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A Fortune for You

EVERY day I receive dozens of requests from inventors and would-be inventors asking me what to invent. Many of my correspondents often bemoan their fate that they have been born in an age "when everything worth while was already invented"! What will these good people think twenty years hence? Hundreds of thousands of important inventions—undreamt of today—will have been made in that time. Thousands of fortunes will have been made by the present and next generation from inventions unsuspected to-day. What is the answer to these good people who think everything worth while has been invented?

Just this: *Look about you.* See for yourself how your friends, your brother, your father, your mother, your wife, slave away day in and day out at their chores or their daily work.

We work more strenuously today, more intensely and much harder than our grandfathers and grandmothers. The railroad, the auto, the telephone, all tend to cut down time and distance. Competition everywhere is keener, fiercer than ever before. That means more intense and harder work; it too means that we expend more nervous energy than we ever did before.

Consequently, we must make all of our tasks lighter, and we must save more time every day, if we don't want to go to pieces.

Look about you. Strive to reduce the load from our workers. Take, for instance, your mother, or your wife. Their daily dishwashing task—particularly where there are no servants—is tremendous, if you figure up the time and the hard, unpleasant work.

Dishwasher. What is wanted is a *practical* dishwasher. To be sure, there are some of them on the market today. But I've never seen a good one. To begin with, it must not be too big. It should fit the sink, or be of an equivalent size. *It should have a gas attachment to generate steam.* Hot water alone does not cut the grease from a roasting pan. You must have steam, or steaming hot, *boiling water.* That does the trick, and quickly, too. And the dishes, glasses, forks and knives come out perfectly dry, because the heat from the steam evaporates the water, drying everything. The big hotels use such dishwashers—why don't we make one for our mothers and wives that we can sell for $35? Here is a fortune for you if you go about it right.

Envelope-Letter. Down in the office we still use our prehistoric letters and envelopes. We first write a letter, then an envelope. In a busy office—unless they use the expensive "open face" envelope, it happens dozens of times that Jones receives Smith's letter, and vice-versa. Why not combine letter and envelope? To be sure, many patents exist on such, but the ideas were not good because we recall few firms using such an envelope-letter. Your fortune is made if you invent one that, *when opened does not mutilate the letter, and looks respectable after opening.*

Letter Opener. Big firms receive thousands of letters in every mail. Such letters are not opened by hand any more today. Machines are used. But there are few that fit the bill. And they all get easily out of order, and mutilate the contents of a letter. Here's your chance, and a small machine for the small firm would find a good market. Why not combine a letter opener and an envelope sealing machine? Here's a real idea for you.

Pencil Sharpener. Ah, for the genius who will bless our stenographers with a REAL pencil sharpener. There is, as yet, none in captivity. They all break more pencils and chew them up faster than you can feed them. A simple sandpaper-wheel, correctly constructed, should be better than anything containing funny knives and foolish cutters. Here is your chance.

Paper Collars. Now for a cheap white paper collar that you can't tell apart from a linen one. Sells for five or ten cents apiece. Used once only, then thrown away. But it must be stiff and non-wilting—*a man's collar.*

H. GERNSBACK.

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Volume VIII.
Whole No. 90

Science and Invention

H. GERNSBACK – EDITOR
H.W. SECOR – ASSOCIATE EDITOR

OCTOBER
1920
No. 6

How Were the Pyramids Built?

THOSE of us who have been interested in, or studied the great pyramids of Egypt, particularly that phase of the subject having to do with the erection of these gigantic stone monuments to a worthy but little known people, have undoubtedly been nonplust when it came to reasoning out just how the Egyptians raised the huge stones weighing many tons, even tho they had tens of thousands of men available for the purpose.

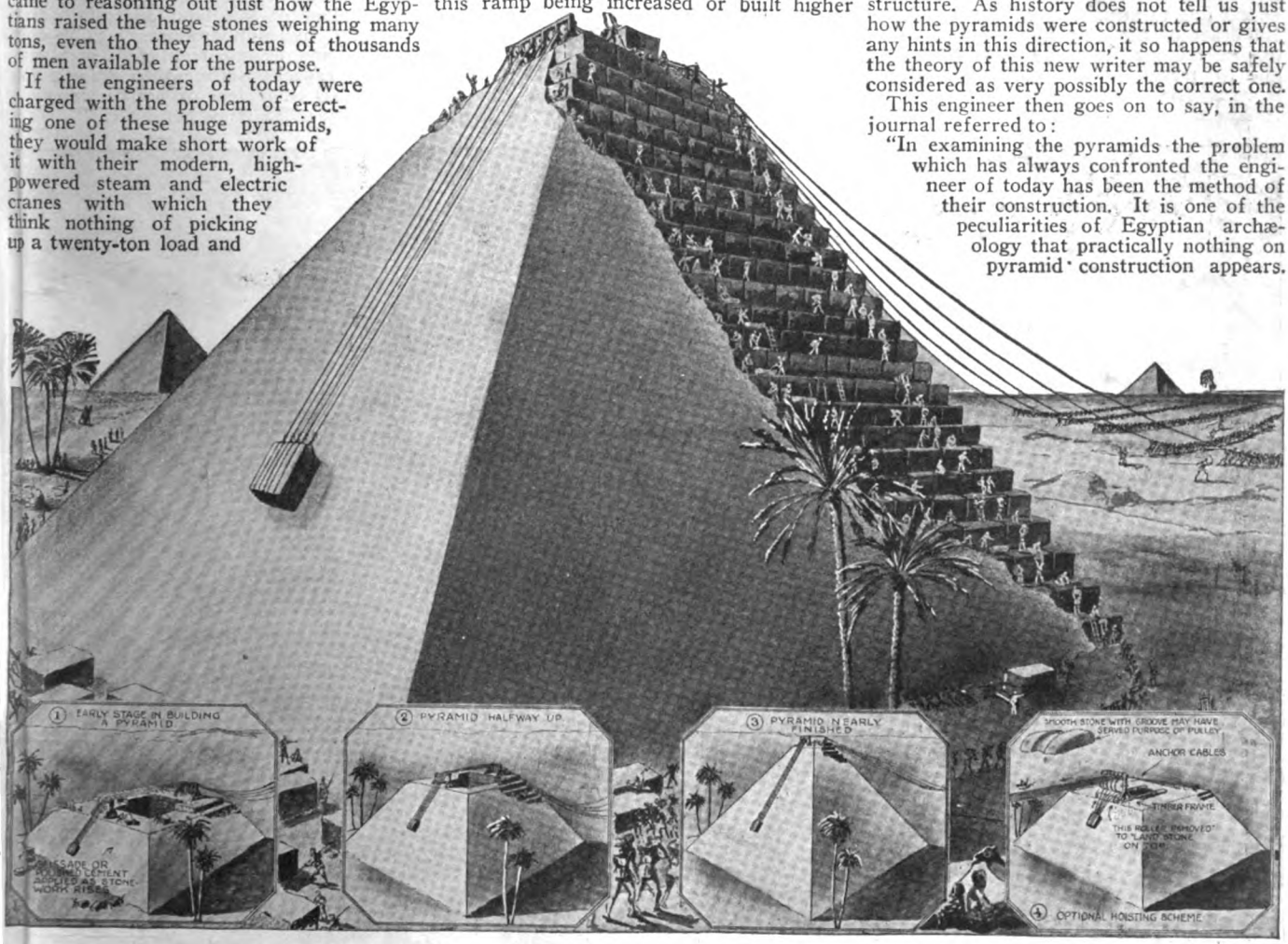
If the engineers of today were charged with the problem of erecting one of these huge pyramids, they would make short work of it with their modern, high-powered steam and electric cranes with which they think nothing of picking up a twenty-ton load and swinging it thru the air like a scuttle of coal at the end of a one hundred-foot steel boom. But history teaches us that the Egyptians had no such facilities as those provided by our modern cranes, and even granting that they possest the ingenuity to build cranes, there were no gasoline or steam engines to operate them. And so the problem of how the pyramids were built, as usual, hammered down to the point where we can see in our mind's eye the picture which our historians have drawn for us—of great, long ropes, perhaps a mile or so in length—and ten thousand men pulling on each rope, with one of the rocks or stones sliding slowly and stubbornly up an inclined runway or ramp built of earth, the pitch of this ramp being increased or built higher as the work proceeded.

Altho this is one of the principal methods suggested by students of the subject of how the pyramids were built, a startling new theory, which seems to have considerable essence of logic in it, has been brought forward by a present-day engineer who writes on the subject in the *Indian and Eastern Engineering*, of Calcutta, India. In a few words, the theory of this engineer is that the polisht coating, which still remains on part of the pyramids now standing, served another very important purpose besides that of ornamentation, namely, that of acting as *a runway* up which the giant ten to twenty-ton stone blocks were pulled by ropes past over a series of rollers at the top of the structure. As history does not tell us just how the pyramids were constructed or gives any hints in this direction, it so happens that the theory of this new writer may be safely considered as very possibly the correct one.

This engineer then goes on to say, in the journal referred to:

"In examining the pyramids the problem which has always confronted the engineer of today has been the method of their construction. It is one of the peculiarities of Egyptian archæology that practically nothing on pyramid construction appears. Thus no evidence of any kind has been unearthed to show that they had that profound knowledge of mechanics which would enable the construction and operation of cranes sufficiently large and powerful to swing blocks of stone weighing several tons and place them in position anywhere up to nearly 500 feet in the air. The absence of such proof is only negative; but on

(*Continued on page* 665)



It is Thought by a Present Day Engineer That the Great Pyramids of Egypt Were Built in the Manner Illustrated—the Gigantic Stones Having Been Pulled Up the Smooth Surface of the Pyramid, Which Surface Finish of Cement Is to be Seen to This Day on Some of the Pyramids. The Older Idea Involved the Construction of Large Earthen Ramps, Which Had Afterward to be Destroyed.

A "Propeller-less" Airplane

By H. WINFIELD SECOR

SINCE the invention of the first airplane, practically every inventor who has evolved new principles for the propulsion thru the air, of a heavier-than-air type of machine, has invariably advocated the employment of some form of air screw or propeller. Every airplane today, used in the armies and navies of the world, uses a propeller rotated at high speed by powerful engines, developing several hundred horsepower.

Wherefore and hence we have with us at present the very latest idea in airplanes, not only for small machines, but for large ones which may eventually be used for transatlantic and transcontinental air travel —*the propeller-less airplane!* One of the main features of the new blower-type airplane, here shown and designed by one J. W. Webb, of Chicago, is the fact that the machine can be elevated vertically from a given spot and does not require an elaborate landing and starting ground of considerable size as at present.

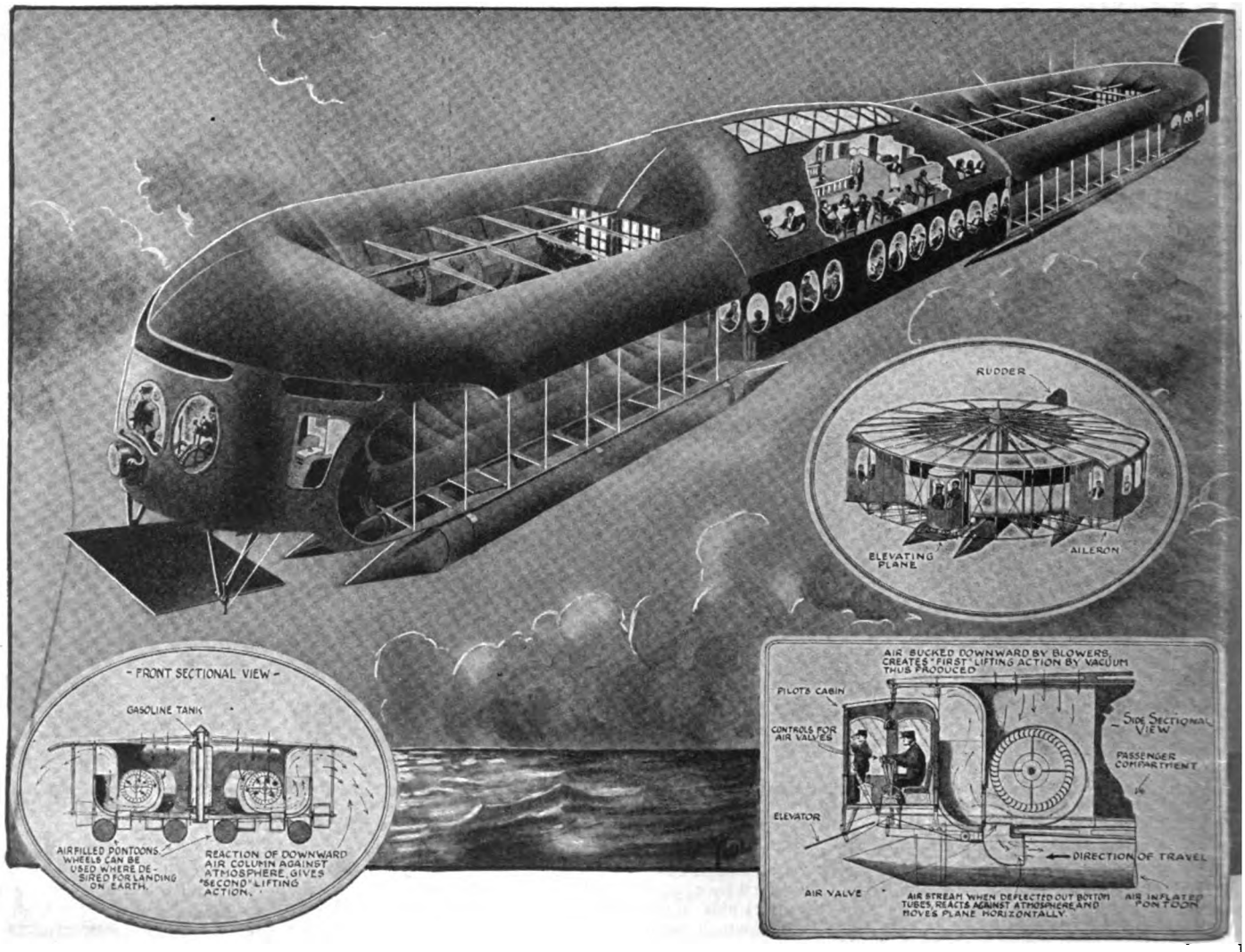
Among the other features claimed for this machine (which employs the resulting effects due to sucking downward a powerful draft of air thru the openings in the top of the machine, and blowing the air out by means of powerful engine-driven blowers from under the wings) are the following: That the machine will be able to sustain a considerable load and ascend vertically to any desired height; maneuver laterally at any desired angle with or against the wind; and, moreover, it is capable of hovering in a stationary or fixt position in any desired point, ascending or descending as may be necessary to avoid air currents or to take advantage of them.

Such a stationary flying craft would be of untold advantage in military maneuvers when used as a wireless station for directing artillery fire, and for numerous other purposes in both peace and wartime.

