the man to be thanked. Had you not invented the control system now in use, the mails to Europe would still be almost a week in transit."

"Well," Morgan's chief replied, "as long as we hurl compliments at each other we arrive nowhere. Suppose we let the matter rest and turn our thoughts elsewhere."

"A fine suggestion," assented Morgan, glancing at his watch, "and one that I was just about to offer. The fact is, your daughter expects to see me in twenty minutes and for that reason I fear I must make a hasty departure. Good night!"

DeFoe's eyes twinkled as he replied, "Bon nuit! and see that you take good care of her, young man!"

## SKATERS GET MUSIC VIA WIRE

Folks who are prone to believe there is no such thing as real wintering in Sunny China, will be interested in the announcement that the Peking Club possesses one of the most up to date ice rinks of the day. Thanks to the introduction of the latest American developments in telephone amplification, the skaters who have been making the rink their headquarters this year, have been able to perform with a regular jazz accompaniment.

The manager of the China Electric Company secured for the Chinese rink a loud speaking apparatus of the same type as that used at President Harding's inauguration. Several amplifying horns were set up about the ceiling of the rink and connected by wires and an amplifying device with a phonograph run by a Celestial youngster in the club basement.

# Scientific Stage Illusions

By H. WINFIELD SECOR

(*Continued from page* 120)

### The Electrified Glass Trunk.

The glass trunk mystery illustrated at Fig. 4, has been performed for many years, but an improvement suggested by the author woudl be to cause high frequency currents to flash over the trunk all the while the performer is locked inside of it and endeavoring to make his escape. This trick does not lend itself to the needs of the amateur magician usually, as it is quite expensive to stage, owing to the trunk being built of ¼-inch thick plate glass. This glass trunk is built in the manner illustrated, the corners being firmly locked by right angle steel or brass bars, held in position by bolts passing thru the glass, while padlocks link thru holes in the bolts on their outer ends. The whole trick of escaping from this and other similar varieties of cabinets, lies in the fact that the bolts holding the hinges in place are *phoney* ones, but this fact is never noticed by the committee from the audience who come on the stage and inspect the glass trunk. The bolts holding the hinges are made with a threaded cap, so as to permit them to be taken apart from the inside. Two small holes in the cap for which a steel key is made of the form shown, explain the mystery.

The performer, once the curtain is drawn on his cabinet, takes his key and unscrews the phoney hinge bolts and pushes them outward, and then raises the glass cover sufficiently to allow him to escape from the trunk. He then proceeds first to pick the locks so as to release the bolts from the hinges, fastens the bolts to the glass side once more, then places the hinges over them and finally resnaps the locks in place. Added theatrical effects can be carried out in several different ways. A good scheme would be to keep the high frequency discharge going continuously all the while the *escape* is being made. Of course it is not safe to keep the discharge passing thru salt water (which may be sponged over the glass just prior to presenting the act (all the while the escape is being made by the performer, so a subterfuge is arranged for, so that no change in the spark effect will be noticed by the audience. By means of a by-pass spark-gap connected to the wires just behind the glass trunk as indicated in the diagram

swallows a *red-hot sword!* In a few words this trick is performed more simply than might be expected and without much chance of discomfort or danger to the performers. Just before this act is presented and the curtain pulled back, disclosing the sword swallower with his head thrown back, he has taken care to swallow a sword scabbard or sheath, which scabbard may be lined with asbestos.

### The Mirrow and Watch Trick.

"Will some lady or gentleman in the audience kindly loan me a perfectly good gold watch for five minutes? I will guarantee to return it in perfect condition within the allotted time. Thank you, sir!" (Saying which he steps back on the stage with the gentleman's gold watch.) On his velvet covered magician's table in the center of the stage, the performer has a mortar and pestle in which he shortly proceeds to apparently smash up the borrowed watch—but does he?

He then takes the dismembered parts of the gentlemen's gold watch and packs them down into the commodious barrel of an old horse pistol.

He fires—you think the various wheels and springs fly thru the air—and presto!—he had spoken the truth—for behold! before the shattered mirror is the very gold watch which he borrowed only five minutes before from the gentleman in the audience.

This watch trick has been staged in several different ways, such as by breaking a cheap duplicate up and either placing the parts in a pistol, or else dropping the parts for an alleged *cleaning* into a glass pitcher of milk. Of course we may as well explain right here that your watch was never harmed or taken apart or anything like that. By a so-called *magician's pass* palming, or other subterfuge, the borrowed watch was either dropt into a pocket in the back of the table or perhaps of a chair, as shown in the diagram, from which pocket either the magician or his assistant later picks it up—while the wheels and other parts are taken out from another blind pocket on the back of the table or chair, and placed in the mortar and pounded up. The substitute watch parts are loaded into a false barrel under the main barrel of the pistol. A blank cartridge is used, about 22 calibre, which is fired thru the usual barrel on the top of the pistol. If this trick is performed with a mirror held by the attendant it can be arranged with a double-faced mirror mounted on a vertical shaft, the bottom of the shaft being fitted with a powerful spring, released at will by a push button. In one way or another, such as by having the mirror lie on the magician's table or otherwise, the borrowed watch is placed on the cracked mirror face, or else the watch is placed in between the false back and the perfect mirror of the second arrangement shown in the illustration, where a spring operated hammer is released by the attendant holding the mirror so as to smash the glass when the gun is fired by the magician.

One of the best methods of presenting this act is by means of a trick picture or mirror frame shown in detail at Fig. 6-B. This frame is easily arranged with a half-flap which can be released by a string by an assistant behind the back scene drop. The frame is mounted on the scene drop and the diagram shows by means of the dotted lines, how the magician walks over to the chair, drops the borrowed watch into a *servante* pocket on the back of the chair, and how—a moment later, his clown assistant may amble in and lean against the chair, making funny faces at him, *et cetera*, and most important of all *securing the watch from the servante pocket*. Shortly the clown wanders out thru the door and then walks up behind the screen to the spot where the frame is located, places the good watch within the frame by means of the hinged door and all that remains is for the magician to fire his pistol at the frame; the attendant pulls the thread releasing the hinged half-mirror in the front, disclosing some broken mirror pieces in the top part of the frame, with the watch hanging among them.

### The Famous Milk-Can Trick and Steel Boiler Escape.

The top is made very massive looking with several rows of rivets and a series of heavy hinged hasps which are locked securely with heavy padlocks. This is one of the best tricks ever performed on the American stage. As the can is brimming full of water just before the cover is placed on it, and as the performer rightly states before hand, if he

does not get out of the can before his breath holding capacity is up, he will be a dead one. But never fear he will not die so young—thanks to two or more wing nuts or else phoney rivet heads, nicely provided with holes to fit a key, like that used in the glass trunk mystery

The *steel boiler escape* is a clever trick due to Oudini (not Houdini) a master performer with the handcuffs and other mysterious tricks which he has performed successfully on the American stage for several years. The steel boiler as shown in Fig. 8, is usually made by some boiler concern located in the town where the performance is to be held.

Sometimes he provides his own boiler and of course this is an easier and less nerve-racking way to stage the escape. The boiler is ordered made in a perfectly substantial manner with two iron bars crost at right angles, the ends of the bars being drilled to receive padlocks.

But in many cases the performer actually does saw his way out, if the bars are not light enough for him to bend or break with his hands, or else with a bar of iron secreted on his person when he enters the boiler. Of course if he saws or bends the bars in half and pushes the pieces out thru the holes, which gives him his freedom, it is almost impossible for him to rejoin the pieces of iron bars by cement or otherwise in the short time allotted him for the escape, for the committee would undoubtedly, in examining the boiler and bars, find the points where they had been joined together. To get around this difficulty, the performer carefully examines and measures ahead of time the bars used in sealing the boiler and top and provides hmiself with two exactly similar bars. These additional bars, drilled of course for the padlocks, he secretes between the two cloth walls of his cabinet and after making his escape from the boiler, which may take from twenty to thirty minutes, he picks the padlocks off of the old bar pieces, and puts his own new bars into place in the holes and then snaps the padlocks in place on them. The pieces of old bars are hidden of course in the walls of the cabinet and at the signal given, the attendant pulls up the curtain and—Presto! there stands our hero, outside and not inside of the boiler.