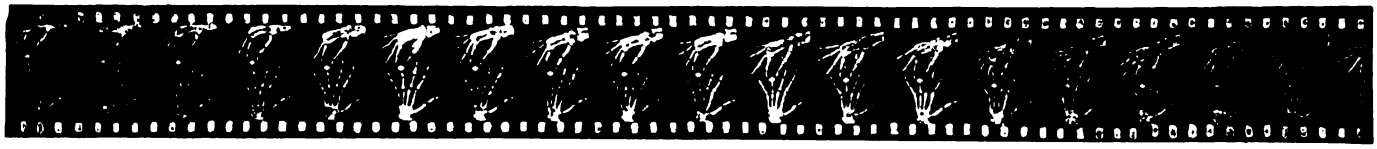
The inventor of this new propeller-less airplane makes use of several aircraft engines such as the *Liberty*, or other type of gasoline motor, which are directly connected to a series of powerful air *blowers*, enclosed in the usual steel housings, these fans sucking the air downward thru the top of the plane and whirling it around until it attains a high velocity, and then shooting it out thru the funnels, as shown by the arrows in the drawings. The reaction of these multiple blasts of air against the atmosphere causes the plane to rise.

The plane is also caused to rise due to the partial vacuum produced above it when the blowers are started, owing to the powerful suction present. The airplane is directed or steered in any desired direction by deflecting a certain number of blower air streams by means of suitable dampers or valves down thru a series of curved nozzles placed under the floor of the machine. The powerful drafts of air shot out horizontally thru these nozzles react on the atmosphere, causing the plane to move in the opposite direction, as the arrows clearly show. Suitable elevating and rudder planes are provided fore and aft also to help navigate the craft.

This airplane may be fitted with collapsible wheels for use when descending upon land also with pontoons for landing on water. The inventor provides a clever system of inflatable pontoons which are quickly filled with air from a motor-driven air blower. These may be covered with rubber cloth or *doped* airplane fabric and not only may serve as soft cushions in landing the machine, or pontoons for water descents, but also serve as *keels* which assist in maintaining the machine in a true course while flying. The air dampers or valves as well as the elevating and starting rudders are all controlled from the pilot's cabin at the front of the machine. For a circular airplane of this type, 32 feet in diameter, the inventor proposes to use a 400 H.P. engine, driving eight fans or blowers with a capacity sufficient to draw a total of 280,000 cubic feet of air per minute at a velocity of 55 miles per hour.



"Propeller-less" Airplane Devised by Chicago Inventor Which Employs the Usual Engines But Instead of Driving Propellers, They Serve to Rotate High Speed Blowers Which Develop Powerful Drafts of Air. These Rapidly Moving Air Currents Are Deflected Out and Downward from Under the Wing Surface, for Vertical Ascension—and Horizontally, Thru Curved Nozzles, for Lateral Propulsion in Any Direction. The Vacuum Produced at the Top of the Machine Aids in Ascending Vertically from a Given Point.



Top Strip of X-Ray "Movies" Shows Ring Being Placed on Finger. Note the Bones and How Gradually and Accurately the Successive Motions Are Depicted by This Latest Triumph of Science.

Vertical Strip of "Movie" X-Ray Film Shows Progressive Bone and Muscle Actions Resulting From Flexing the Muscles of the Arm. Such Films Are of Untold Educational Value.

X-Ray "Movies"

A PROOF that electricity is well-nigh universal in its applications, and that every phase of human activity is invaded and improved by this potent and benevolent form of energy, is vividly demonstrated in a new one reel educational film "Revelations," just completed by C. F. Bateholts. It deals with the remarkable progress made with the X-Ray outfit, perfected by Dr. W. D. Coolidge. This portable outfit can be taken to the bedside of the patient and attacht to an ordinary electric light socket.

Pictures taken by the X-Ray are not new but a motion picture film prepared by the use of this wonderful machine is something entirely new to science. It is an innovation in the movie field, a thing which had always been considered impossible.

The opening part of this wonderfully interesting film shows a few of the essential operations in the manufacture of the Coolidge X-Ray tube, the device which generates the powerful rays capable of penetrating to the inner structure of opaque objects. By animated drawings the electrical action in producing these rays is shown so clearly, that a child can understand the process.

The next step in the film visualizes the wonderful power of the rays in piercing such objects as wood, steel, cast iron, and even the hidden wheels of a clock. You can follow the workings of every wheel of the timepiece and see just how the second hand moves; you see just how a nail appears in the center of a solid block of wood; how a hole or flaw in steel may be discovered; the composition of a shotgun shell, showing the buck shot, powder and detonating cap.

HUMAN BODY IN ACTION.

The closing part is devoted to X-Rays of the human body, showing the action of the bones of the hand as the fingers are moved, the wrist as it is bent, the elbow as the arm is doubled up and straightened out, the knee and ankle in the same motion, the teeth, showing fillings, the nerves, and an abscess at the root of one and closes with an X-Ray of the entire body—the skeleton of a living person, a picture marvelous in itself.

For years the X-Ray has been the invaluable ally of surgery but until the portable machine was perfected it has been necessary to transport the patient to the hospital. Sufferers whose condition forbade being moved, were thus deprived of the X-Ray benefits with the result that medical skill has been handicapt in diagnosing conditions which otherwise might have been recognized.

The film shows how easily the portable machine may be carried about, the simplicity of its operation and setting up at the bedside of the patient.

All in all it is a wonderful film showing the marvelous things science has been able to accomplish in lessening the sufferings of mankind. —*Photos Courtesy General Electric Co.*

Here At Last!

Amazing Machines

Automatic machinery to overcome the high cost of production is being developt at an amazing rate and with remarkable results. It is evident that a revolution is going on in the science and technic of production. One corporation, for instance, now has under construction machines to weigh the product, fill the box, wrap it and label it; having a capacity of 15,000 finished boxes per day; machines to fold paper napkins, 100,000 per day; machines to wrap sandwiches in a sanitary way without the aid of human touch; machines to make ice-cream cones at the rate of 2,400 per hour without the touch of the hand; machines to pit cherries, to wrap pieces of goods, to sew bags and turn them inside out, to paste labels on phonograph records, to develop films. Machines that will automatically make boxes from sheets of cardboard; put them together, tuck in the bottom end, place jar or bottle with circular or directions therein and then tuck in the top, making a complete cartoned package without the touch of the human hand. Machines that build up a carton or box; weigh and fill the same with powder or a floury substance, place cover on box, then wrap the box completely with a printed wrapper and then place a trademark seal on each end of the package. Machines that will label bottles (120 per minute), bottles fed from magazine and labeled automatically. Machines that will remove a cover from a box, place a product therein, place cover back on box, label the top of the box, place label around the side, and then fold a circular, placing the same around the box, fastening it to box with a tack driven into the box by the machine. Machines ironing and folding sheets, pillow cases, towels, handkerchiefs and napkins. Machines folding and labeling shoe and corset laces automatically; large production per day. Machines that will automatically bind the four edges of advertising glass slides used in moving-picture houses. Machines that will assemble and wrap hard candies, rolling them into a package, producing 25,000 packages in a day. Machines that will automatically wrap in foil, chocolate bars and small candies. Machines that will automatically wrap cigars in paper and foil. Machines that automatically wrap sandwiches or fold paper napkins. Machines that will automatically tie two tapes around piece goods, then wrap in paper, leaving the ticket on the outside of package. Machines for automatically assembling and producing various kinds of buttons and for cracking all kinds of nuts.—*New York Journal of Commerce.*

Sixty Below Zero!

At 60 degrees below every stovepipe throws out a great white cloud of smoke and vapor, resembling a steamboat in its whiteness, and this cloud streams away for from 50 to 100 feet, mingling with the other white-gray mist or haze that remains permanent in the atmosphere of the town like a great fog when it is 40 degrees or more below zero. This white-gray fog is not fog as we know it, but is frozen fog, and every man, woman, child, animal and even the fire that burns is throwing out moisture into the air, which is immediately turned into a cloud of frozen vapor that floats away and remains visibly suspended in the air. Very slowly this settles to earth, and in the morning, about the steps and any protected place, one can see a very fine film of flourlike dust deposited, which is composed of frozen vapor.

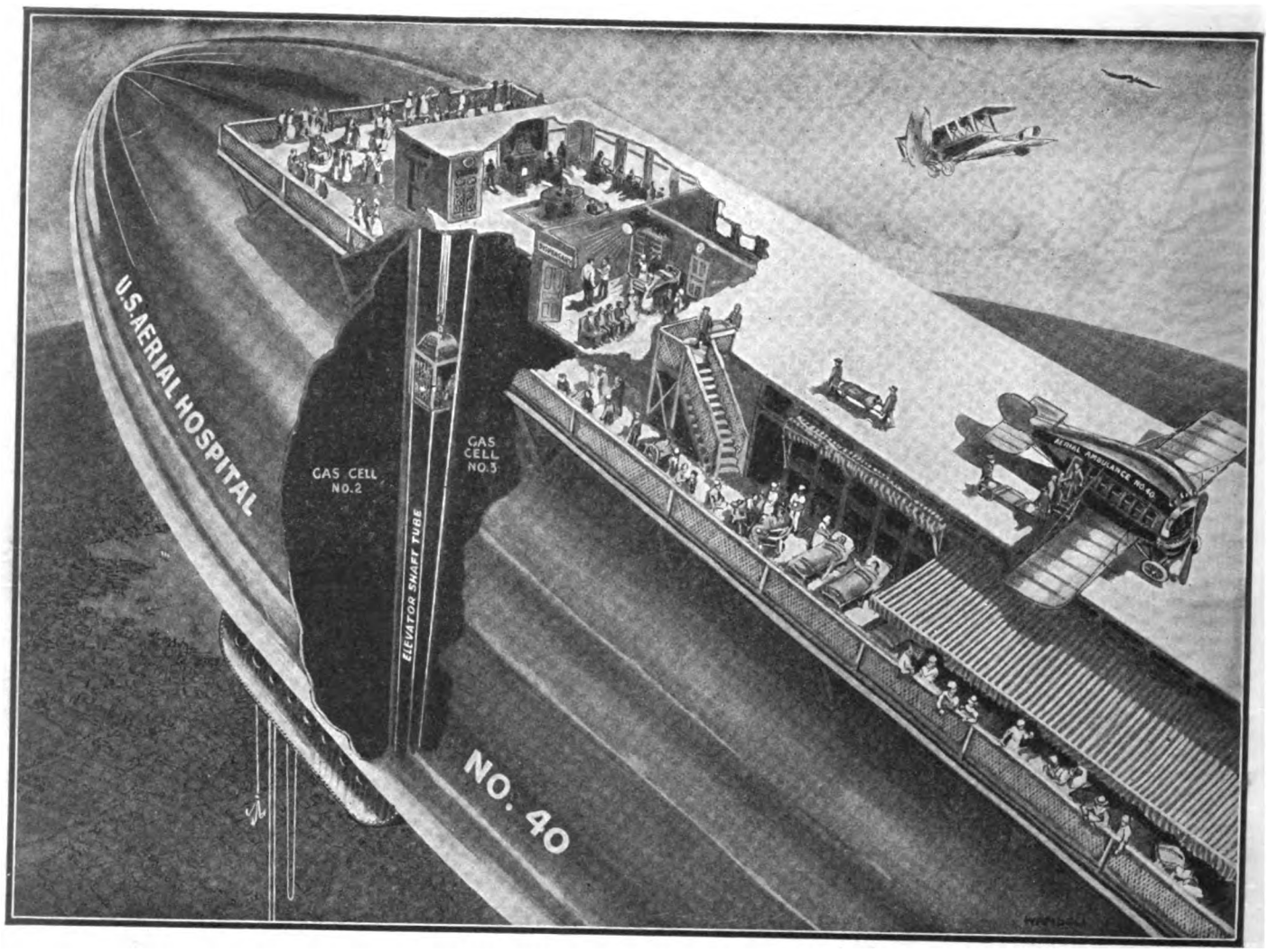
Exposed ears, hands and noses freeze at this temperature in going the distance of about one city square. The breath roars like a mild jet of steam, while a dipper of boiling water thrown out into the air emits a peculiar whistling as its drops circle thru the frosty atmosphere.

Prospectors, attempting to boil a dish of rice or beans upon a camp fire unprotected from the weather, find that the side of the dish that is in the fire will boil, while the part of the dish exposed to the weather has frozen. To remedy this, the dish is set completely into the fire. Edged tools subjected to this temperature become as hard and brittle as glass and will break readily under strain. All vegetables, potatoes, apples, fruit, eggs and the like can be allowed to freeze until they become like bullets. To make ready for use place them in cold water half a day before using, and the frost will slowly withdraw without injury to the food. To attempt to thaw them out by the more rapid process of fire or hot water spoils them for use.

Some remarkable tales are told of thawing out a frozen foot, ear or hand by immersing the member in coal oil for some time—often for several hours.

Iu such temperatures one must be very careful about touching things with unprotected hands. It is dangerous to take hold of a doorknob when it is 60 degrees below zero or thereabouts with the uncovered hand unless one is careful instantly to release his hold, for if he does show this carelessness the inner palm of his hand will be frozen in five seconds. The result is the same as tho he had touched a red-hot stove.

Coal oil begins to thicken at 40 degrees below, and at 60 and 70 degrees below, becomes as thick as lard and looks like it.



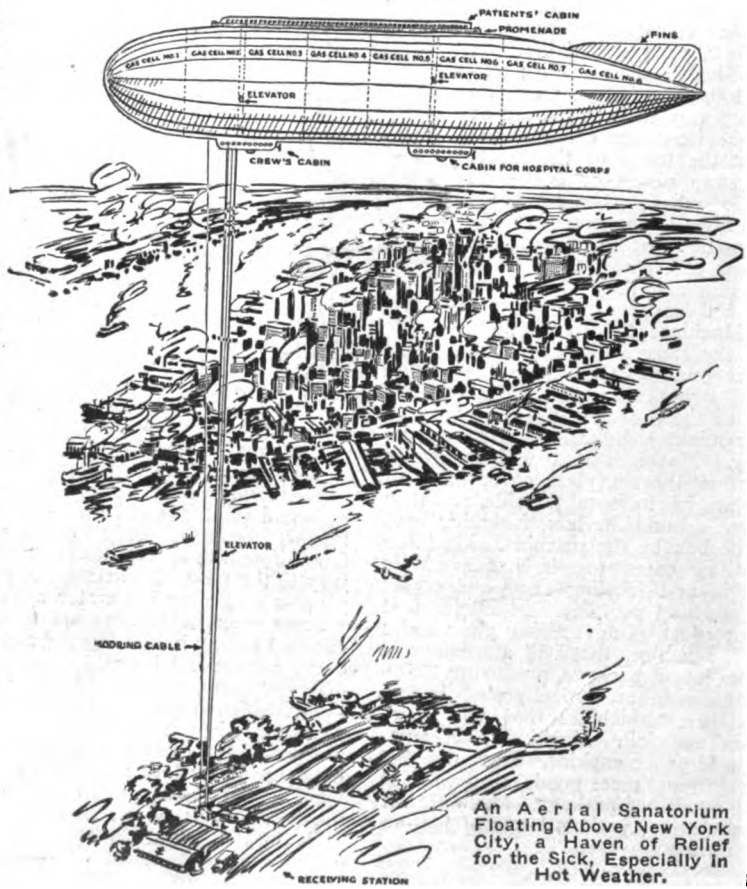
An Aerial Sanatorium

By F. E. LOUDY, AE. E.

TWO things are essential in this world-wide battle against the white plague, sunshine and fresh air. Usually this means a costly trip to Colorado or some other high and dry territory. Instead of transporting tuberculosis patients to the sanatorium we should bring the sanatorium to the patients. This can be done by using giant captive balloons, structurally similar to the great Zeppelins, which can be moored near the large centers of population, like New York and Chicago, where this disease is more prevalent.

These giant airships would be composed of a rigid yet light duralumin structure, containing eight independent helium gas cells. Helium is an inert gas, non-inflammable and while lifting less than hydrogen is quite light enough for good efficiency.

The patients' cabin is located on top of the airship so as to get as much sunshine as possible, while the airship crew occupies the lower forward cabin, and the hospital corps occupies the lower rear cabin. Since this airship is 800 feet long and 100 feet in diameter, it becomes necessary to travel from cabin to cabin by means of an elevator operated by an electric hoist, as shown in the illustration.



An Aerial Sanatorium Floating Above New York City, a Haven of Relief for the Sick, Especially in Hot Weather.

The patients' cabin contains the sleeping quarters, dining-room, galley, library, dispensary, a piano and moving picture outfit. Everything possible is supplied to permit the patients to forget their ills.

The mooring cable, which anchors the airship to the ground, carries with it telephone and electric wires, which means electric illumination and constant telephonic communication.

Food supplies as well as people are conveyed to and from the airship by means of an electric hoist in the forward car or cabin. Patients who cannot stand the elevator trip up to the airship can be carried up by an airplane ambulance in the manner here portrayed, the airplane landing on or hopping off from the giant upper deck easily.

The airship is usually held between 5,000 and 10,000 feet altitude. Here the air is pure and invigorating, and usually cool. There is a promenade around the outside of the patients' cabin where they may sit or walk. Here, everything is restful and quiet. Rain clouds usually form around 5,000 feet, so when they appear the airship is allowed to go above them.

A Universe In Miniature

DR. BIRKELAND, of Christiania, the famous Norwegian physicist and scientific investigator,—well known for his important researches on the phenomenon of the Aurora Borealis, which was described and illustrated some time ago in this journal, by Prof. Lindley Pyle, as our readers undoubtedly recollect,—recently opened up an entirely new line of scientific endeavor by constructing a wonderful *universe in miniature.*

An article recently appeared in the Paris *Temps* in which this latest work of Dr. Birkeland was discoursed on at some length, and the fact brought out that he is a believer, in line with many other scientists of the present era, that electrical phenomena play a most important part in the behavior and functioning of the heavenly bodies. The sun, today, is believed to be like a gigantic dynamo emitting swarms of minute particles of negative electricity, which we are pleased to call *electrons.* These infinitesimal, invisible particles of electrical energy shoot thru interstellar space with the velocity of light itself, and whenever they chance to meet rarefied gases, peculiar luminous effects taking on certain characteristics and forms, are invariably produced similar to those which we see on the interior of exhausted glass tubes and bulbs when charged by an electric current of high potential. These gigantic electrical phenomena are lined up by the present day scientist with the illumination of comet tails, also as aforementioned with the wondrous displays of the Aurora Borealis and, furthermore, the phenomenon known as *magnetic storms,* on which subject Prof. Pyle so interestingly discoursed in the January number of this publication.

To quote the writer in the *Temps,* he says:

"Dr. Birkeland relies for his results more on experiment than on scientific theories. To this end he built his miniature universe of which he himself is the master. This universe has a capacity of seventy liters and is a huge glass bell into which he can introduce various gases and in which he can maintain any degree of vacuum he prefers. In the center of it is a *planet* of eight centimeters diameter (about 3¼ inches), which Dr. Birkeland calls the *terrella* and is actually a copper sphere containing an induction-coil, which can be stimulated by electric currents to reproduce on the *terrella* the equivalent of terrestrial magnetism. On the side is a metallic disk generator of electrons, which represents the *sun.*

"By sending electrical discharges thru the interior of the bell, one produces luminous evidences that vary greatly with the rarefication of the gas, the intensity of the electrical discharges, and the inductivity of the central globe. As long ago as 1908, Dr. Birkeland employed this mechanism for the study of magnetic phenomena and the *aurora borealis,* and he was able to reproduce with astonishing accuracy all the appearances and particularities of the natural phenomena. Last year he took up zodiacal light, the vast and diffused glow which spreads across the solar world lying on the plan of an ecliptic. This time the central globe of his apparatus, the *terrella,* represented the *sun* and became the center for the emission of electrons. Under these conditions a vast luminous ring spread out in the bell around the solar equator. At the same time one could see on the central globe a double band of brilliant points whose distribution reminded one curiously of the spots on the surface of the sun. In the course of these experiences with zodiacal light Dr. Birkeland made an interesting discovery. By diminishing little by little the intensity of the discharge current that traversed his apparatus he saw the large ring representing the zodiacal glow draw itself in and narrow itself until it formed around the equator of the *terrella* a crown similar to the ring of Saturn and formed, as that is, of several zones of different brilliancy. Here one can recognize a dark spot similar to the division of Cassini.

"One must admit the magnetism of Saturn, which is not proved, but which, after all, has nothing of the absurd in it. Above all there is to be explained how these rings of very diluted gas can be at the same time opaque, almost dark, and yet reflective. We know it is true that the tails of comets spread solar light like a trail of dust which is illuminated in a beam of light, but these wandering plumes send forth also a light of

(*Con't on page* 667)

For "November"

Early Inventions of Leonardo da Vinci, by Dr. T. O'Conor Sloane.

Remarkable New Sound-Recording System for Phonographs and Talking Movies, by Eric A. Dime.

Super-Silk Worms and Super-Silk Worm Food—A Silk Worm That Spins Silk in Any Color. By Richard Hoadley Tingley.

Science and the Weather Man—What an Inch of Rainfall Means—How Sunlight and Snowfall Are Measured. All clearly explained in diagram and picture.

Reading Character from the Hand—The Science of Your Hand's Lines, W. de Kerlor.

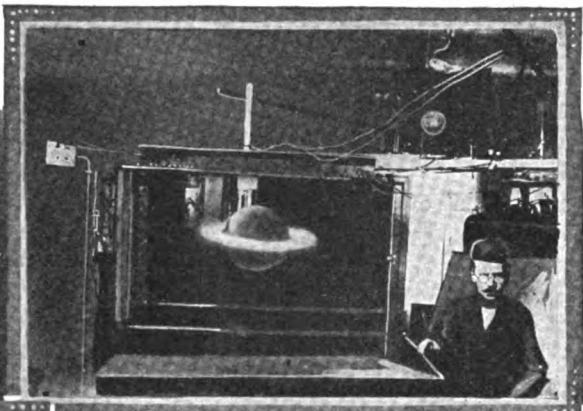
The Velocity of Light, by Prof. James S. Stevens.

New Scientific Story, by Charles S. Wolfe.

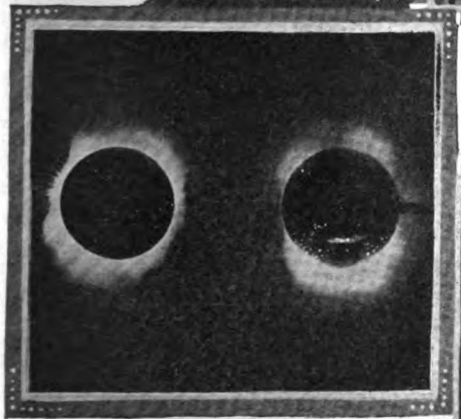
How Radium Is Applied in the Treatment of Cancer and Other Human Ailments. By Joseph H. Kraus.

New Science Tricks in Stagecraft.

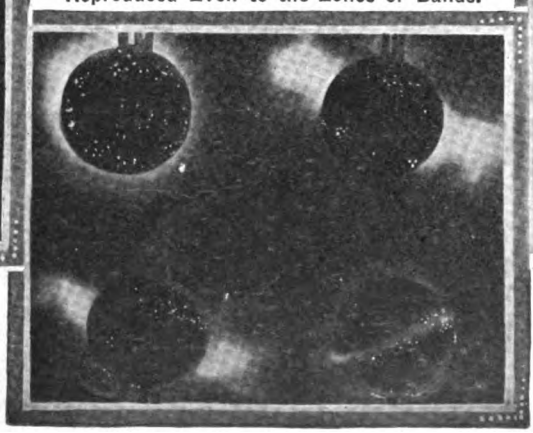
How Colored Magazine Covers Are Made. Illustrated with photographs.

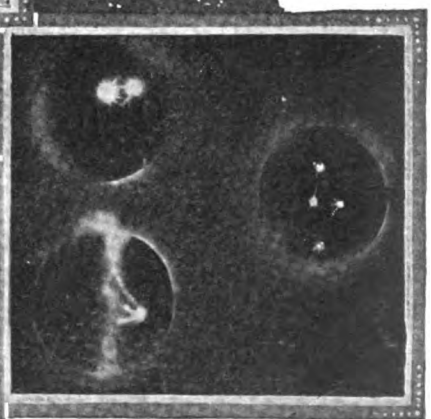


Dr. Birkeland, the Famous Norwegian Physicist, in His Astro-Physical Laboratory Where He Has Duplicated Many of Nature's Mystic Phenomena of the Heavens. The "Rings of Saturn" Are Here Shown, and They Were Faithfully Reproduced Even to the Zones or Bands.



On the Left of the Photo Above Is Shown the Corona Effect During an Eclipse of the Sun; On the Right the Same Effect Duplicated by an Electrified Ball in Dr. Birkeland's Laboratory.



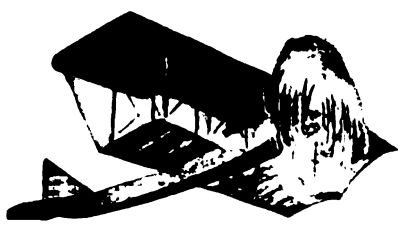


Center and Right-Hand Photos Show "Sun-Spots" Imitated by Means of Charged Metal Spheres in the Laboratory. Halos and Planetary Rings of Various Forms Were Also Reproduced.

New Aircraft Landing Ship

By FRANK BROWN

WHILE many of the world's naval powers are resting on their laurels quietly until another war breaks out and perhaps finds them unprepared, the British navy believes in the old adage, "The early bird catches the worm," and in the accompanying illustrations we behold the latest addition to the English navy, the new naval aircraft carrier, H. M. S. *Eagle*.



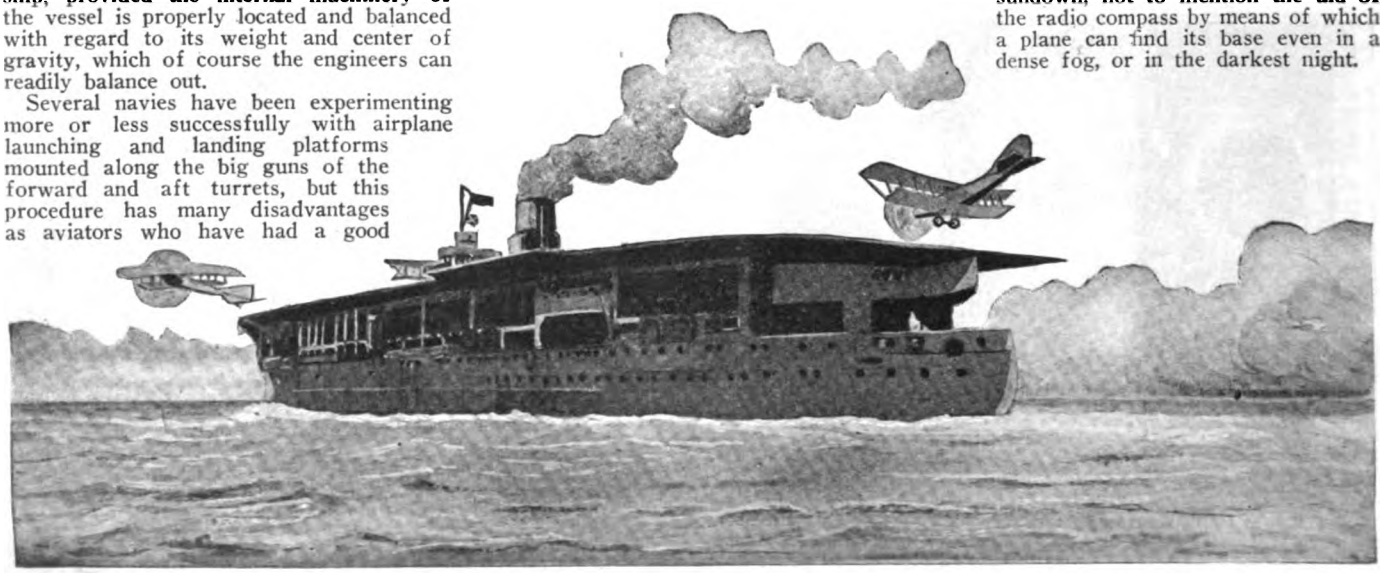
The *Eagle* has been called "The Ugly Duckling" of the British navy, owing to her unsymmetrical appearance, particularly in view of the fact that her superstructure including the smoke funnels, is all placed on one side of the ship. As will be seen from the photos, this gives a very odd effect, but the naval architect who designed this boat knew what he was about. There is no reason at all why the smoke funnels and superstructure, including the bridge, should not be placed to one side of the ship, provided the internal machinery of the vessel is properly located and balanced with regard to its weight and center of gravity, which of course the engineers can readily balance out.

Several navies have been experimenting more or less successfully with airplane launching and landing platforms mounted along the big guns of the forward and aft turrets, but this procedure has many disadvantages as aviators who have had a good bath in the ocean will tell you; and this is not all, for the practise of starting or landing seaplanes from or on such small platforms and which are, moreover, mounted or supported on the big guns of the war vessel, involves one of the most impractical contrivances that has been invented in a long time, for how is a ship going to go into action at short notice, with all of this junk mounted on her big guns?

The best thing yet, in aircraft carriers, undoubtedly is the design followed out in building H. M. S. *Eagle*. This ship has a tremendous, long and perfectly flat deck from, or on, which a dozen seaplanes can ascend or land at a time. This ship has a displacement of 30,000 tons which brings it into the class of real large sea-going vessels. As a general rule, a small high speed seaplane or land plane of today can "hop off" at least within a distance of 100 to 150 feet, and a great deal less in many instances. But with a deck 300 to 400 feet long, it is readily seen that planes can be started or landed in a fractional length of the total deck space available, thus permitting a number of planes to be "parked" amidship, or at one side on the forward or aft deck.