**Man and Girl Transformanion.**

Changing a man to a girl or a girl to a man as the occupant of a magic box or coffin, has always amused and entertained theatre audiences. As P. T. Barnum, the famous showman said—"the public likes to be fooled." The illustration, Fig. 9, shows the method invariably employed in performing this trick, altho several variations of the apparatus here used have been ingeniously worked out by various stage performers. In the present case, the box is fitted with a right angle shelf, pivoted in the lower corner as shown. It is surprising how far this box can be placed from the back drop or curtain, and the escape or exchange with another actor made, by passing a plank thru a slit in the curtain directly back of the box.

In some disappearing tricks where a person steps into a suspended basket and after entering the basket he makes his escape by passing thru the bottom thru a trap door, is camouflaged or hidden from the view of the audience by the stairs up which the actor or actress walks. Mirrors are also used in many of these acts which reflect things in a most mysterious way, so that what seem to be tricks of *Hindu magic*, are tricks conceived in the mind of an enterprising stage performer or showman.

## Frozen Music

By H. GERNSBACK

(*Continued from Page 131*)

is a record that has been played a good many times and is badly worn. In the center can be seen where a piece of the groove wa'l has been knocked out entirely, and every time the needle passes here, a shock is given to it. If there are many similar shocks on a record, the ears will easily note them, and we then say it is a "scratchy" record. It should be noted that even the best new record is not perfect. A perfect record where the groove-walls as well as the bottom are absolutely smooth cannot be produced mechanically. If it were, then you could start a record and it would give no noise whatsoever until the actual music part of the record were reached. We know very well, however, that when we start playing a record, we hear quite a good deal of noise before the music or selection begins. This scratching noise is simply a magnification of the imperfection of the groove.

Our front cover shows this very well. This is a magnification of several thousand diameters of a phonograph record groove. The supposed view—which is not to be considered imaginary—is supported by numerous photomicrographs; it is a view, as it would appear to a microbe at the bottom of the groove. Ordinarily, such a groove would be in the form of a huge letter U, and the walls of the canyon would be separated in an amount equal to their height. This, however, does not hold true in all cases, as an inspection of Fig. 4 of an Edison record will reveal. The Edison record is of the hill-and-dale type, and for this reason, the grooves in many instances are greatly constricted in places as will be seen in Fig. 4. Our front cover, is therefore a view of Fig. 4 taken at the bottom of such a groove. The yellow object which we see rising into the sky is a fibre or bamboo needle. In Fig. 5 we see another magnification of such a fibre needle, but the magnification here is so great that we no longer see the circular hole-like formation of the fibre. By holding Fig. 5 at arm's length, these holes appear slightly.

In most of our illustrations, as for instance in Fig. 6, the white broad strip is the top wall of the groove, while the narrow white band is the very bottom of the same. It should be noted that all these photomicrographs are taken with vertical illumination. The bottom part really is not lighter than the rest of the canyon walls, but the light is reflected here at right angles.

From the foregoing it would seem that the two important things to remember are, to change the needles as often as possible, throwing them away after use; second, to keep the record grooves clean. The little attachment that fastens to the sound box carrying a small brush seems admirable for this purpose; it automatically cleans the grooves for the next playing.

## Wiring for Uncle Sam in France

By FRANK H. BROOME

(*Continued from Page 128*)

used. (See photo of bridge.) The motor was tested and it was found that the rotor was short-circuited. When Mons. Riquier saw the slide-wire bridge, his first question was, "C'est pour moi?" "Do I get that?" He didn't.

With a new shop it was necessary to have a telephone to the guard room for

reporting trouble. The French intercommunicating system was tried out. A phone was installed in the electrical shop and all others left where they were. The switchboard was in the guard room and was of cam construction, but just opposite to the American system, i.e., all cams were left up with the exception of the party called, which was pushed down. This was discovered when Butts at the switchboard called Mike, whose bell did not ring but those of the Commanding Officer and Director of the French school did.

The following conversation ensued:

Mike: "Hello!"

Director of School: "Allo!"

Mike (believing Butts trying to speak French): "Is dis de brewery?"

D. of S.: "Comment" (What).

Mike repeating above.

D. of S.: "Ne comprend pas" (Don't understand).

Mike (getting wise) Deep stuff for American soldier in France: "Je suis electricien, je reparai le telephone" (I am the electrician, I am fixing the telephone).

D. of S.: "Ne comprend pas."

Mike (repeating): "Je suis, etc."

D. of S.: "Ne comprend pas."

Mike: " 'Ne comprend pas' yourself etc.*"

The wire to the D. of S. was immediately cut. Just then the C. O. (Commissioned Officer) called Butts, who disconnected the C. O.'s bell and the telephone system worked serenely. However it was necessary to give the wet cells a little common salt once in a while for no sal-ammoniac was available. Epsom and Rochelle salts were not tried.

One night, when several hundred wounded French soldiers arrived, it was necessary to put some of them in new wards which had been wired but not lampt. This was an emergency job, like most of the jobs in army work, and after all the lamps were installed it was found that there was a short-circuit in the line somewhere. This was a great habit of the French sockets and meant that all the sockets had to be turned off and then turned on one at a time to find the offending one. It was fast growing dark and the C. O.'s face was also dark, so this was the time for action. Mike was light and built low to the ground so he mounted on Butts' shoulders and away they went down the hall, Mike turning off the sockets as he past them. This was something new for the Frenchmen and they set up a howl of "Bravo" and a wonderful line of French lingo. The juice was then turned on and the trip repeated, the sockets turned on and the short-circuited socket found and repaired. Thus the place lightened, likewise the C. O.'s face, and in a few days Butts and Mike became respectively Sergeant Butts and Sergeant Mike and the "Acrobatic Electricians."

Butts and Mike continued their acrobatics and their shop, probably the best fitted in France for its size, had many visitors for the repair of electric irons, sterilizers, heaters, etc., also watches, cameras, crutches and even for building a body for a three ton auto truck.

### HEART EXPOSED 26 HOURS

Physicians at a New Orleans hospital have decided to furnish a complete record for medical journals of the case of Ben Hoelzel, 50 years old, who died there recently after living twenty-six hours with his heart exposed to the eyes of the surgeons.

While working in a local coffee-grinding plant Hoelzel's left sleeve was caught in a machine. His arm was mangled and a piece of flesh the size of a man's head was torn from his breast, leaving his heart exposed, the ribs directly over that organ also being torn away.

The fact that the injured man lived twenty-six hours after the accident is said by physicians observing the case to be one of the most remarkable ever recorded in local practise.


**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.**

## COMBINATION LETTER-ENVELOPE.

(445) M. Anderson, Winnipeg, Man., Can., submits a combination letter and envelope.

A. We would state that altho the combined letter and envelope which you have designed has several novel features, there have been so many of these patented recently, that we do not see where the market for them will come from. In fact, your design is so similar to other designs already patented, that we would not advise further procedure.

## SELLING PATENTS.

(446) Frank Kidock, Plains, Pa., writes: I would like to get some information about selling patents.

All patent attorneys supply booklets which deal with the selling of patents. These booklets may be obtained free of charge by writing to the attorney and asking him for full literature with reference to patents and marketing them.

There are many ways of selling patents but we cannot possibly deal with them all here. For instance, you can sell a patent outright; you can sell a patent for a certain sum down and the balance to follow; or you can sell on a royalty basis and realize a certain amount on each sale.

Perhaps your letter would give us a little more information as to what you intend to sell, etc., we could be able to give more complete data.

We also refer you to Mr. Hobson's recent valuable articles in these columns.

## SKATE SHARPENER.

(447) Edwin S. Warner, Mohnton, Pa., submits a plan for an ice skate sharpener in which the emery wheel rotates parallel with the blade of the skate. It is operated by hand.

A. We do not see that the device which you have forwarded holds any value commercially, as numerous skate sharpeners embodying the same constructional details as yours, have been on the market and many of them have met with utter failure.