A naval aircraft carrier of this type has, as might be supposed, a perfectly fitted repair factory for the flying boats which she carries. Several machine shops are fitted up complete with lathes and other necessary machinery for the quick overhauling of the intricate machinery of the seaplanes, besides the repair departments for the radio apparatus. There are, besides, commodious, well furnisht quarters for the aviators as well as the crew of the "Ugly Duckling."

In battle practise such a ship as this would, of course, keep out of the range of battle as far as possible. It can be armed, of course, with a fairly heavy battery of 6 to 10-inch guns for defensive operations when hard prest. As the seaplanes have a considerable range of flight, however, it is not necessary that the airplane mothership follow the battleships into action at all; in fact, she can lay back many miles from the scene of action. Attacks from the air by enemy bombing planes would be combated by her own armed seaplanes, several of which would constantly hover aloft when in enemy waters. Electric flash signals would guide the planes back after sundown, not to mention the aid of the radio compass by means of which a plane can find its base even in a dense fog, or in the darkest night.



New Type of Comic "Movies"

By ERIC A. DIME

With the Familiar Distortion Mirror, a World of Fun and Mystery is Provided

IN the good old days when the dime museum flourisht in all its pristine glory one of the chief attractions was the variously curved mirrors which furnisht distorted reflections of the patrons. The dime museum is rapidly passing into oblivion, but these mirrors are still found in penny arcades and in some Turkish baths, where they furnish amusement for the visitors.

Not long ago Peter Orance, an inventor of New York City, visited a Turkish bath in the Metropolis. In these sweat emporiums artificial aids to beauty are stript away and the human frame is left unadorned. Many blooming flowers of the boulevards and the drawing rooms are found to be but rank weeds in the Turkish bath. Therefore, the stark reality is somewhat relieved by distorting the plain ugly into the startlingly grotesque. And it was perhaps for the purpose of injecting a little humor into the prosaic Turkish bath that the proprietor of the establishment in question installed these mirrors of distortion for the benefit of his patrons. The inventor saw other visitors enjoying themselves in this manner and took a good look at himself—and had an idea.

This resulted in the working out of a practical plan whereby humorous films could be produced for entertainment purposes, either still or motion picture films. Mr. Orance perfected an apparatus, which consists chiefly of two mirrors. The act is staged along ordinary lines in front of the first mirror and the light rays are deflected into another and smaller mirror and thence into the lens of the still or motion picture camera. These mirrors may be either concave, convex, or in various compound forms. The entire apparatus is small and inexpensive, and it is not too much to predict that this invention may be made wide use of in the not distant future. The mirror arrangement may be attacht to ordinary cameras, offering wide commercial possibilities, as well as opening up an unlimited vista in the motion picture world.

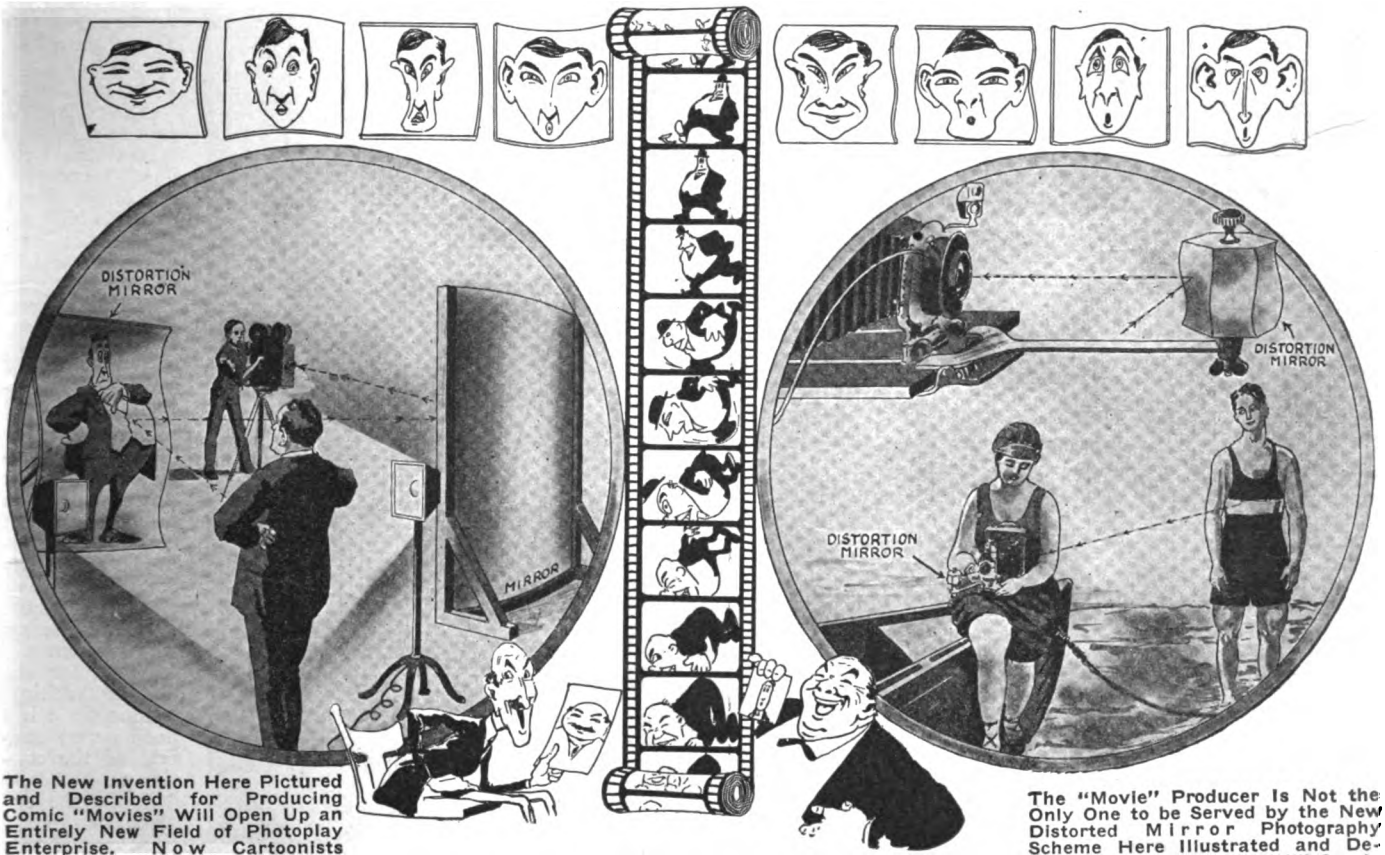
By the intelligent use of this device one star may do the work of three or four. One with a Sherlock Holmes figure may get away with a Fatty Arbuckle stunt with great *éclat*. No longer need the harassed director bemoan the lack of a fat star, when a thin one will do the work. The dwarf shall sprout into a giant, and the giant shall shrink into the minute proportions of a dwarf. Broomstick calves can gracefully be rounded like unto the well-turned spindles of a Richelieu, and graceful plumpness shall blossom where before only spareness reigned. Figures, which normally are upright, can be made to show a list to starboard or port which will defy the laws of gravitation.

This invention is of such universal application as to throw Charlie Chaplin's feet into the shade and make entirely unnecessary the wearing of rubber trousers by maids of the chorus, and which are inflated, sometimes with disastrous results. Ears may be increased to the proportions of a flivver's mudguards, eyes may be separated by the proverbial chasm which yawns between Kipling's East and West, chins may be sharpened to a razor's edge or bifurcated like twin mountain peaks. Horselike noses may be sported and all the monstrosities of the midway may be brought into the privacy of the home.

In this latter connection it may be explained that by a slight adaptation of the same principle this device may be used on any camera for the purpose of making trick pictures.

The possibilities of humor on ordinary lines appear to have been nearly reached, but the Orance invention offers a new and wide field. Its chief value lies in the fact that slap stick is unnecessary and it provides a medium whereby vulgarity may be reduced to a minimum.

A further explanation as to the principle of curved mirrors might be given in this connection. A person looking into a curved mirror will see his features distorted and the direction of the distortion depends upon the direction of curvature, and the amount of distortion varies with the degree of the curvature of the mirror. If the curvature is convex about a horizontal axis the image is shortened and broadened, and if convex about a vertical axis it is lengthened and narrowed. A concave horizontal mirror produces an elongated image constricted at the middle of its height, and a concave vertical mirror a broadened image constricted at the middle of its breadth. By combining convex and concave curvatures in various ways into the form of concave-convex combination mirrors, more or less complex distortions of the subject will result including longitudinal and lateral curvatures in addition to the contractions and elongations.



The New Invention Here Pictured and Described for Producing Comic "Movies" Will Open Up an Entirely New Field of Photoplay Enterprise. Now Cartoonists **Draw a Thousand Funny Pictures for One Film Story. Thousands of Grotesque Poses Can Be Rapidly Filmed with Suitably Distorted Mirrors.**

The "Movie" Producer Is Not the Only One to be Served by the New Distorted Mirror Photography Scheme Here Illustrated and Described. **These Mirrors Will Surely be Sold to the Public by the Thousand, Especially Adapted for Attachment to the Ordinary Hand Camera as Here Shown.**

What Caused the Great Flood?

THE Bible teaches us that some thousands of years ago there was a great inundation, the so-called Noachian Deluge. In comparatively recent times, the biblical account was not taken seriously, until in recent years science has taken hold of the problem, and has begun to make investigations.

It has been established today, without any doubt whatsoever, that such a cataclysmic deluge actually did occur since man appeared on this globe. And the flood can be proven today in many ways.

In the first place, with the exception of some African tribes, there are flood stories in every country of the world, whether they be European, American, Asiatic or Australian. All of these peoples or races have some tale which was handed down by word of mouth, that such a great deluge occurred some thousands of years ago. To be sure, the story varies considerably, as is the case of any story transmitted by mouth down thru generations, but the fact remains that the story persists. If this was the only proof, it might be questioned. But there are many geological reasons which teach us that a great flood actually did occur. The following proofs are taken from Professor G. FrederickWright's article on the "Geological Confirmation of the Noachian Deluge." Many other geological proofs can be cited, but the following will be sufficient:

1. "The filling of the numerous ossiferous fissures in Western Europe with an indiscriminate mixture of the separate bones of widely diverse species of animals, mingled with angular fragments of rock and with earth without stratification, and containing occasional stone implements made by the hand of man. These could not have been filled gradually, because there are no entire skeletons of animals, and none of the bones are gnawed. But they were evidently filled by the indiscriminate action of a (water) wave of translation sweeping everything before it.

2. "The enormous accumulations of the bones of hippopotami in the cave of San Ciro, near Palermo, on the Island of Sicily, where whole herds of this animal, which now lives only in Southern Africa, evidently sought refuge from rising water in an extensive cave at the base of the rugged cliffs of Monte Grifone.

3. "The existence of Arctic seals in Lake Baikal (Siberia) two thousand miles from the ocean, and 1,680 feet above it.

4. "The historical Chinese tradition of the existence of such a vast body of water in the same region, known as the Han Hai."

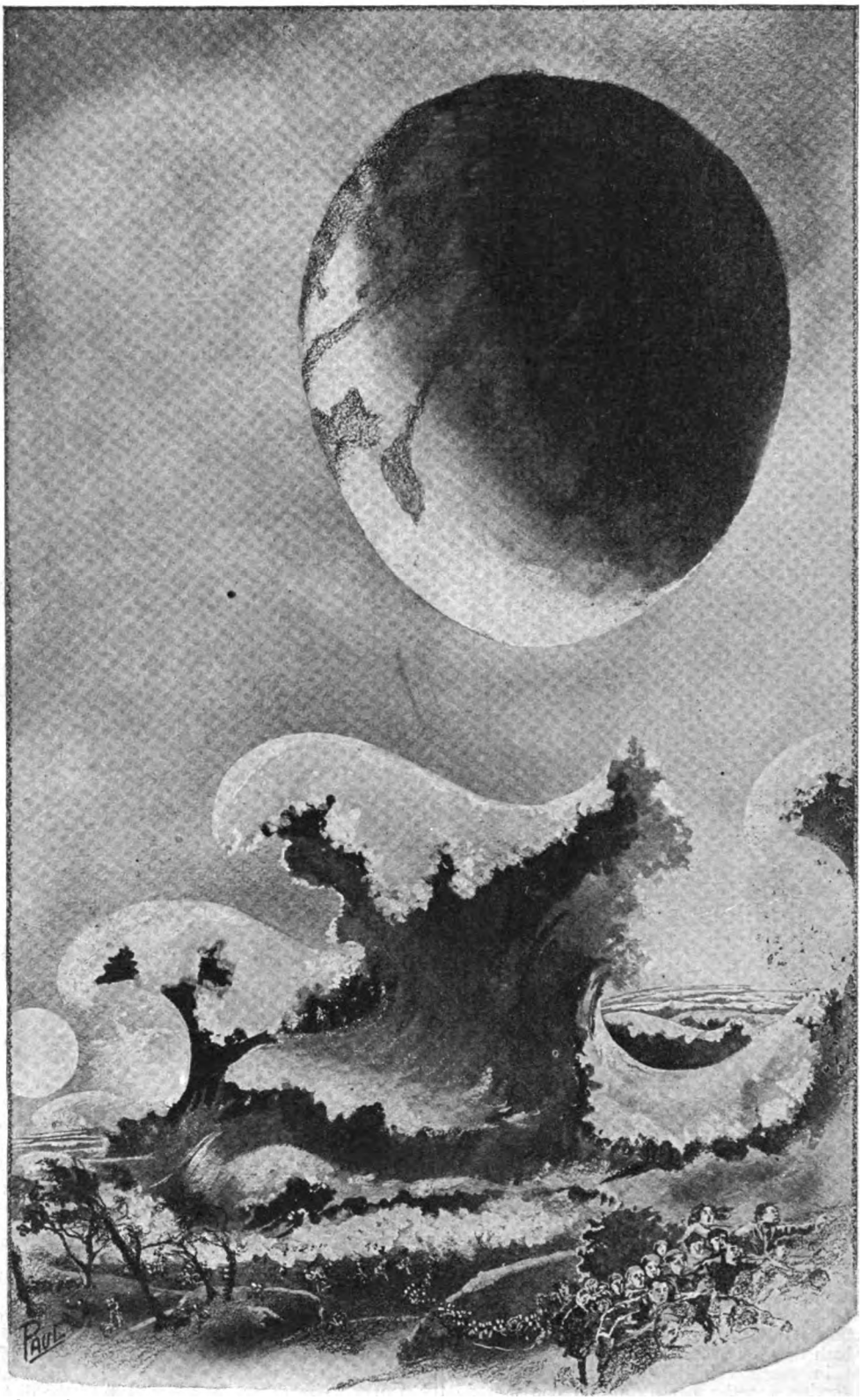
However, Professor Wright thinks that the flood occurred due to the glacial period which accumlated a tremendous weight of ice on the northern hemisphere, particularly in America and Europe during that time. Professor Wright reasons that due to the enormous amount of water deposited on these continents about two hundred and fifty feet of water was thus subtracted from the oceans, which when released later on, due to melting, produced the flood over several of the continents.