We will cite just a few reasons why this is so: First, the emery wheel is traveling parallel with the blade of the skate and turned rapidly in rank. It therefore follows that this emery wheel, regardless of how hard it is, will wear, not should, but a groove will be formed on its and therefore, the convex surface which on the emery wheel when newly purchased will wear away immediately or at least very few skates have been sharpened. In addition to this, inasmuch as skate blades have a thickness, a groove formed in the face of the wheel will at times dull the corners of the when the skates are thin, and where are thicker, will grind down these corners and leave the center portion bulging both features being very undesirable for

We do not see how it is possible for you to overcome conditions arising from such usage, which naturally would demand that the emery wheel travel at right angles to the plane of the skate. We therefore, would hesitate advising on your invention.

## ELECTRIC GASOLINE INDICATOR

(448) E. F. Ahlin, Leavenworth, Wash., submits a drawing of an electrical gasoline indicator, in which a float makes contact with two uprights. One of these is conductive and the other is made of resistance alloy. The current then passes thru two solenoids where its magnetizing action upon an iron core actuates an indicator. He asks whether there is a market for such a device and our opinion of his system.

A. Your idea of an electrical gasoline annunciator is not new by any means, except perhaps as a slightly different method of employing the solenoid to actuate the indicating needle.

Up to the present time, indicators of this nature employing variable resistances or several magnets and sectional slides have always met with considerable difficulty as regards their operativeness. In the first place, contacts must be positive, no oil allowed to remain on the contacts, as this would tend to insulate the points and a greater voltage would be needed.

Secondly, if very great pressure is used on the brushes, you will find that a spark may result when the level of the gas sinks and the float drops suddenly. This could result in the ignition of the gascline.

Thirdly, you will find that with your method, a weak battery will give practically no indication, even tho the gas tank may be full and a newly charged battery might give the correct indication; or perhaps a very high reading, even if the gas were low. For this reason, we do not advise a patent on the device you have submitted, altho we will say that there will be great demand for the really successful electrical gas annunciator which will overcome the other drawbacks and hindrances heretofore existing.

## SPECIAL BATTERY

(449) J. A. Byrne, New York City, offers a battery, open at both ends, each end being supplied with two binding posts. Thus single or double connections can be made to the battery electrodes.

A. Your recent query at hand, requesting patent advice, we would state that we doubt very much whether your battery will be of any distinct advantage or whether even patentable.

First, there is the extra cost of binding posts on both ends.

The batteries are open on the ends causing great difficulty in manufacture and greater liability to breakage.

No advantage is gained by the extra two posts, inasmuch as your voltage is not raised and it cannot be used as two distinct cells, so why the extra posts?

In addition, it cannot be placed on a shelf in an upright position due to the projecting lugs at the bottom.

Inasmuch as you have not stated what your claims on the battery are, we cannot give you any encouragement.

## BLEACHING PROCESS FOR NEWSPAPER STOCK

(450) John J. Collins, Boston, Mass., submits a new bleaching process for newspapers and sends two samples from which printers ink has been removed. He asks for advice as to how to sell it whether outright or on royalty.

A. The samples of paper which you have submitted, altho not of the same quality as newspaper stock and not as white, shows a marked improvement toward processes for removing printers' ink from publications. Such a process has long been desired, and up to the present time, is very expensive at best. Inasmuch as each concern has its own method, we are unable to quote the market price of removing inks, and the cost of paper subject to such methods.

We would not advise that you sell your patent process outright. The royalty basis with quite a considerable amount down, is the best method of proceeding with this work, and any of the large paper mills or concerns supplying materials to such paper mills, will undoubtedly be very glad to get in touch with you regarding this process.

There is certainly a very great demand for such a method, and we would advise that you immediately attempt to secure patent rights upon this system.

## PHONOGRAPH STOP

(451) Joseph Carter, Saskatoon, Can., sends us several drawings of an automatic phonograph stopper, and says that he submitted it to the Edison Phonograph Company who returned the drawings. He claims that "an accessible adjusting screw for automatic stopping makes it unnecessary to remove turntable, and insists that all records must have a fixt margin circumvented by a notch."

A. Undoubtedly there have been very many drawbacks to your invention which have resulted in its being turned down by the Edison Company. In the first place, you definitely state that all new records must be made with the outside margin of the same width. This of course, is a very undesirable feature, as many of the Edison machines play Pathé records and also are adapted for playing Victor and Columbia records by simply inserting a different style reproducer.

And in reference to your second idea, the Edison machine was once placed upon the market with an automatic stop, which did not need any regulation whatsoever. You undoubtedly have often noticed that as the record moves along, the weight applied to the needle keeps bobbing up and down as long as this weight moved up and down rapidly, in accordance with the vibrations the automatic trip was not set off, but the instant that the weight ceased its vibratory movements, the trip was released and the record automatically stopped. This idea was far superior to yours and was likewise discarded.

What is now desired is an automatic stop which will stop rotation properly without pre-adjusting stops.

## RENEWABLE TIRE TREAD

(452) Leslie Cone, Canastota, N. Y., sends us a drawing of a renewable tread tire in which the rubber of the tire acts as a clincher and only a small area of surface tread is exchanged when the tire is worn.

A. Regarding your recent communication requesting patent advice on a renewable tire, we would say that although this tire is probably patentable, we do not see any commercial value in the idea, inasmuch as an automobile tire wears not only on the surface that touches the ground but also against the rims. It is likewise subject to puncture in any portion of its structure. Therefore, the mere insertion of an extra shoe as narrow as you plan (which by the way would be very difficult to hold in place when the automobile is proceeding at a lively rate of speed with the tire in various conditions of inflation) will not save the tire sufficiently to warrant the adoption of such a system.

## AUTO HEAD-LIGHT DEVICE

(453) John G. Bain, Vancouver, Canada, submits a rather elaborate magnetic headlight orientator and asks what its commercial value is.

A. Devices for orientating the head lights on automobiles are now on the market, to the extent of at least a half-dozen,—some of them worked by the action of the front wheels, and some of them by the steering wheel, and are all quite simple. One in particular we can recollect, has a solenoid on each side with a cross beam, the light itself being pivoted; and energizing either solenoid, to a greater or less extent, causes the light to swing.

In another, the light is pivoted directly to the wheel proper thru a series of levers and has no extra electrical connections to break down. Somehow or other, devices of this nature do not seem to meet with much favor among automobilists, as they break down too quickly or else are too weak in their inherent construction.

We would advise that if desired to obtain a patent on an article of this nature, that you first try to simplify it. Secondly, that you look to rigidity of construction, and thirdly place it in the hands of the automobilists, so that their pockets will not receive too much of a shock when they discard their old lights and install the new ones.

In other words, make it worth while for them to change their head lights, for your self-orientating light.

## Hello! Is This Havana?

(*Continued from page* 118)

In order to help the transmission of the telephone currents, each conductor is wrapt with a spiral of fine iron wire. Outside of the gutta percha the cable is wrapt with copper tape to prevent destruction of the gutta percha from sea life which would burrow into it. Around this are laid heavy copper tapes which furnish a return path for the telephone and telegraph currents. Surrounding these in turn are jute wrappings and steel armor wires to protect the cable from mechanical injury, as the illustrations clearly show.

Even with these highly developed types of cable, less than 1 per cent of the energy of the telephone waves which enter the cables is received at the distant end. However, by means of special vacuum tube (audion) amplifiers installed at the terminals, the energies of the telephone waves are amplified over thirty times.

The accompanying map shows where the three submarine telephone and telegraph cables run between Key West and Havana. Down thru the state of Florida the usual land telephone cable extends and when it reaches the southern-most point of the mainland, it is carried along the viaduct which carries the only railroad that "goes to sea"—the track being built on piles and concrete piers and bridges along the line of the small islands constituting the well-known Florida keys and having its terminus at Key West. Suitable cable-huts or anchoring stations are provided at Key West and Havana.

One of the accompanying diagrams shows how the current in a cable passes thru the single insulated conductor, and returns thru the copper sheath or jacket covering the cable.