While the explanation is a good one, it does not satisfy for the reason that the melting glaciers could only have released the waters very gradually, and that if a flood occurred in this manner, it would have taken hundreds of years to produce deluge effects. Thus the rise of the waters over the continents, if it did happen, would have been almost imperceptibly slow.

Mr. H. Gernsback recently advanced a more plausible reason how the historical flood might have occurred, and his theory is based at least on undeniable astronomical facts.

That the flood was caused by the oceans and not by rain can even be proven from the biblical account where the inundation is represented to have been occasioned, not

(*Continued on page* 667)



One of the Most Plausible Explanations of the Historic Flood Has Been Proposed Recently by Mr. H. Gernsback; It Is Illustrated Graphically Above. If in the Course of the Ages a Great Body as Large or Larger Than the Earth Had Chanced to Pass Within Ten or Twelve Thousand Miles from Our Earth, the Tidal Waves Created by the Gravitational Attraction Would Have Been so Tremendous as to Result in the Flood Conditions Which Science Now Knows Actually Occurred in Historical Times.

Your Furniture In a Trunk

This Remarkable Trunk Contains Practically Every Household Utensil and Piece of Furniture You Can Think Of, Including a Sewing Machine, a Dining Table with Dishes, Three Chairs, a Bed Large Enough for Two People, and After Numerous Other Miscellaneous Articles Have Been Counted, We Wind Up by Finding Therein, a "Wash-tub".

AT last the moving "bugaboo"—as well as a good part of the "housing problem," has been solved by a young French inventor, Monsieur Louvet. As the photographs will clearly show, he packs nearly every human want imaginable into a special "trunk," measuring but 49 inches long by 54 inches wide and but 33 inches high. This trunk, altho seemingly quite large, will pass thru any standard size doorway.

As may be surmised, the great secret of this wonderful trunk lies in the proper folding and packing of the respective chairs, tables, etc. Monsieur Louvet packs everything in his trunk,—starting with a bed for two people, not to mention three chairs, a sewing or dining table, a stove, linen closet, and sideboard with dishes complete,—and finally winds up with a wash-tub having a capacity of 130 quarts of water. With two of the chairs, a *chaise longue* is easily made. All the chairs are fitted with compartments containing all the necessaries for a bedroom. The double bed at the bottom has drawers and cupboards containing space for other personal articles and effects.

Another photo shows the remarkable table fitted with all the usual kitchen accessories, including the sewing machine which folds on top of the table, with a nest of drawers full of accessories for the home, etc. Each object has its special place in a compact form, so that nothing rattles or falls out.

The third photo shows five pieces of furniture, all of which have been resurrected from the "mystery trunk" and covering a floor space of 78 by 103 inches. In these pieces of furniture are contained all the other utensils for the tabloid household *de luxe*. These five pieces fold into a compact space, the trunk measuring but 49 inches long by 54 inches wide and 33 inches high.—*Photos (C) by Kadel & Herbert.*

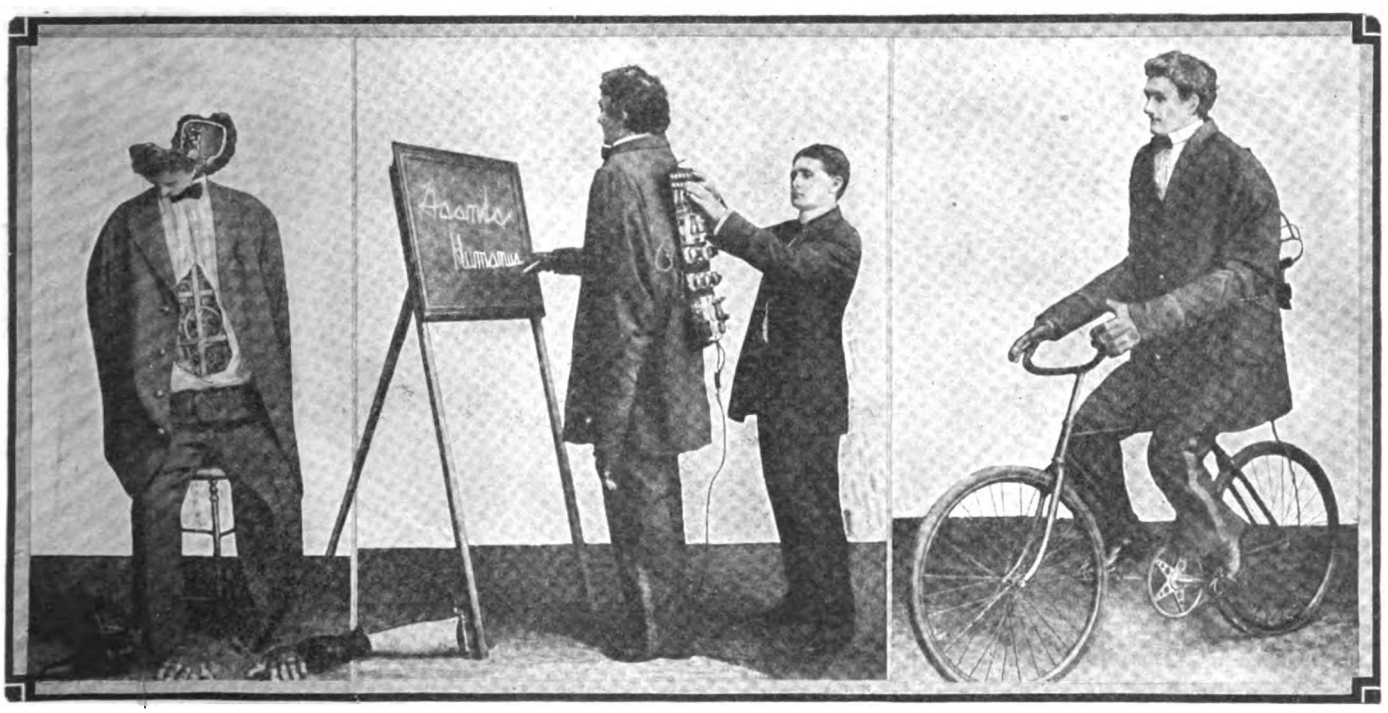
Automaton Mimics Real Man

YEARS ago there was exhibited at the Chicago Exhibition an automaton which was entirely mechanical, driven by internal motive power, and which walked and did various other human-like stunts. At this time Mr. Lu Senarens, under the pen name of "Noname," was writing a series of articles in the popular boys' magazines, describing adventures of a mechanical man created by his own brain. At first in these stories this mechanical man was steam driven and later became electrical.

A good many years have past since these fiction stories were first printed and now Fred LaReine comes forward and presents to the American theatre-goers a new mechanical "miracle man."

It may be that some of the old-time theatre-goers remember having seen a mechanical figure years ago, which did everything but talk. Writing his name on blackboards, driving horses and numerous other stunts of a similar nature were easy for him, and the mechanical device defied the best experts in the country to give an explanation of how all these things were done.

(*Continued on page* 664)



Automatic "Man" Dissected. **Automaton Writing Upon Blackboard.** **The Electro-Mechanical Man Riding a Bicycle.**

How We Balance Ourselves

BY WILLIAM M. BUTTERFIELD

WHY does a man sit or stand right-side up? On the spur of the moment, and without reflection, this seems a very easy question to answer—nine people out of ten will say, "Simply because the man *sees* he is right side up, of course." This is *not* the answer, strange as it may seem, for sight has practically nothing to do with it. If you do not believe this, place yourself in one of the six airplanes we show in the center of our drawing and, as you fly about above the clouds in this topsy-turvey maneuver, tell by observing your own plane, or any or all of the others, when you are right-side up—just merely by looking.

You cannot do it. And the makers of the planes never expected that a pilot would, for they provide a very delicate mechanical guide which, working by gravity, furnishes such information on a specially prepared dial.

Now that you have begun to consider this question, explain, if you can, why people born *totally blind* carry themselves more erect than those with perfect vision, or why the blind respond more quickly to necessary protective movements in case of a fall or accident.

Man, in common with all four-legged animals, is provided with a pair of ears whose internal parts, with the exception of size, are like the internal parts of all other ears; or every pair of ears, whether in or on the head of a man, a pigeon, a dog or an elephant, perform the functions of hearing in absolutely the same manner because the physical machinery of the ears in each head is the same. This is fortunate, for the study of these organs by anatomical investigations in vivisection on animals yields the same results as those obtained by surgical operations on the human organs. Most of man's knowledge of the performances in the human ear has been obtained by studying the action of animal ears by means of vivisection.

When, therefore, we say that "in each ear of man there lie a series of sacs and canals that keep his body right-side up," we are in possession of that proof—a rather important position to be in, when giving a definition of how the sacs and canals perform the work. Particularly so, when perhaps few persons that ever see this article will know by any direct or acute sensation just when the parts are exercising their influence.

If a person cares to receive a warning sensation, or series of sensations caused by these organs, he may let his body be carried swiftly up or down as in an elevator or seaplane, swayed violently as in a swing or boat, or spun around for a considerable time, when he will suffer nausea and dizziness.

In the ordinary movements of the head and body, there are no such sensations, yet one cannot lie, recline, stand, sit or walk in unusual attitudes *without being made aware of it,* for the organs establish a series of natural poses that fit the normal positions which the body takes at such times.

Each group of organs consists of two spherical sacs (utricle and saccule) and three semicircular canals that connect at both ends in fine openings, with the larger of the two sacs (Fig. 2). They constitute the larger and upper portion of membranous labyrinth and fill about a third of the bony cavity in which they lie (Fig. 1), held there by fibrous bands (Figs. 3 and 4). This bony cavity is filled with a fluid (perilymph) while the hollow interior of the organs is partly filled with a separate fluid (endolymph). This arrangement, it will be seen, places a sac of many parts filled with fluid within a bony cavity which corresponds identically in shape, and with all of its space not occupied with the sac—filled with another fluid. The outer fluid acting as a cushion, the inner fluid moving about in the elastic sac, thus forming a kind of pneumatic indicator that can assume any shape or take any position.

Each of the three canals is placed so that it is at right angles to the other two (Fig. 6), and is provided with a bulb that joins

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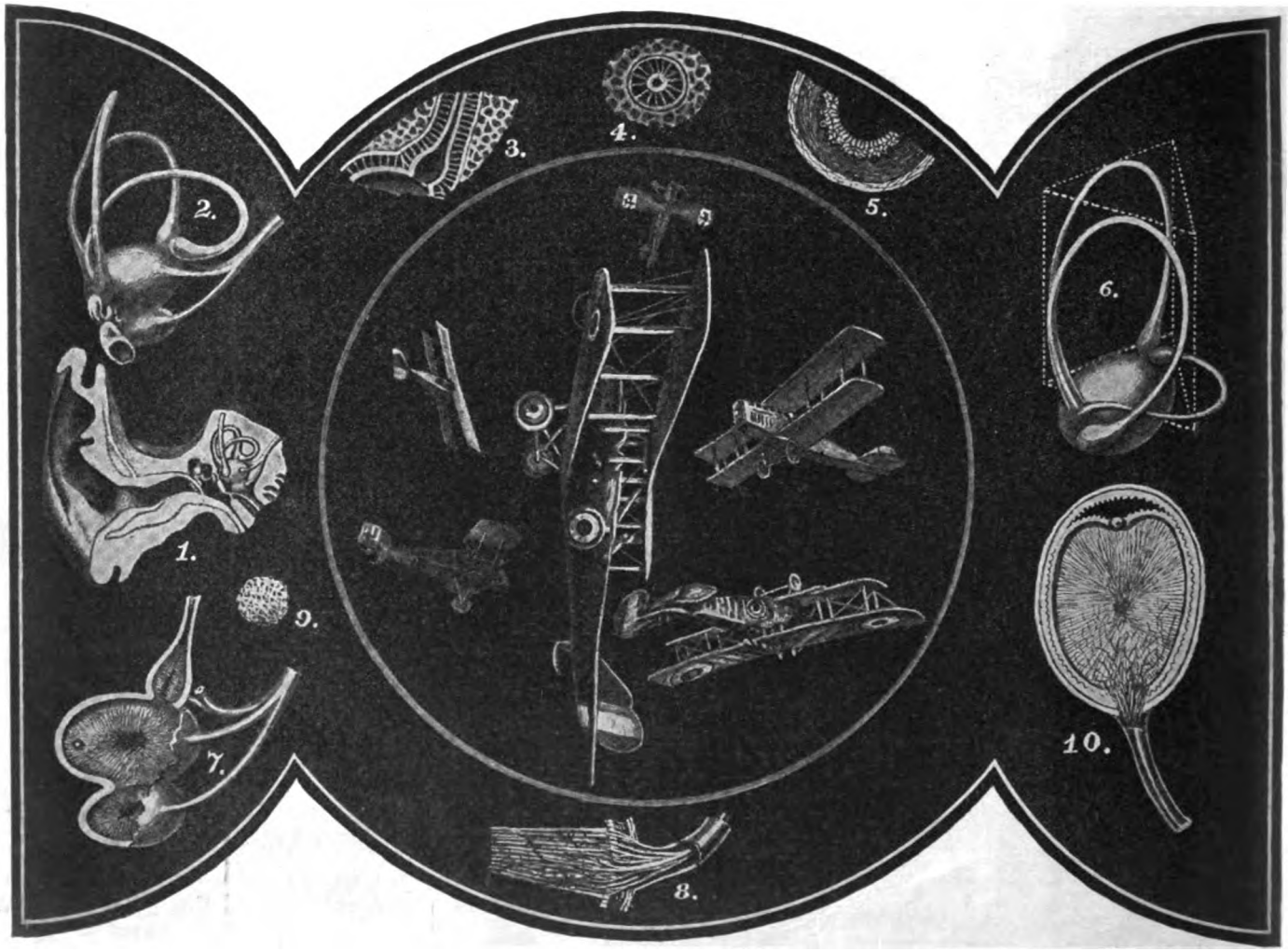


In Fig. 1, We See a Section Thru the Ear, Showing the Labyrinths of the Inner Ear in Their Position as in Life; the Function of Which Is to Tell Us Whether We are "Right Side Up" or Otherwise. These Semi-Circular Canals are More Clearly Illustrated in Fig. 2. Each of These Contains in Its Center Another Canal, Held in Position by Fibrous Bands, Shown in 3 and 4. And the Three Skins of the Organs are Depicted in 5. The Peculiar Arrangement of the Canals, Each at Right Angles to the Other, Can be Seen in 6, and the Branching of the Nerve Entering These Canals in 7 and 8. A Tiny Crystal-Like Ball is Found in These Canals 9, Which Weighs Down a Portion of the Region in Which It Lies, 10. The Shifting of These Weights Convey Thru the Nerves, to the Brain, Varieties of "Position Changes," According to a Well-Known Authority.

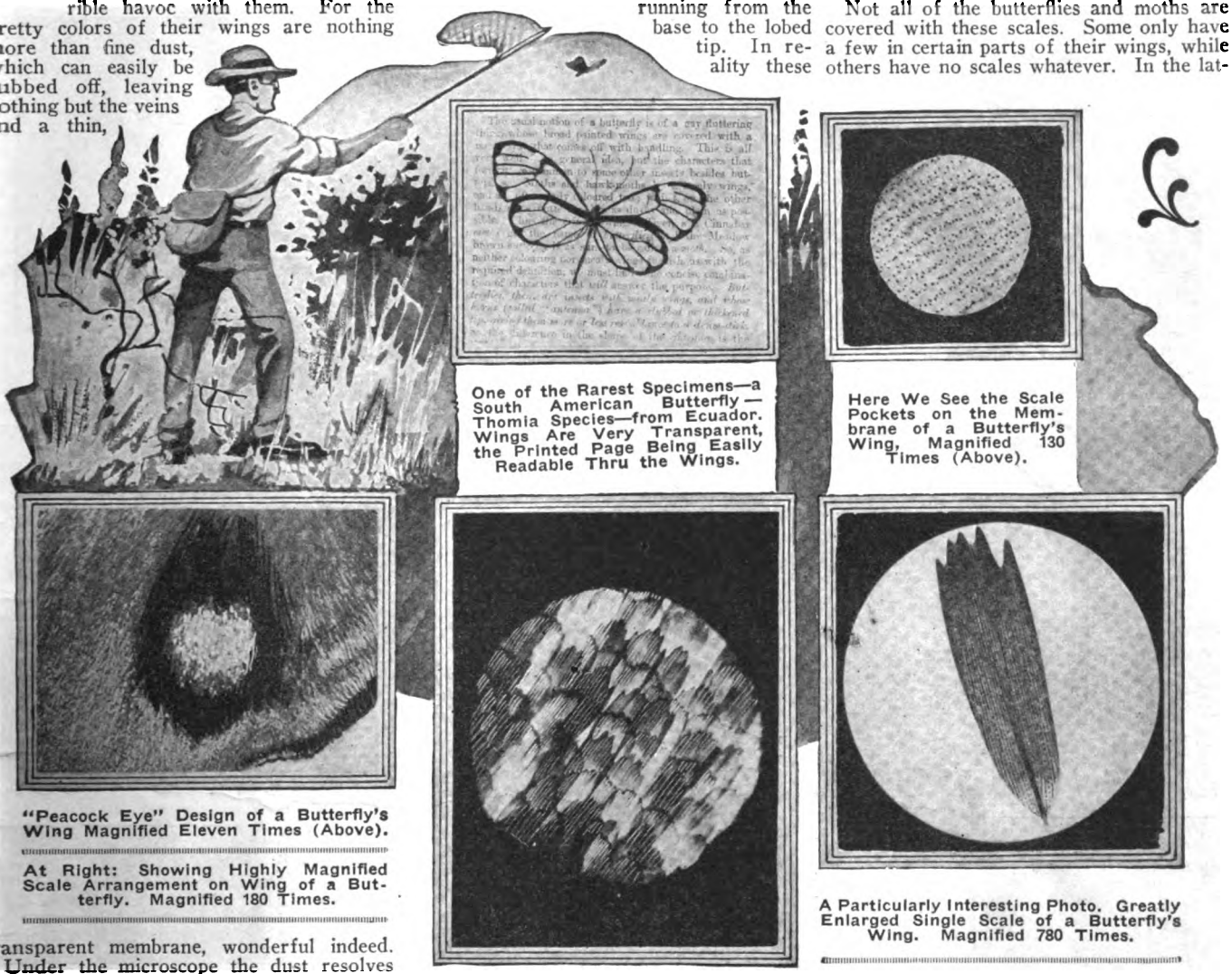
Why the Wing of the Butterfly Is Colored

By DR. E. BADE

ALTHO the wings of both butterflies and moths are very beautiful, they are indescribably delicate. Even the winds and the rains often play terrible havoc with them. For the pretty colors of their wings are nothing more than fine dust, which can easily be rubbed off, leaving nothing but the veins and a thin, transparent membrane, wonderful indeed.

Under the microscope the dust resolves itself into numerous plates, which overlap each other like the shingles on a roof. When one of these plates or scales is magnified 780 times it will be seen to consist of two parts; a base or place of attachment, and a blade or scale proper. The entire scale resembles a leaf. The base or point of attachment is like a short petiole, while the blade proper resembles the leaf. The scale consists of numerous fine tissues running from the base to the lobed tip. In reality these lines are tiny tubes used, probably, for the conduction of air. As the light strikes these tubes, it is refracted and broken up just as a prism breaks up the light into its component colors. This refraction of the light on the scales gives the wings of these insects their bright color, and the multiplicity of color is caused by the arrangement of these tubes on the scales.

Not all of the butterflies and moths are covered with these scales. Some only have a few in certain parts of their wings, while others have no scales whatever. In the latter case the wings are perfectly transparent, the veins only being readily distinguished, as shown in one of the accompanying photographs, where one can readily read the printed page thru the butterfly's wing.



"Peacock Eye" Design of a Butterfly's Wing Magnified Eleven Times (Above).

At Right: Showing Highly Magnified Scale Arrangement on Wing of a Butterfly. Magnified 180 Times.

One of the Rarest Specimens—a South American Butterfly—Thomia Species—from Ecuador. Wings Are Very Transparent, the Printed Page Being Easily Readable Thru the Wings.

Here We See the Scale Pockets on the Membrane of a Butterfly's Wing, Magnified 130 Times (Above).

A Particularly Interesting Photo. Greatly Enlarged Single Scale of a Butterfly's Wing. Magnified 780 Times.

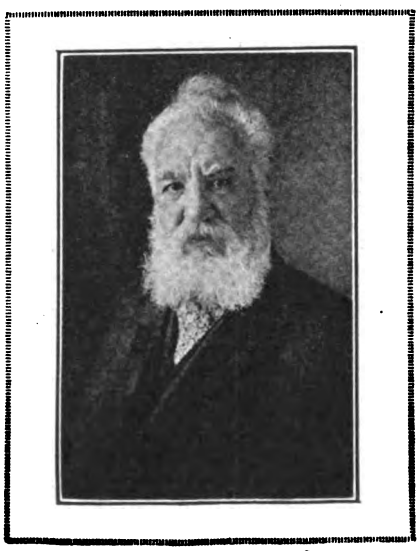
FROM THE INVENTOR OF THE TELEPHONE

Editor Science and Invention:

It has always seemed to me that the name ELECTRICAL EXPERIMENTER did not fully cover the scope of your interesting and useful magazine. In my opinion the title SCIENCE AND INVENTION is a great improvement and I wish you every success.

Alexander Graham Bell.

Baddeck, Nova Scotia.



FROM CLEVELAND PLAIN DEALER.

Editor Science and Invention:

While I do not know how much value you place upon a new name, I am certain that if the magazine, rechristened, delivers the goods as successfully as it has under the old name it will be a great success.

The ELECTRICAL EXPERIMENTER was one of the first in this large field and certainly has been a pioneer in giving information along the line of electrical development.

You certainly have the good wishes of the *Plain Dealer* for your success.

W. G. Vorpe,
Sunday and Feature Editor.

NO—WE WON'T!

Editor Science and Invention:

As one who has followed the rise of your publication from its first few pages in 1913 to its present size with the keenest appreciation, you may understand my interest. When I went to school I heard the ELECTRICAL EXPERIMENTER quoted as an authority, and when in turn it was my fortune to teach Science classes I recommended it to my pupils as being worthy of their study.

Here's wishes for your continued success, Mr. Gernsback. But please, Oh please don't make of your wonderful magazine a mere kid's picture-book of unusual things, which is what most of our so-called science magazines have evolved into.

Corliss L. Parry.

Jackson, Ohio.

Photo-diagram Showing How a Blood Clot May Form Under the Bony Skull Structure and Cause Pressure on the Brain.

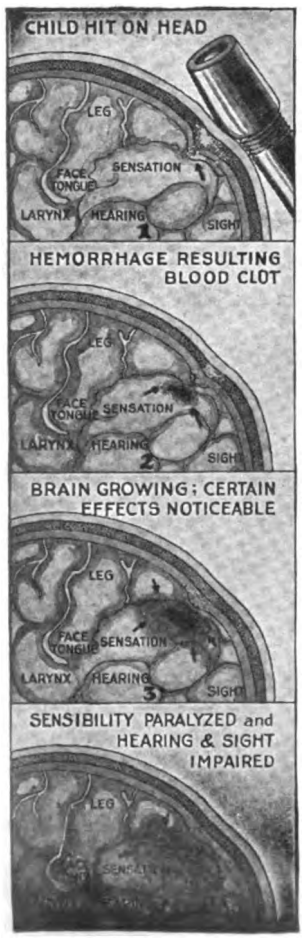
In Modern Trephining, a Silver or Other Metal Plate Is Screwed in Place Over the Opening in the Skull, in the Manner Shown.

The Series of Picture-diagrams, Numbers One to Four, Shown Below, Will Prove of Extreme Interest, Undoubtedly, to the Layman, Showing, as They Do, the Progressive Conditions Resulting from a Severe Blow on the Head of a Child or Adult. After Some Months or Years a Brain Tumor May Develop.

The Actual Trephining Saw, Driven by an Electric Motor, Is Shown in Operation Above in the Act of Cutting a Piece of Bone from a Skull.

The Progressive Illustrations Below, Figs. 5 to 8, Show the Progression of a Trephining Operation. The Motor Saw Cuts Thru the Bone, Which Is Afterward Removed, and Eventually a Metal Plate Is Screwed On Over the Opening Thru Which the Tumor Growth Has Been Removed.

Trephining the Skull



Brain Pressure Released by Surgery

TREPHINING the skull is undoubtedly one of the oldest and withal one of the most delicate operations known to medical surgery. Distinct and well marked signs of this operation can be seen in skulls coming from the Neolithic period, down thru the prehistoric iron age and the later Celtic period, and in such tribes as the Incas and the Youngans it was a very common practise.

Trephining consists of removing from the skull a considerable section of bone, and the purpose is generally to relieve intercranial pressure or for other surgical operations as indicated by proper diagnosis. Of course, there does not seem to be a plausible reason for the operation as conducted among the Incas and various savage tribes of Northern Africa.

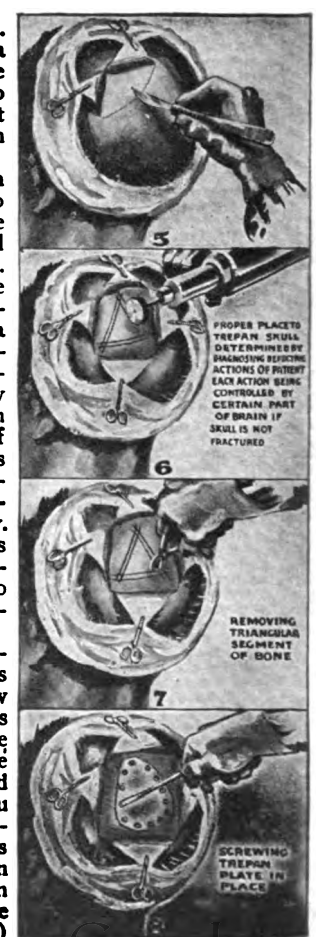
It seemed as tho this operation among those people was more a matter of form and "style" than anything else. Perhaps it also functioned greatly in helping the medicine man to keep up his prestige in the practise of medicine, and also making him appear to be a most wonderful sorcerer. The implements in use in those ages differed materially from those in present use.

Let us go back to about the seventh century B. C. Here we find the operation to be conducted as follows: The "doctor" after preparing his tools by heating them in the fire first proceeded to administer to the scalp a circular instrument which had been heated red hot. This branded a round groove into the scalp and facilitated the removal of that portion of flesh immediately within the circular burn.

At the same time it assisted in sterilizing the flesh preparatory to the operation, altho perhaps the ancients did not know that the red hot iron was of a sterilizing nature. The brand also helped to stop the blood from flowing. After the circular piece of scalp was removed, a very small drill was placed in contact with the bone and rapidly rotated between the fingers until a tiny hole penetrated the skull. Then with crude saws and other methods of chipping out the bone a hole was finally cut into the skull. This operation always took months to perform, as little was done each day.

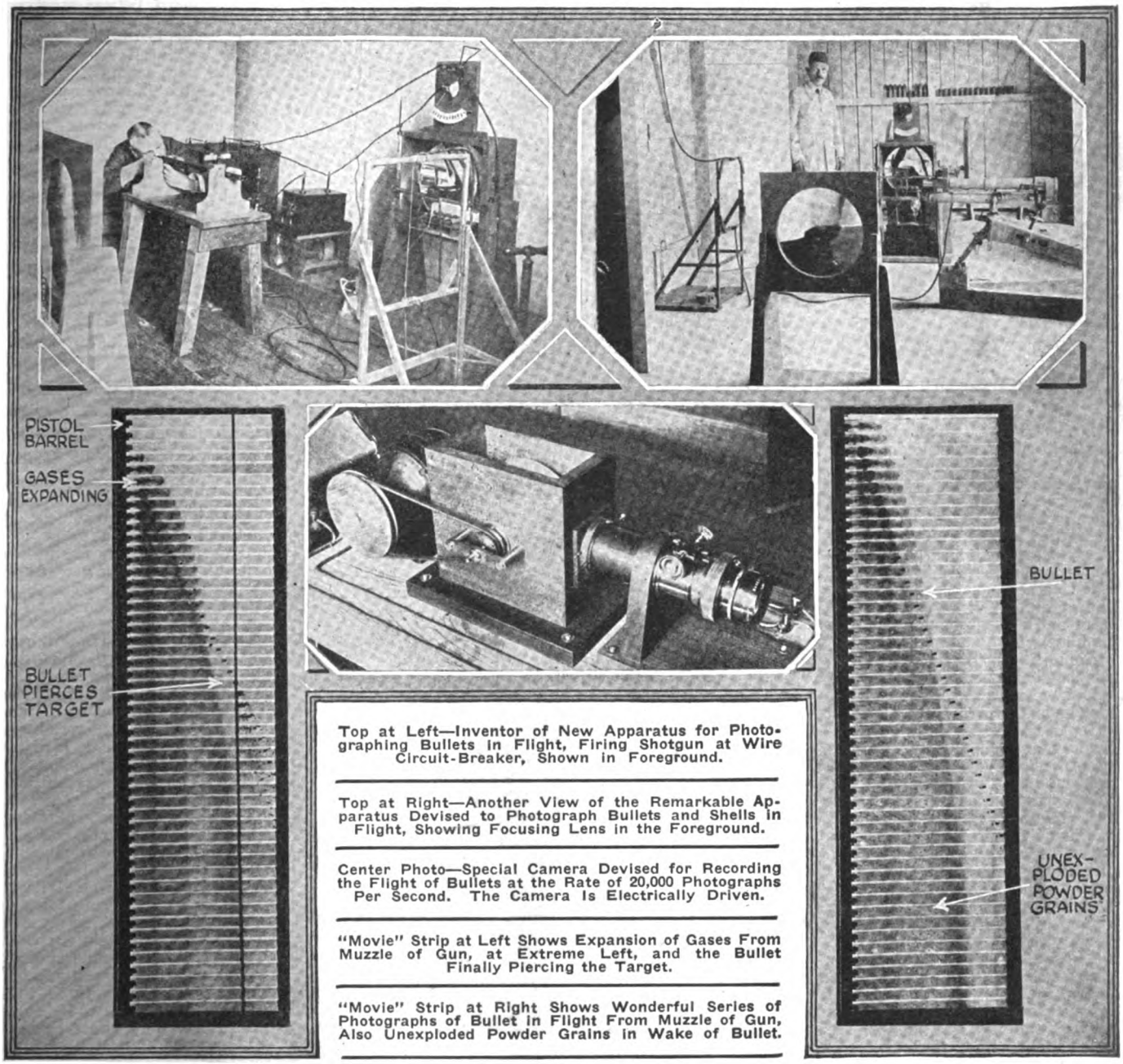
For what purpose the hole was intended has not definitely been ascertained, but the fad seemed to create a profound effect and hundreds had their heads trephined.