This cable was specially made, of course, as might be surmised, for no ordinary submarine cable could be used for ocean telephony over any such distance as 115 miles. One of the diagrams shows a section of the Key West to Havana cable, the diameter of which varies from 1″ for the deep sea sections, up to over 2″ for the shoreward sections. The solid copper wire constituting the core of the cable is surrounded with copper tape as the drawing indicates, the function of this tape being to preserve the continuity of the conductor if the solid core wire should break. To offset the untoward capacity effect due to its lying in the water, it was found that excellent results accrued from *loading* the cable by winding a sheath of fine uninsulated iron wire over the copper tape covering the inner solid conductor. Over the iron wire loading sheath is placed a heavy layer of gutta percha; them comes a wrapping of three copper tape sheaths which serves two important purposes—first, that of preventing the deep-sea pest, the *teredo*, from boring holes in the cable, thus putting it out of commission; and secondly, the outer copper sheaths fulfill the important function of carrying the return current, or at least the greater part of it. Over this outer copper sheath is placed the usual steel wire wrapping or armor, while this is in turn reinforced with jute.

Contrary to popular opinion perhaps, there were but three splices made at sea in the entire 115-mile length of a given cable, and one of the most interesting things in ocean cable engineering comes to light with regard to this point. Most of us undoubtedly have thought that the cable was made up on reels, such as we frequently see about the streets, and then shipt by railroad to the cable port or else loaded right on to the cable ship and the various lengths of cable as they came off the respective reels spliced together. But this would call for an inordinate number of splices necessitating the

(*Continued on page* 193)

# Will the Helicopter be the Flying Machine of the Future?

BY E. H. LÉMONON

(*Continued from page* 129)

ever the speed of the machine, because they are placed in the air-flow created by the propelling screw which is placed towards the rear, on a horizontal axis, driven by a second "Gnome" engine 50 h. p.

Papin & Rouilly completed just at the outbreak of war an original apparatus called the "Gyroptere" whose performance is similar in principle to that of the sycamore seed. Its inventors claimed that it solved the following problems:

1. Direct starting and landing by vertical ascent and descent.

2. Staying still or progressing in the air according to the will of the pilot.

3. Very slow fall in case the engine stopped.

The system comprises an 80 h. p. Le Rhone engine B, with vertical shaft and driving a propeller. The flow of air thus produced is led into the interior of the wing C, E and A and escapes from an opening on the trailing edge at the wing tip H. There is a reaction thus produced on the surrounding air causing the wing to rotate and to lift the apparatus into space. A circular hull I provided with a shock absorber serves as a float on the water and as a carriage or landing gear on the ground The fuselage D is prevented from taking up the gyratory movement of the wings by means of a current of air discharged in an opposite direction to that from the wings J. F. G.

In case of the engine stopping, the inventors claim that the Gyroptere should take up automatically the angle of approach suitable for a slow fall, and descend gently turning like a sycamore seed. In consequence of the "funnel-like" rotation, the centre of gravity is always above the centre of support, a condition indispensable to the stability of the system.

During the war an engineer, Mr. Louis Lacoin, who is in charge of a course of engineering at the School of Arts and Crafts, was working on the construction of a machine with revolving wings, which he has christened "Alérion." He is working in connection with Mr. Louis Damblanc, who has already specialized in the study of engines with variable compression for high altitude flights. This machine is designed to lessen the dangers of landing. It is claimed by the inventors that it will be possible to climb or to drop vertically, but in case of engine trouble, it will also be possible to glide as easily as in any other type of aeroplane. The machine is shaped like a monoplane with the surface said to be quite as efficient as that of an ordinary airplane.

The *Alerion* has an ordinary fuselage, landing gear and tail-skid. In the rear is the rudder G and the stabilizing tail plane S, the latter capable of being raised during vertical flight, in order to diminish the resistance. For the same reason the fuselage is not covered with cloth. There are two engines M of 120 h. p. each placed in front of the fuselage and behind the tanks R. They cause the wings to turn by means of a connecting shaft A. These rotary wings P are exactly like four-bladed propellers, each blade has longerons T and wing-ribs resembling those of the wing of an aeroplane. The wing revolves round a brass tube fixed on a cross-piece for axle C. The tops of the vertical axis of the two propellers are joined to the cabane above the fuselage by another beam of great resistance and strongly braced H. The controls comprise a handle for wire-warping, with a steering wheel for controlling the revolving wings, a wheel for the stabilizing tailplane and a rudder-bar for steering. The wings are 15 feet in diameter, making a total span of nearly 33 feet. The total supporting surface is 470 sq. feet including the stabilizing plane. The wings turn at the rate of 160 turns per minute. It is said it would be possible to make them revolve with one engine only if the second were to break down and that if both engines broke down the wings would continue to turn owing to the pressure of air. The blades would then have a negative incidence and thus would produce a vertical thrust, which would act as a brake in the descent and the machine would regain the ground in a glide. The constructors are hoping to make the tests of this remarkable machine in the Spring.

Another designer, Mr. Pateras Pescara, has finished a machine of the helicopter type. In the Pescara helicopter, built at Barcelona (Spain), there are two concentric lifting screws, mounted one above the other and turning in the opposite direction. Each screw has six biplane blades, constructed very much like an ordinary biplane with struts and wire bracing.

At Valentigney (Doubs, France), Mr. Oemichen, E. C. P. Engineer, has lately tried out a helicopter of his invention. In the first test, the machine was assisted by a small balloon which lifted a fair proportion of the weight of the machine thus reducing the risk of a crash in case of engine failure. Later the balloon was removed and the machine is said to have risen to a height of ever al feet.

# A RADIOTRON DID IT!


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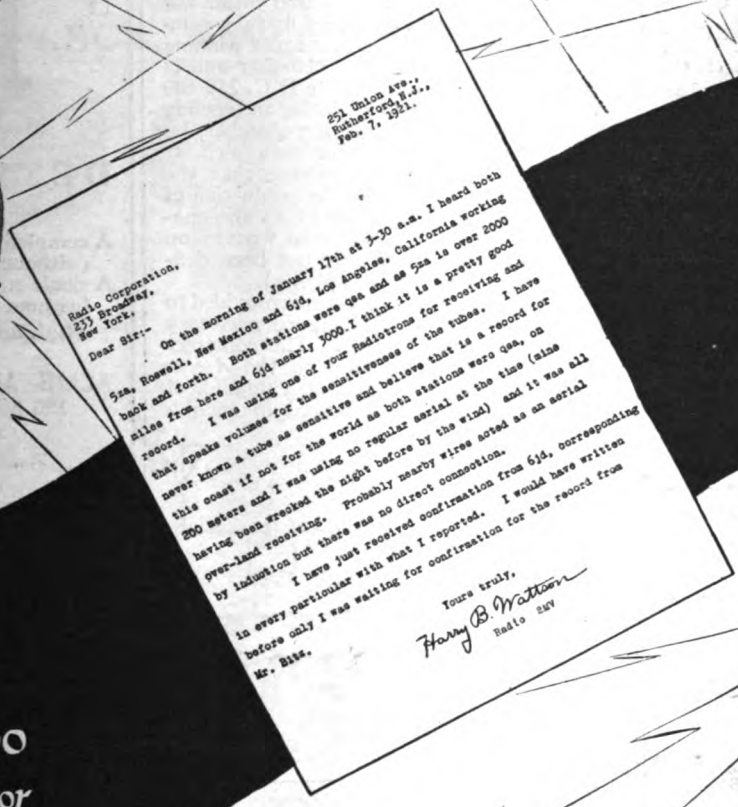

251 Union Ave.,
Rutherford, N.J.,
Feb. 7, 1921.

Radio Corporation,
233 Broadway,
New York.

Dear Sirs:-

On the morning of January 17th at 3-30 a.m. I heard both 5xa, Roswell, New Mexico and 6jd, Los Angeles, California working back and forth. Both stations were qsa and as 5xa is over 2000 miles from here and 6jd nearly 3000. I think it is a pretty good record. I was using one of your Radiotrons for receiving and that speaks volumes for the sensitiveness of the tubes. I have never known a tube as sensitive and believe that is a record for this coast if not for the world as both stations were qsa, on 200 meters and I was using no regular aerial at the time (mine having been wrecked the night before by the wind) and it was all over-land receiving. Probably nearby wires acted as an aerial by induction but there was no direct connection.