The skulls which have been unearthed indicated that the hole was cut in during life. How do we know this? Very simply. Bone which has been destroyed will finally heal the same as any cut or wound and the edges become very smooth. Should a hole be driven into the head thru some accident, it would invariably result in death and of course the edges of the hole would never smoothen up. Even as early as the seventh century B. C. attempts were made to cover (*Continued on page* 663)



"Movies" of Flying Bullets

By PIERRE H. BOUCHERON



Top at Left—Inventor of New Apparatus for Photographing Bullets in Flight, Firing Shotgun at Wire Circuit-Breaker, Shown in Foreground.

Top at Right—Another View of the Remarkable Apparatus Devised to Photograph Bullets and Shells in Flight, Showing Focusing Lens in the Foreground.

Center Photo—Special Camera Devised for Recording the Flight of Bullets at the Rate of 20,000 Photographs Per Second. The Camera Is Electrically Driven.

"Movie" Strip at Left Shows Expansion of Gases From Muzzle of Gun, at Extreme Left, and the Bullet Finally Piercing the Target.

"Movie" Strip at Right Shows Wonderful Series of Photographs of Bullet in Flight From Muzzle of Gun, Also Unexploded Powder Grains in Wake of Bullet.

Photographing a Projectile as it Leaves the Gun, at the Rate of 20,000 Photos per Second

ORDINARILY, the popular snapshot means the reproduction upon a plate or film of the image of a scene which may last either a tenth or a hundredth of a second. It may also consist of the reproduction of a movable scene either animated or of machinery which lasts a thousandth of a second. Today a good photographer, by means of very good light and very rapid plates, accomplishes, without any great difficulty, all manner of rapid photography. However, when it is a matter of photographing revolver bullets in flight which are traveling thru space at 600 meters per second, or photographing shrapnel-shot traveling thru air at a speed of 800 to 900 meters per second, that is another story, and the problem becomes a rather complicated proposition.

There is today no mechanical device which will permit the photographing of projectiles at such high rates of speed, and it is thus that *electricity*, as usual, comes to the aid of science.

During the war Mr. Lucien Bull, subdirector of the Marey Institute, at the suggestion of the Bureau of Inventions, began work upon the problems of ballistics as applied to chrono-photographic phenomena. This method we will now briefly describe.

REMARKABLE WORK OF PHOTOGRAPHING MOVING PROJECTILES

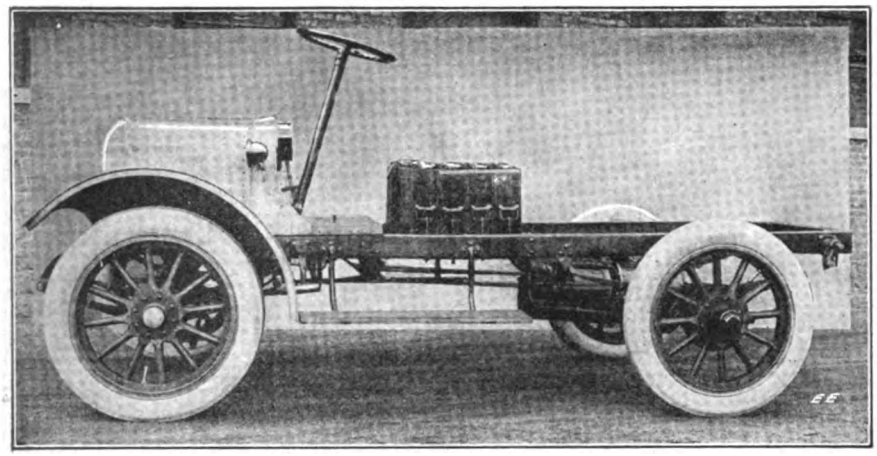
In the first place the electric spark is made to discharge in front of a concave mirror at a point situated at the principal axis, and in such a manner that the rays will converge after reflection in the objective of the photographic chamber. The entire surface of the mirror is thus illuminated at each spark discharge and since the projectile must pass thru the luminous rays, it will produce a silhouette of itself. Thus by producing a series of sparks at regular intervals and of very short durations, as well as by exposing with great rapidity the sensitive film surface upon which is projected the successive images of the projectile, it is possible to chrono-photograph the various phases of the phenomena. The photographs and diagram described in this article will enable the readers to understand the system employed by Mr. Bull and its operation.

THE ELECTRICAL APPARATUS USED

Essentially, the installation consists of a condenser C1, of large capacity shown in Fig. 1, which is in turn charged by the induction coil IC with a secondary potential of about 12,000 volts, thru the intermediary of a thermo-ionic or Villard valve, S. Connected to these instruments is another circuit having a very large resistance R, in the order of 100.000 ohms; with means of opening and closing the circuit thru the key K2 and which connects the large condenser to

(Continued on page 652)

Latest Electric Vehicles.



The Newest Thing In Electric Autos Is That Shown Above, the Invention of Dr. Charles P. Steinmetz, the Famous Electrical Wizard of the General Electric Company. The Field and Armature of the Motor On This Machine, Both Rotate, Thus Doubling the Power.

STEINMETZ ELECTRIC AUTO.

Dr. Charles P. Steinmetz, who has been chief consulting engineer for the General Electric Company, of Schenectady, N. Y., for the past twenty-five years, has just announced the successful development of a new type of electric delivery car upon which he has been working for the past fifteen years. The accompanying illustration shows the chassis, battery equipment and power plant of the new Steinmetz car.

Simplicity of design and light weight characterize the design of this new vehicle. Its other advantageous features are low cost of operation and maintenance, reliability and simplicity of operation, the method of motor control and the design of the motor itself. With standard battery equipment the Steinmetz car has a working radius of fifty to sixty miles at a speed of sixteen miles an hour. In package delivery, to which this car is especially adapted, it has been found that the daily working radius of electric cars is in the vicinity of thirty miles; therefore, the Steinmetz car more than fulfills the necessities of this specific use.

The motor is given compound characteristics by the use of a storage battery floating on the field circuit. As a result, the following advantages are gained: the speed is well maintained on heavy up-grades, and with heavy loads. The car has a specially quick start. On down grades the maximum speed is limited, so that a careless driver cannot race the car. Another very important advantage is that on down-grades the motor becomes a *generator*, acts as a brake, *and feeds electric current back into the storage batteries.* The brake is used only in stopping the car, as the regenerative system acts as a speed check on grades.

The field and armature of the motor *both* revolve, each driving one of the rear truck wheels. Thus the motor acts as a differential, with a decided and corresponding saving of weight. The motor is claimed to give *twice* as much power as the same motor in the customary arrangement with the field standing still.

Turn On the Current From a Storage Battery Carried Between Your Feet, On This Newest German Electric Roller-Skate, and You Can Ride Along the Street or Side-Walk At Any Desired Speed,—Simply by Adjusting the Speed Regulator!

ELECTRIC ROLLER SKATES.

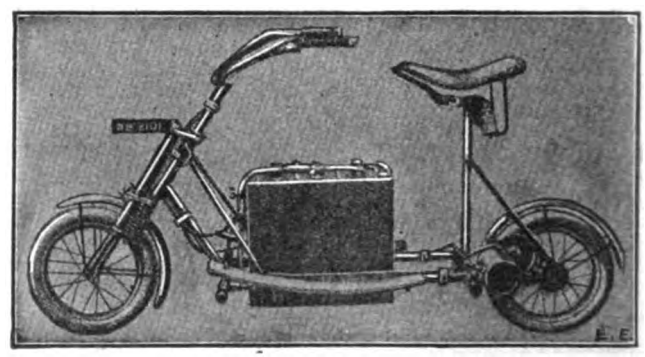
The latest electrical news from Berlin tells us of an "electric roller skate," shown in the accompanying illustration, with which German users have been having a "world of fun" and sport the past winter.

It is in reality an electric roller skate. Both skates are fastened together as shown and placed between them is a 20-volt storage battery, made up by a number of small cells. A flexible wire connected to a control switch and speed regulator or rheostat is connected up with the storage battery and the driving motor in the manner indicated in the diagram. A speed of from eight to ten miles an hour is easily obtained with these skates, and the speed is under perfect control of the *skater de Luxe* at all times.

The electric motor is of the small battery type with which all Americans are familiar and develops about 1/40 horsepower. A smaller motor can be used than at first imagined, especially when the skater gives himself a good start, as it takes a great deal less power to keep him in motion, once he has gained a reasonable momentum. The motor drives the rollers of the skates by friction in this case, but of course there are an infinite number of ways in which the driving power of the motor could be transferred to the skate rollers, such as by chain or belt drive, worm gear, etc.

AN ELECTRIC SCOOTER.

A scooter novelty is being produced by an English concern whose experimental machine has, we understand, been tried out successfully. The frame of this machine, which bears only slight resemblance to the proposed standard article, is of tubular construction and duplex so that a cradle is formed in the center position. A motorcycle saddle and footboards are provided; the wheels are intended to be 18 in. in diameter, altho those shown are only 12 in. The power plant of the machine consists of a ½-H.P. electric motor, forming one unit with its reducing gear, bolted on to and projecting from the rear portion of the frame and driving the back wheel thru a short chain. The motor will probably be later incorporated in the rear wheel. The battery, which weighs one hundred pounds and forms the bulkiest part of the equipment, is situated amidships, resting in the previously mentioned cradle. It is fitted with a quick detaching device and rollers underneath, and also a charging plug on the frame so that the battery may be either removed or charged in position. The controller is in the form of a twist-grip on the handle bar; the machine is said to attain a speed of 9 m.p.h. with a 12-mile radius on one charge of the 6-volt accumulators. No brake is fitted to the machine, but it is intended to provide a retarding effect by means of an easily-operated armature short-circuiting device, thus providing an electro-dynamic brake.



At Last We Have the Electric Storage Battery Motorcycle, or Electric "Scooter" As the English Call It. A British Concern Is Building This One-Half H.P. Electric Motor-Driven Cycle, Which Attains a Speed of 9 Miles Per Hour.

MOTOR HINTS

How I Save My Old Tires

First Prize $25.00.

I CONSIDER it quite a stunt to have run two Ford cars as taxi's for two years without having bought a single new tire. I have solved the tire problem by riveting my tires, such as double treading, etc., and obtain repair junk from the junk man for a few cents and fix up a tire good for from 2,000 to 6,000 miles; oftentimes a riveted will run longer than a new one.

I use four methods of riveting my tires as follows: retreads, reliners, rimcuts and blowouts. The accompanying pictures will show how they are prepared. In retreading, the rim is cut off of the cover and the cover is then placed over a tire on which the tread is worn off, but has a good body and riveted on both sides with the rivets about three inches apart. If a tire has been prematurely ruined by a blowout or cut, I generally put a liner inside of the tire instead of a cover. The liner is prepared the same as a cover but the edges are beveled as shown in the picture so as to make a smooth fit inside (shown in picture) and the rivets are placed about five inches apart except near the cut or blowout, and are placed about an inch apart there. If a tire is rimcut, a rim can be taken from an otherwise worthless tire and riveted on the rimcut tire as shown by picture; also blowouts and punctures may be repaired by making a boot from an old tire and riveted in the damaged casing.

Using Old Tires to Repair Your Present Ones, Forms the Basis of Mr. Smith's Suggestions to Lengthen the Life of Your Tires.

I use No. 10 copper and copper plated rivets in this work. At first I put these rivets in with a wood block and a hammer, but now I use a little machine which cost me six dollars. It is absolutely necessary for success that the following precautions be taken—first a piece of old inner tube or a thin layer of fabric must be cemented over the rivet heads to prevent any possible injury to the inner tube. This strip can be cemented with ordinary cold patch cement. Second precaution—use plenty of cheap talcum powder to keep inner tube from sticking to tire. Third, a good inner tube must be used (an inner with a single cold patch is not good as the cold patch will invariably come off and you ruin your tire and tube). Fourth, precaution—keep the riveted tire well inflated at all times; they will stand as much pressure as a single tire of corresponding size. Contributed by C. L. SMITH.

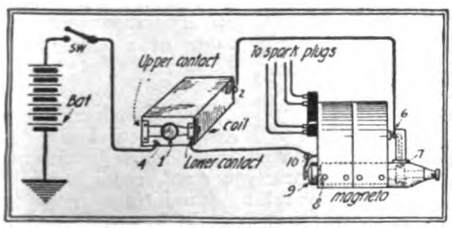
"Burnt Out" Magneto

Third Prize $10.00.

I have a car fitted with a high tension magneto, with which I have had continual trouble. I took it to a magneto service station, and there I was informed that it was "worn out" and that a new one would cost about $50.00. I didn't feel in a position to spend that amount for a new magneto, so I connected an old spark coil to it, as shown in the diagram.

First I took the vibrator points (1) off the coil and fastened the latter to the dash. Then I disconnected the wires at (8), which connects the armature with the breaker box (9) and removed the high tension brush (7). The wires must be connected as shown in the diagram, and the wire (5), which is the high tension lead must be heavily insulated.

Contributed by JOHN W. SWEIGART.



How to Hook Up a Spark Coil to the Distributor of a High Tension Magneto "Gone Dead".