I have just received confirmation from 6jd, corresponding in every particular with what I reported. I would have written before only I was waiting for confirmation for the record from Mr. Bitz.

Yours truly,
Harry B. Watters
Radio 2AV

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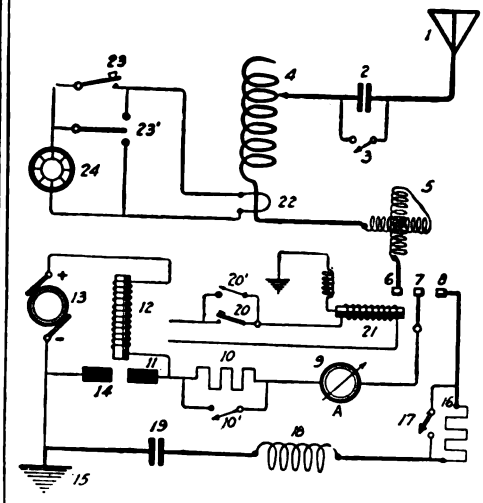
# S.S. "Aeolus" Works 3,013 Miles with 2 K.W. Arc Set

BY ARTHUR H. LYNCH

(*Continued from page* 151)

copper, and the cathode—made of carbon, are placed in a horizontal position with relation to the chamber and at right angles with relation to each other; the point at which the arc takes place being located within the center of a magnetic field, set up by a combination choke- and electro-magnet winding which is contained in the chamber and is in series with the arc and the D.C. 250-400 volt supply. A water circulating and cooling system is carried thru the arc chamber, by suitable piping to a water reservoir. It may be mentioned, in passing that the action of a D.C. arc for the production of high frequency oscillations in an antenna-ground system, tho copiously written up and talked about, still has not been definitely and satisfactorily explained.

An antenna-loading inductor is provided to compensate for the inductance necessary for various wave lengths. The construction of the inductor used on the *Aeolus* is of interest. It consists of a number of pancake-wound coils arranged in such a




**Wherein 1, Antenna; 2, Antenna Series Condenser; 3, Condenser Shorting Switch; 4, Antenna Inductor; 5, Variometer; 6, Relay Contactor to Antenna Circuit; 7, Relay Armature; 8, Contactor to "Back Shunt" Circuit; 9, Antenna Ammeter; 10, Resistance for Low Power; 10', Low Power Shorting Switch; 11, Copper Arc Anode; 12, Combination Choke Coil and Arc Magnet; 13, D.C. 250-400 Volt Supply; 14, Carbon Arc Cathode; 16, "Back Shunt" Resistor; 17, Resistor Shorting Switch; 18, "Back Shunt" Inductance; 19, "Back Shunt" Capacitance; 20, Hand Telegraphing Key, Controlling Relay Circuit; 20', Shorting Switch for Hand Key; 21, Relay Magnet; 22, Loop for "Chopper" Operating; 23', Hand Key for Chopper Operation; 23, Chopper Hand Key Shorting Switch; 24, Electrically Driven "Chopper."**

manner as to admit of their being added to or taken out of the circuit, at will. The wire used, is a cable of many strands and heavily insulated. For this reason the inductance is not continuously variable, as is the case with bare inductances. In order to allow for finding any wave length, between two adjacent pancakes, the inductor is provided with a number of turns of bare wire, upon which the necessary fine adjustments may be made.

In order to operate efficiently on the lower waves, it is necessary to insert a series condenser in the antenna circuit, which is provided with a short-circuiting switch. In series with the loading inductor is also found a variometer. It is used for varying the wave somewhat, while transmitting. It is constructed in such a manner as to cause it to remain in a neutral position when not changed by the operator. The purpose of the variometer is to enable the operator to call on several waves, within a limited range, to offset the possibility of not being

(*Continued on page* 186)

# Radio Specialty Co

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068 Comp. Knob, diam. 2-3/16", height 1", hole 5/32, ea. 60c. The same No. 098, but with 8/32 bushing, ea. 64c.

139B

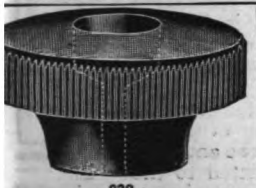
139B Comp. Knob, diam. 1⅜", height 15/16", bushing 8/32, ea. 30c.

139A

139A Comp. Knob, diam. 1⅜", height 15/16", hole 3/16", pin holes 3/32", ea 27c.

748

748 New Telegraph Key Knob, used on all wireless keys, screw 8/32, ea. 45c.



838

838 Comp. Knob, diam. 1¼", height ¾", hole 5/32", ea. 15c.

8701

8701 Comp. Knob, diam. 1-1/16", height 13/16", bush. 10/32, ea. 20c

039B

039B Comp. Knob, diam. 1", height ¾", bush. 10/32", pin holes 3/32", ea. 20c.

815

815 Comp Knob, diam. 1-1/16", height 11/16", bush. 8/32, ea. 30c.

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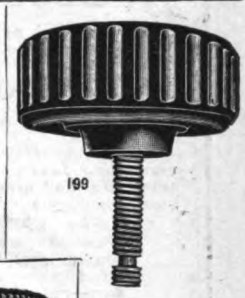
4451 Camp. Knob, diam. 1¼", height ⅝", bush. 8/32 and 10/32, ea. 10c.



199

199 Comp Knob, diam. 1⅛", height ⅝", screw 8/32, ea. 15c.

238

238 Comp. Knob, diam. ¾", height ⅞", bush. 10/32 ea. 12c.

039A

039A Comp. Knob, diam. 1" height ¾", hole ⅛", pin holes 3/32", ea. 20c.

224

224 Comp Knob, diam. ⅞", height ¾", bush. 8/32, ea. 15c.

6241D

6241D Comp Knob, diam. 1", height ½", hole 5/32", ea. 15c.

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558 Comp. Knob, diam. ⅞", height 11/16", bush, 8/32, ea. 10c.

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783 Comp. Knob, diam. ½", height ⅝", bush. 8/32, ea. 8c.

767

767 Comp. Knob, diam. ⅝", height ½", bush, 8/32, ea. 7c.

323

No. 323 Litz Wire, 20 No. 38 Strands, enameled double silk wire, per ft. 2c.

031

201

202

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325

326

028

029

Particular attention is called to our new type **Rasco** Binding Posts No. 201 latest style tapered metal nut, nickel plated and polished. Ea. 12c., doz. $1.00. No. 202, ea. 10c., doz. 90c. No. 031, ea. 18c. No. 08 ea. 15c. No. 325 New style lock post, ea. 25c. No. 326, smaller type shown closed, ea. 15c. No. 028, ea. 12c. No. 029, ea. 10c. All posts nickle plated.

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300 Switch Handle, nickle plated with hard rubber knob, complete as shown, 20c.

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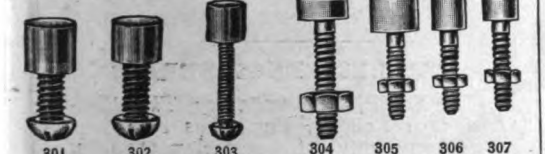
No. 315 Standard Telephone Cord-tip, nickle plated and polished, ea. 4c., doz., 40c.



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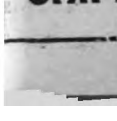
Switchpoints—cuts accurately full size. No. 301 and 302—6/32" screw. No. 303—4/32" screw. No. 304—8/32" stem and nut. No. 305. No. 306 and 307—4/32 stem and nut. **All styles** ea. 3c. doz. 35c.

308



309

310



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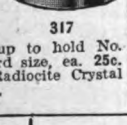
No. 308 Brass Lug—doz. 10c. No. 309 Copper Lug to fit No. 4, 6, 8 screw, doz. 12c. No. 310 Brass Lug for No. 8 screw, doz. 15c. No. 311 Copper Lug for No. 6 and 8 screw, doz. 12c.

318



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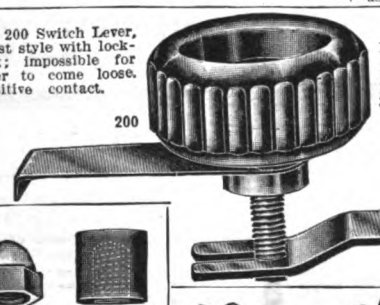
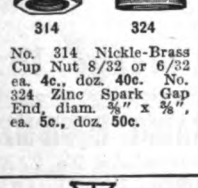
No. 318 Crystal Cup to hold No. 317 Crystal, standard size, ea. 25c. No. 317 Mounted Radiocite Crystal ½" x ¼", ea. 35c.

No. 200 Switch Lever, latest style with lock-fork; impossible for lever to come loose. Positive contact.



200

No. 199 Knob (see above) used. Blade radius 1¼" complete, 30c.

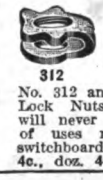


314

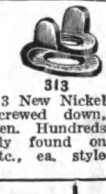


324

No. 314 Nickle-Brass Cup Nut 8/32 or 6/32 ea. 4c., doz. 40c. No. 324 Zinc Spark Gap End, diam. ⅝" x ⅜", ea. 5c., doz. 50c.



312



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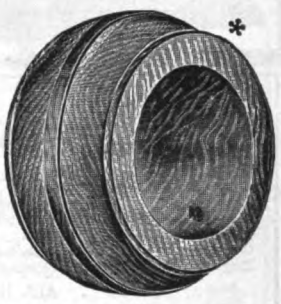
No. 312 and 313 New Nickel Lock Nuts. Screwed down, will never loosen. Hundreds of uses readily found on switchboards, etc., ea. style 4c., doz. 40.



343

No. 343 Variocoupler Rotor, accurately turned, hard wood form—for secondary coils. Hole 2", diam. width of spool 2". Diam. 3⅜", ea. 75c.

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**WATCH FOR THE Rasco BABY ???**

**WE ACCEPT NO ORDERS FOR LESS THAN 50 CENTS**

# S. S. "Aeolus" Works 3,013 Miles with 2 K. W. Arc Set

(*Continued from page* 184)

heard at the receiving station, because of the exact tuning which is necessary for the reception of arc. As soon as the receiving station has been picked up, the variometer is set in its normal position.

The antenna and ground system need no particular description.

The signaling device is as unique as it is effective. A great deal of difficulty has been experienced in arc reception because of the presence of the *compensating* or *back wave*. Tuning in on the back wave would lead one to believe that he was listening to some "new" radio language—a cross between Chinese and Eskimo. When tuning to the transmitting wave, it has been found difficult to hold it, at times, especially when the transmitting wave and the back wave are comparatively close together. By the employment of a new circuit, this back wave is eliminated. This system of transmitting is known as the *back-shunt* method. In series with the arc output circuit a double contact relay is provided. The armature of the relay is directly connected to the ground side of the output circuit and one of the stationary contacts is connected to the antenna circuit, while the other is connected to the "back shunt" circuit, which comprises a resistance, inductance and capacitance (condenser), in series with the ground. The action of the armature is controlled by an electro-magnet, in series with a hand-transmitting key. When the arc has been struck, the current passes thru the back shunt circuit into the ground and there is no radiation until the hand key is deprest. The contacts of the relay are so arranged as to allow contact to be made with one circuit, before it is broken in the other, which thus permits the arc to remain in constant operation, while the transfer from one circuit to the other is made. In order to communicate with stations which are not equipped with arc receiving apparatus, it is necessary to break up the continuous waves. That is accomplished by using a "chopper." The chopper is a motor-driven commutator, which may be connected to the transmitter circuit, by several methods. The most common method is to use a coupled circuit which is placed in inductive relation to the transmitter inductor and which is closed and opened by the action of the commutator, changing the emmitted wave at a frequency which produces a musical note in the receiver.

The illustration shows the circuit employed for the production of arc signals by the *back shunt* and *chopper* methods.

## WIRELESS ENGINEERING

Our English contemporary *The Electrician* of London, Eng., thus speaks of the present status of the wireless problem.

In spite of the extraordinary theoretical and practical developments that have taken place in wireless telegraphy during recent years it would hardly be going too far to say that it has not become a branch of engineering. Like all other movements of a similar kind its growth began in the laboratory, and altho it has now become an important factor in international communication it has not altogether freed itself from the trammels of its early surroundings. Much of the apparatus is too "scientific" in design and construction, it fulfills few of the laws imposed on engineering mechanisms, it is often makeshift when it might be permanent. These are all matters to which attention must be given in the design of masts, we find an excellent example of the application of true engineering methods.

## Practical Chemical Experiments

By PROF. FLOYD L. DARROW

(*Continued from Page* 145)

Fold a filter paper and fit it into a funnel. Pour into it a few drops of the liquid from the test tube and wait until the benzol has entirely evaporated. Then examine the filter paper. Grease will be left on the paper and if held to the light a translucent grease spot will at once be seen. The benzol dissolves the grease which upon evaporation of the solvent is left behind.

Any food may be divided as finely as possible and subjected to the same test. For benzol gasoline may be substituted, but in both cases it must be remembered that these liquids are inflammable and dangerous in the presence of a lighted burner.

**Test for Proteid:** For this test a reagent known as *Geis's biuret reagent* is required. It is prepared by adding a 3 per cent copper sulfate solution to a 10 per cent potassium hydroxid solution, a drop at a time, until a faint but clearly recognizable blue appears in the resulting solution. By a 3 per cent solution is meant 3 grams of the substance to be dissolved to 100 cc. of water.

Now place a small quantity of finely divided lean meat or the white of an egg in a porcelain evaporating dish and pour over it 5 cc. of Geis's biuret reagent. For purposes of comparison place in another evaporating dish an equal quantity of the reagent. In the dish containing the proteid a pink or violet color will appear. By a comparison of the two the color will be clearly seen.

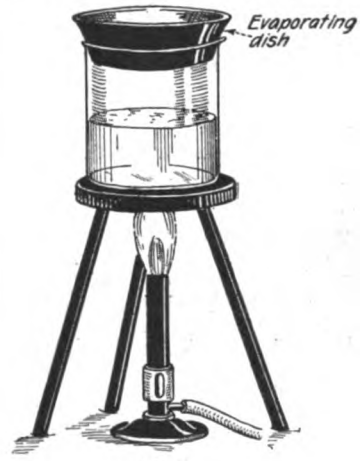



Fig. 1

A Convenient Water Bath Employing a Bunsen Burner to Supply the Necessary Heat

Now make tests of foods in general to discover whether they contain proteids.

**Examination of Milk:** Milk is the most perfect food that the race possesses. In it we find all of the three principal food constituents in addition to the mineral matter necessary for the bones and teeth. Milk is also frequently adulterated. Therefore, a thoro examination of this essential article of our diet will prove interesting and instructive.

**Test for Casein:** It will be necessary first to prepare a solution of acetic acid. To do this mix 5 cc. of glacial acetic acid with 370 cc. of water.

Then pour 25 cc. of sweet milk into a large beaker and add 175 cc. of distilled water. Then with constant stirring add 40 cc. of the acetic acid a drop at a time, using a separatory funnel or a burette or even pipette. After the milk has stood for 20 minutes filter into a clean beaker and save the filtrate. The curdled precipitate that appears on the filter paper is casein. Since it contains proteid it may be removed from the filter paper and tested for with Geis's biuret reagent as already described.

**Test for Sugar:** To half a test tube of the filtrat obtained in the preceding part add 1 cc. each of Fehling's solutions Nos. 1 and 2 and heat to boiling. The characteristic red color will at once appear. The sugar in this case is not glucose but lactose, one very similar to glucose.

**Test for the Ash:** The mineral constituents of the milk will be found in the ash. On a water bath evaporate to dryness 5 cc. of the milk placed in a porcelain crucible. Remove the crucible and place it on a porcelain triangle over a Bunsen burner. Gradually raise the temperature to the full capacity of the burner and continue the heating until the residue has ceased to be black and only a white ash remains.

**Detection of Bicarbonate of Soda:** Sometimes sodium bicarbonate is used as a milk preservative. If present sodium carbonate will be found in the ash. To detect its presence add a few drops of hydrochloric acid to the ash and if effervescence results sodium bicarbonate is indicated.

**Babcock Test for Butter Fat:** One day during the summer of 1914 the writer was visiting the University of Wisconsin at Madison. As he was walking thru the chemical laboratories of the agricultural college, an elderly gentleman with white hair and beard greeted him with a friendly smile and asked if he were a visitor and wished to see the laboratories. As a result I spent a very pleasant hour there and upon leaving learned that my host was Professor Babcock, the originator of the famous test, which everywhere goes under his name.

To make this test requires a centrifuge, two Babcock milk bottles, a pipette, a small measuring cylinder and sulfuric acid of 1.83 specific gravity. Sets for this purpose may be obtained from various companies. The centrifuge, too, will prove to be very useful in a number of other determinations.

**Making the Test:** An accompanying photograph shows the whole outfit. First place on tripods over Bunsen burners a large beaker and a wash bottle, each filled with water which should gradually be brought to a boil while the rest of the determination is in progress.

Stir the sample of milk thoroly to mix the fat and with the pipette, which up to the mark on the neck holds just exactly 17.6 cc. remove a sample to be tested and transfer it to one of the bottles. In like manner transfer another sample to the second bottle, as two tests are carried out simultaneously. To each bottle add exactly 17.5 cc. of the sulfuric acid. The specific gravity of this acid must be exactly 1.83, and to determine this it must be tested with a hydrometer. Ordinary concentrated sulfuric acid has a little higher specific gravity and will not give satisfactory results. Measure out 200 cc. of it, *add it* to a little water and test. Repeat the process until the acid is of the proper specific gravity.

After each addition of acid shake the bottle with a rotary motion so as thoroly to mix the acid and the milk. This will cause the contents to become very dark in color and the bottle will grow very hot owing to the union of the acid with the water of the milk.

Now place the two bottles in the centrifuge and rotate them for 5 minutes. Then set the bottles in the beaker of hot water and add from the wash bottle enough hot water to bring the separated fat up to the neck of the bottle. Centrifuge again for 2 minutes and placing the bottles in the beaker add enough hot water to bring the fat opposite the scale. Centrifuge for one minute and immediately read the precentage of butter fat. This is done by taking the reading to tenths at the bottom and the top of the column of fat. The difference in these two readings is the percentage.

This test may be readily applied to determining the butter fat in cheese, ice cream, condensed milk, skim milk and in any substance which may contain it.

**Detection of Coloring Matter in Milk:** In order to give a rich, creamy appearance to milk, it is frequently colored. There are two principal colors that are employed—annatto and some coal-tar dye.

**Annatto:** To 5 cc. of the milk to be tested add twice that volume of ether in a large test tube and shake. Allow the tube to stand until the contents have separated into two layers. Then pour off the ether extract and evaporate on a water bath. A convenient form of water bath consists of a beaker of water placed on a tripod over a Bunsen burner. The water may be brought to boil and the evaporating dish rested on the rim of the beaker. See Figure 1. (*In using ether remember that it is exceedingly inflammable* and that its vapor may ignite from a distant flame.)

Now make the residue alkaline with sodium hydroxid solution and pour onto a small wet filter paper placed in a funnel. The paper will absorb the annatto if present. Wash off the fat with slightly warmed water. If annatto is present it will give the paper a distinct tinge of orange and if a few drops of stannous chlorid are added the color will change to pink.

**Coal Tar Dye:** The dye used is *azo orange* and to detect it add 10 cc. of hydrochloric acid to an equal volume of the milk. Mix them thoroly. If azo orange is present a pink coloration will result.

**Milk Preservatives:** The most common of these are formaldehyde, borax or boric acid, and sodium bicarbonate. The test for sodium bicarbonate has been given in connection with the ash of the milk.

**Formaldehyde Test:** To learn this test add 1 drop of a 10 per cent solution of formaldehyde to a glass of milk and stir thoroly. Then mix 1 cc. of a dilute solution of ferric chlorid with 25 cc. of concentrated sulfuric acid. Place 4 cc. of this latter mixture in a large test tube and inclining the tube carefully pour down the side 5 cc. of the milk containing the formaldehyde. At the juncture of the two layers a violet ring will appear. If the ring is not very pronounced add another drop of formaldehyde solution to the milk. This test, however, is an exceedingly delicate one. For purposes of comparison make a similar test using milk known to be free from formaldehyde.

**Test for Borax and Boric Acid:** In this determination *tumeric tincture* will be required. To prepare it digest a small amount of ground tumeric root in successive small quantities of water, throwing the liquids away. Digest the residue with about six times its weight of alcohol and filter. Preserve the filtrat.

Now pour 5 cc. of pure milk into a watch glass and make slightly acid with a dilute solution of hydrochloric acid. To the acidulated milk add 5 drops of the tumeric tincture and evaporate to dryness on a water bath. Note the color thus obtained.

Next add a drop or two of a solution of boric acid or a little of a solution of borax to 5 cc. of milk and transfer to a watch glass, proceeding with the test as before. The red color of the residue is caused by the presence of boric acid from the borax.

**Detection of Gelatin in Milk Products:** The method employed is known as *Stoke's Test* and to make it requires an acid nitrat of mercury solution. This solution is made by dissolving 5 grams of mercury in 10 grams of concentrated nitric acid and diluting the solution with 25 times its volume of water.

To 10 cc. of the milk or other sample to be tested add 10 cc. of the acid mercury nitrat solution and twice that volume of cold water. After shaking the mixture thoroly allow it to stand for 5 minutes. Then filter and if gelatin is present the filtrat will have an opalescent appearance, i. e., it will have a milky, pearly aspect as from the reflection of light from the interior. If the filtrat is treated with 1 cc. of a saturated solution of picric acid the gelatin will give a yellow precipitate.

(*Series to be continued*)

## 240,000 "Movie" Photos Per Minute

By C. H. CLAUDY

(*Continued from page* 123)

But it is in the realm of motion picture analysis that the Jenkins device makes its greatest revolution felt.

The ordinary *slow motion* camera makes pictures of moving objects at the maximum rate of one hundred pictures per second to make more, as has been said, is not possible, because the strain will tear the film. If such pictures be projected at the rate of 16 per second, motion which in life took one second, will be *spread out* on the screen to occupy six and one-quarter seconds. It is upon such pictures we depend to show us just how a horse jumps, an athlete runs, a dog leaps. Such *slow motion* pictures *slow up* natural motion by six and a quarter times. But six and a quarter times is not enough to analyze rapid motion. The impact of projectiles, the start of an airplane, the action of an airplane propeller, the movement of rapid machinery, are all too fast, even when slowed up six times, to be easily seen.

With the Jenkins camera and projector the limit of speed of picture making is the limit of the chemical ability of the film to record. In his camera, Mr. Jenkins cuts eight or more reversing prisms on the edge of a single plate of glass. He is thus able to make pictures in unheard of numbers in a small interval of time, fifteen hundred, two thousand pictures a second with the probability of four thousand per second as a limit. Two thousand pictures a second, projected at the rate of sixteen a second, slow up natural motion one hundred and twenty-five times . . . things which happen in life in one second take over two minutes to "happen" on the screen.

All the possibilities of the new device have yet to be visualized . . . the camera and projector, while both have been made and used, and are now in use in Army and Navy laboratories, are still to some extent in the experimental stage, and not yet ready for commercial development. But Mr. Jenkins is hard at work upon both, perfecting details, and it should not be long before the continuous motion projector, and the *slow motion* camera are available to all.

## Chinese Pigeon Whistles

(*Continued from page* 139)

destructive influences of the atmosphere. The tube whistles have either two, three, or five tubes. In some specimens the five tubes are made of ox-horn instead of bamboo. The gourd whistles are furnished with a mouth-piece and small apertures to the number of two, three, six, ten, and even thirteen. Certain among them have, besides, a number of bamboo tubes, some on the principal mouth-piece, some arranged around it. These varieties are distinguished by different names.

The materials and implements used in the manufacture of the pigeon whistles are small gourds that serve for the bodies and halves of large gourds ("a particular species imported from Shantung to Peking for this special industry), from which stoppers are made that fit into them; and four kinds of bamboo, cylindrical pieces of a large species that grows in the south, for making the mouth-pieces of the large tubes; thin sticks for making those of the small ones, hard bamboo for the large tubes themselves, and a soft kind for the smaller ones. The separate pieces are fastened together by means of fish-glue, which is applied with an iron nail..

## Hello! Is This Havana?

(*Continued from page* 181)

stopping of the ship while each splice was made, which would take considerable time; particularly if the sea was running high, when there would be great danger of the cable breaking. The cable for the Key West to Havana service was made in England and loaded directly into great steel tanks about 40 ft. in diameter, extending down into the hold of the ship which later laid the cables along the route. On a cable ship these tanks occupy the greater part of the hold, each tank having a capacity of 700 miles, or more of standard ocean telegraph cable.

Each of the three cables, which are spread out to be separate from one another as regards wear and tear, accidents, etc., may carry at the present time but one telephonic current, but it also is arranged to carry at the same time two telegraphic currents, one of low frequency and one of high frequency. The low frequency telegraphy current will have a value of about fifteen cycles per second, while the high frequency carrier wave will have a value of about 5,000 cycles per second. Each cable can be duplexed, so that two telegraph messages can be sent over a single cable in each direction at the same time as the telephone current is passing over it, without any interference whatever between the five messages. By employing vacuum tube, high frequency generators and specially tuned circuits in connection with the cables, it will undoubtedly soon be possible to carry on several (5 to 10 or more) telephonic conversations over any one of the cables simultaneously, thus extending the advantage of modern multiplex telephony to the submarine cable.

## Recording Earthquakes

By Prof. T. O'Conor Sloane, Ph. D., LL. D.

(*Continued from page* 132)

that the instrument has extreme sensitiveness. The pendulum varies from less than a pound to nearly a ton. Few instruments for doing identical work have so wide a range of dimensions. In some cases, the record is made on a strip of paper, smoked over a lamp, and past thru a solution of shellac and alcohol and dried. This is caused to travel by clockwork and upon it, a stylus at the end of the system of levers rests, and when all is quiet makes a straight line along the paper band. Another stylus, operated by an independent clock, makes transverse marks upon the paper at regular intervals. If an earthquake occurs, it may be on the other side of the earth, the tremor passes around or thru our sphere, and reaching the observatory, agitates the base of the instrument, moving the point of suspension of the pendulum rapidly back and forth, exactly comparable with what we described as being done with the crude demonstration apparatus.

The system of levers operating the stylus has one end attached to the motionless locus of the pendulum. It follows therefore that as the standard and registering paper are moved back and forth by the earth tremors, the stylus, held motionless by the pendulum, will record what is taking place. It is as if when one were writing the pen were held stationary, and the paper were made to move so as to describe and produce letters.

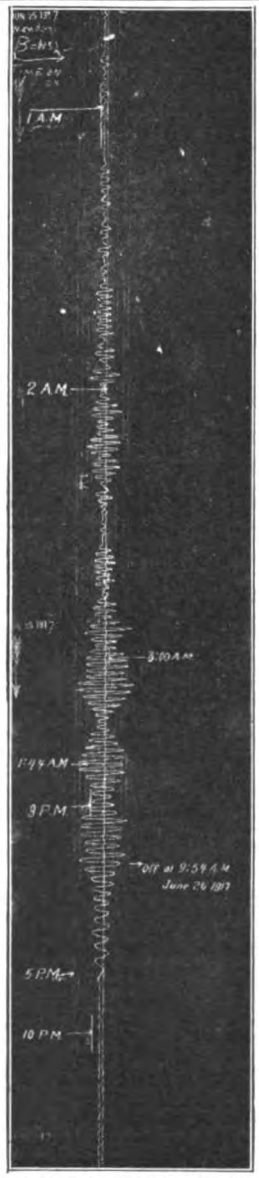
Various forms of Seismographs are illustrated herewith. The principle of all is the same. The pendulum is motionless and consequently the stylus is motionless, and the earth tremors move the paper back and forth beneath the recording device.

Sensitized paper is used and a photographic trace is obtained.

There are many Seismographs set up in the United States; the most important station is at Georgetown University, just outside Washington, D. C. Many other universities have them and a very fine one of massive construction is established in the American Museum of Natural History, New York City. Another instrument is located at Fordham University, New York City.

In addition to illustrations of different Seismographs, we show some interesting examples of the records they give. The modern conception of the earth, as principally a spheroid of meteoric iron with a comparatively thin crust of rock and earth enveloping it like the rind of an orange, may be taken as complicating to a certain extent our ideas of the transmission of earthquake shocks. Sometimes they are supposed to go directly thru the earth in a straight line; sometimes they are supposed to follow its surface curve. Wonderfully complete records are kept of the earth's movements. Quite elaborate calculations locate the seats of disturbance and a number of observers have won for themselves considerable fame by their work in this line.

In the construction of Seismographs, the Japanese and the Germans seem to have joined hands. Some types are Japanese, some types German, and others may be termed "hyphenated" in origin. Other nations of course have built them.




Actual Earthquake Record Taken On the Seismograph at the American Museum of Natural History on June 25th, 1917. The Heaviest Vibrations of the Earth Occurred About 1.44 A.M.

## Measuring the Motion of a Telephone Diafram

BY PROF. LINDLEY PYLE

(*Continued from page* 153)

fram. Fig. 2 is a copy of one of the records obtained in this manner.

To compute the actual extent of motion of the diafram one needs only the radius of the needle, R, the distance, S, of the photoplate from the mirror, and the width, *W*, of the wavy record as it appears in Fig. 2. Now when one rotates a mirror receiving a beam of light the reflected beam rotates twice as fast as the mirror. (When the sun is overhead a horizontal mirror sends the reflected beam straight up; tilt the mirror 45° and the reflected beam is thrown off in a horizontal direction, or 90° from its former direction.) Thus the motion of the spot of light on the photographic plate is not simply greater than the motion of the surface of the needle in the ratio S/R as one might expect,—but twice as *great*, 2S/R. The motion of the diafram, which is of the same amount as the motion of the surface of the needle in contact with the silk thread, is therefore magnified on the photographic plate 2S/R times. In other words if the to-and-fro swing of the spot of light on the photographic plate is of magnitude *W*, the to-and-fro swing of the receiver diafram is W ÷ 2S/R.

The actual measurements for one set of data were: S = 30 inches; R = 0.015 inches; W = 0.40 inches; whence the diafram moved to-and-fro thru only one ten-thousandth of an inch of space.

## Why Insects Fly Towards Light

By DR. E. BADE

(*Continued from page* 135)

ward. For this purpose the compound eyes may suffice for the day-flying insects, but these are much too weak for the nocturnal prowlers and here the ocelli, which are much more sensitive to light and darkness, must come into play. These, as well as the compound eyes are focust upon the light, so that the axis of the body lies in line with its source and both sides of the head receive equally strong illumination. In this position the insects fly toward the lamp. When therefore an insect is flying in the dusk and it receives a beam of light upon any one of its three simple eyes, it immediately turns its body so that all eyes receive the light with equal intensity, *and then flies directly into the light.*

Under normal conditions, the ocelli are equally illuminated from the sky, and the insects are able to dodge darker objects which lie in their path. Thus the simple eyes admirably serve that purpose for which they are adapted.

The majority of insects have, on the retinal lining, only rods, and such eyes are color blind and are only able to distinguish between light and darkness to a much greater degree than normal eyes, which have in addition cones with which colors can be distinguished. All animals possessing only the rod-bearing retina are nocturnal in habit and shun the light. But in the darkness these animals can distinguish the slightest differences in light and shadow, and these eyes, are, at this time, much superior to those of the color-seeing animals.

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