$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**

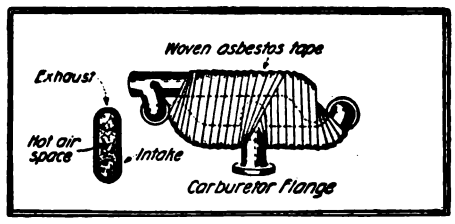
All other accepted articles, which win no prizes will be paid for at the rate of $2.00. Articles submitted should not be long ones. About one hundred to two hundred words will suffice. Address all manuscripts to Editor, "Motor Hints," care of this publication.

Vaporizer for Poor "Gas"

Second Prize $15.00.

The owner of an automobile made some years back, is aware of the fact that the design of his engine is such that considerable difficulty is noted in using the present-day fuel, which contains a large percentage of kerosene. The gasoline mileage is low, the engine is sluggish, and carbon deposits are heavy, and cylinder oil must be renewed at regular intervals, owing to thinning from raw gasoline reaching the crank case.

The heat of the exhaust pipe is utilized to heat the intake gases, by wrapping several layers of asbestos tape around both, that make them practically one unit, with a hot air space between. The asbestos, being a non-conductor of heat, confines the heat to the exposed surfaces of the intake manifold, which gives an ideal heating condition that many motorists are striving for. This asbestos may be obtained at any accessory supply house or plumbing shop at slight cost. It can be wrapt about the manifolds by anyone, care being taken to have each strip of tape over-lap the other strip at least one-half inch, to guard against the possibility of cracks appearing in the walls of the tape.



Simple Yet Effective Stunt for Vaporizing Low Grade Gasoline by Using Exhaust Pipe Heat.

Contributed by R. L. PRINDLE.

CURE FOR "SMOKING" ENGINE.

A modern high speed six-cylinder auto engine had to have its cylinders ground in order to correct an annoying *piston slap*. New pistons and rings were fitted.

The entire job was done to perfection, but when the car was assembled, clouds of smoke resulted. This pumping of oil persisted even after it was reasonable to expect that the rings were worn in smooth.

When the engine was taken apart no fault was found except in large deposits of carbon.

This will be understood when one realizes that one gallon of oil was burned every hundred miles or so.

Finally the original pistons were carefully examined once more.

Under the lowest of the three rings, in the groove, were found hidden five small holes about 1/32 in. in diameter, drilled right thru into the cavity of the piston.

Similar holes were drilled in the new pistons with the immediate result that not an atom of smoke is visible operating the car, while oil consumption is lower even than before the cylinders were ground.

Contributed by C. D. MARTINETTI.

Popular Astronomy

By ISABEL M. LEWIS, M.A.

of U. S. Naval Observatory

Giants and Dwarfs Among the Stars

JUST as our planet Earth is a pigmy compared to the major planets of the solar systems, Jupiter, Saturn, Uranus and Neptune, so is the ruler of our solar system himself far inferior as a sun in size and light-giving power to such brilliant suns as Rigel, Canopus, Arcturus, and Antares. The latter are classified among the giants of the universe. Our sun must be counted among the dwarfs.

All of the intensely hot and luminous helium or Orion stars (labeled astronomically type B stars) are giants. In light-giving power the typical helium star is the equivalent *of one hundred suns.* The quantity of matter in such a star, that is, its mass, probably totals that of eight or ten such suns as ours, and it exists in these stars in such an extremely diffuse state that they usually considerably exceed our own sun in volume.

The density of a typical Orion star averages from one-hundredth to one-tenth that of the sun.

It can be shown that to act as a perfect gas a star must have a density not greater than one-tenth of that of the sun, the density of the sun being one and four-tenths that of water. Practically all of the helium stars, therefore, behave as nearly perfect gases wherein they differ greatly from our own sun with its comparatively great condensation of matter.

Tho the bluish, helium stars are massive giants and the hottest of all the stars, they are greatly surpast in size and luminosity by the giant red Cepheid variables, which are the most diffuse and voluminous of all stars.

Cepheid variables form a peculiar class of stars that have come into great prominence within the past few years thru possessing certain characteristics that have proved to be of the highest value to the astronomer in his efforts to gage the size and extent of the visible universe.

Cepheid variables received their name from Delta Cephei, the first known variable star of this class. They are without exception giant suns — red, yellow or bluish in color. They possess a peculiar form of variability of light of a periodic nature, consisting of a sudden rise to maximum brightness followed by a slower decline to minimum brightness. The cause of this periodic variability of light is still doubtful, but Shapley's interpretation of it as due to "periodic pulsations in gigantic volumes of luminous gas" is the most reasonable and satisfactory explanation that has yet been advanced. For any one star the period of variability of light is as exact and invariable as clockwork, one cycle of variability usually differing from another in length by less than a small fraction of a second.

From star to star, however, there is great difference in the length of period. Cepheids with periods of only a few hours' duration are known to be intensely hot, bluish stars, similar to the Orion stars, with an average luminosity equal to that of one hundred suns, individual stars differing very little in luminosity from the average.

This Photograph Shows the Lower Half of the Constellation Orion. The Disk-Like Appearance of the Stars Is Due to the Cumulative Effect of Light on the Photographic Plate During the Exposure of Two and One-Half Hours. Even the Nearest Stars and the Most Brilliant Stars Appear Visually as Mere Points of Light in the Telescope. The Great Nebula in Orion Is Dimly Seen Just Below the Center of the Photograph. The Three Stars Evenly Spaced Form the Belt of Orion. Rigel Is the Brilliant Star at the Lower Right. Orion Stars Average One Hundred Times More Luminous Than the Sun.

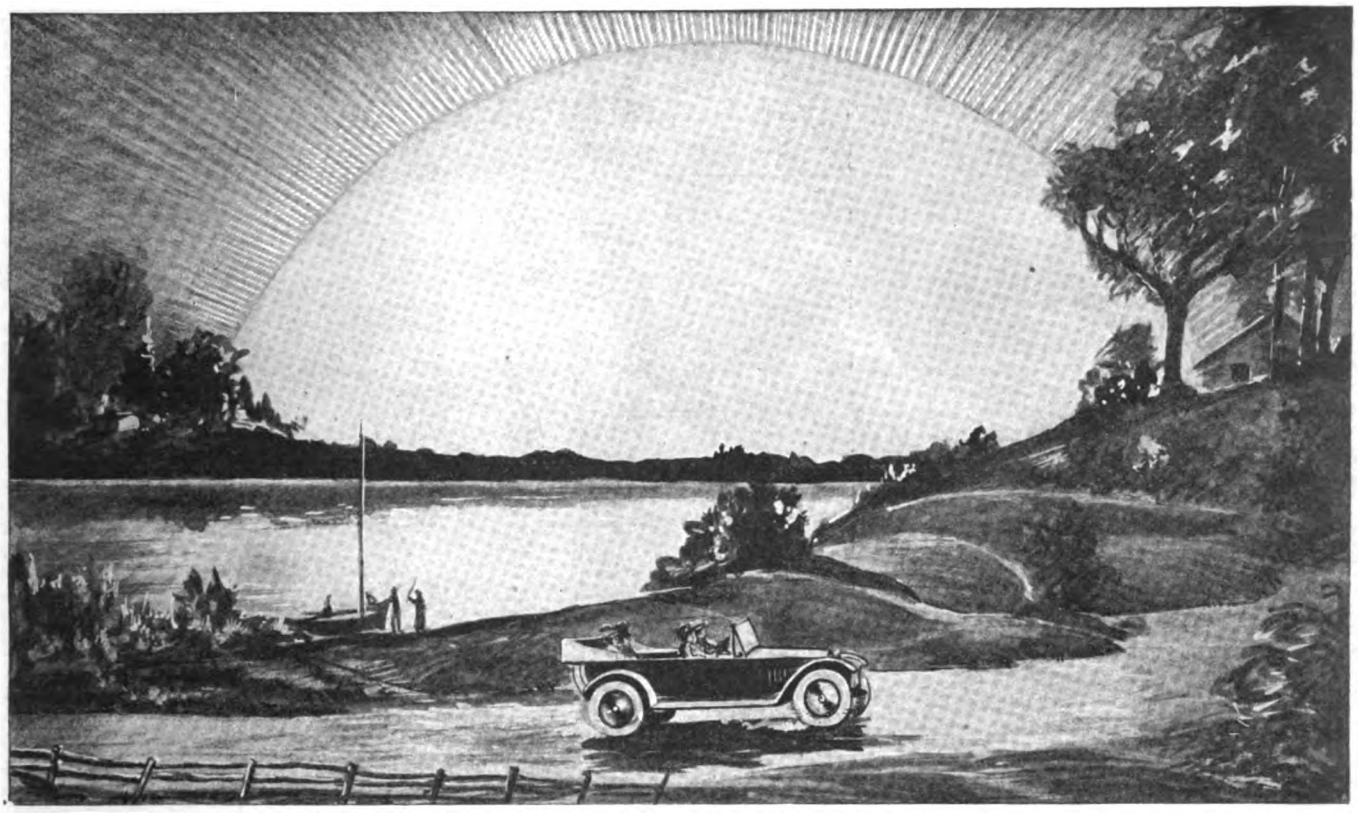
Photograph of the Nebula in Orion, Showing Stars in Midst of the Nebulosity. The Entire Constellation Is More or Less Enmeshed in Nebulosity. Are the Stars Condensing From the Nebulae or Are the Nebulae Emanations From the Surfaces of Excessively Hot Massive Stars That Are Driven Forth by Radiation Pressure? There Is Considerable Uncertainty as to Whether the Nebulae Are the Progenitors of the Stars, or the Products of Their Dissolution. Only the Bluish White Stars Are Found Associated With Nebulae. Red Stars Are NEVER Found in the Midst of Nebulosity.

The density of these bluish colored Cepheids never exceeds one-tenth that of the sun and they are the densest and the hottest of all Cepheids. The yellow Cepheids have longer periods of light variation ranging from two or three days to fifteen days and they are cooler and less dense than the bluish variety. They are also more luminous than blue Cepheids, a typical yellow Cepheid being equal in luminosity to a thousand such suns as our own. Since they are cooler than blue Cepheids their greater luminosity is due to the fact that they radiate light from a more extended surface, that is, they are greater in volume.

Cepheids of longest period, ranging from about fifteen days to two months, are invariably red. They are the coolest of all the Cepheids, the least dense and the greatest in actual size. Exceptionally large *giant red Cepheids radiate as much light as ten thousand such suns as ours.* The average density of a red Cepheid variable is only a few millionths of that of the sun, or less than one-hundredth of the density of the earth's atmosphere at sea level. A super-giant of this class is equivalent in volume to one hundred thousand suns, and its diameter is therefore something like forty million miles as compared to a solar diameter of eight hundred and sixty-four thousand miles. If placed at the center of the solar system such a luminary would extend more than half way to the orbit of Mercury and would have in our skies an apparent diameter of nearly twenty-five degrees. In rising it would cover nearly one-third of the distance from the horizon to the zenith. To add to the weirdness of the effect this huge volume of deep red gaseous vapors would pulsate rhythmically in an invariable period of several weeks' duration, if the theory of an internal cause of the variability of the Cepheids is correct.

We have noted that the size luminosity, density, temperature and color of a Cepheid is a function of its period of variability.

The Cepheids of longest period are always great in volume, and low in density, and are comparatively cool, reddish bodies averaging several thousand times more luminous than the sun. Owing to the great extent of their radiating surface they are the super-giants of the universe. As the periods of the Cepheids decrease in length from a few weeks to a few days, a change takes place in the size, color, density and temperature of the stars. Cepheids with periods of only a few days' duration are yellow and denser, hotter and less voluminous than giant red Cepheids. Typical yellow Cepheids are one thousand times more luminous than the sun on the average with very little departure from this average for individual stars. When we come to Cepheids



We Are Accustomed to Think That Our Sun Is a Giant, But This Is Not the Case. There Are Dwarf Suns and Giant Suns, and Even Super-giant Suns. Our Own Sun Is An Intermediate Between Giant and Dwarf Suns. A Sun of the Size of Planet Jupiter Would Be Considered a Dwarf Sun, While the One Shown In This Illustration Is One of the Super-giants, Many of Which Exist Thruout the Universe. Such a Sun Would Give About 10 Million Times the Amount of Light and Heat of Our Own Sun. It Would Take Up Nearly Three-quarters of the Entire Sky, If That Sun Was Spaced at the Same Point In Space as Our Own Sun. The Above Illustration Shows This Graphically, and Also Shows How Such a Giant Would Appear to Our Eyes. Needless to Say, the Great Heat from Such a Sun Would Be Sufficient to Wither Everything on Earth and Dry Up Every Ocean and Lake in Short Order. The Picture Is Simply Given as a Comparison to the Size of Our Own Sun as Per Illustration Below.

with periods of variability of only a few hours' duration we find that all such stars are bluish in color, and hotter, denser bodies than Cepheids belonging to the two preceding groups of red and yellow variables. Blue Cepheids are uniformly giant suns approximately one hundred times more luminous than our sun, as is also true of the helium or Orion stars.

It is evident, then, that knowing the period of variability of a Cepheid we are able to say just how luminous a body it is intrinsically in terms of the luminosity of our own sun. That is, we know its *intrinsic brightness,* or absolute magnitude as the astronomers call it, and we have a means for finding the *distance* of such a star, which is a matter of highest importance in gaging the scale of the universe.

A street light of known candle-power will appear fainter the more distant it is from us and its apparent brightness will decrease with distance according to a definite known law, so that by measuring the light's apparent brightness and knowing its *true* brightness we can find its distance from us. The same principle holds for the stars for they are but light sources at varying distances from the earth. When we once know the absolute magnitude or *intrinsic* brightness of a star and have observed its *apparent* brightness we can obtain its distance by the simplest computation, and that is exactly what the astronomers have done in the case of the giant Cepheid variables. The period of variability of a Cepheid is observed; the intrinsic luminosity of the star, which has been found to be a function of the period then follows directly from the period. A measure of the *apparent* brightness of the star is next made and a comparison of the two shows the distance of the star.

It was by this method that Shapley found the distances of globular star clusters which contain Cepheid variables of all three types, red, yellow and blue, and which are so distant (between 30,000 and 200,000 light years from the earth) that a star of the luminosity of our own sun, if existent in even the nearest of such clusters would be hopelessly beyond the reach of the most powerful telescope in existence.

We have spoken so far of giants of the Orion or helium type, the hottest and most massive of all stars, and of the giant Cepheid variables, red, yellow and blue, the blue type resembling the Orion stars in temperature and density and the huge red giants being the most diffuse and greatest in actual size of all known stars, tho lower in temperature than the more condensed blue giants.

How is it, then, with other classes of stars, the hydrogen stars and the calcium stars, which are respectively white and yellowish-white stars, the class of yellow solar stars to which our own sun belongs (type G), and reddish stars (the K and M types of the astronomer's classification), in which the formation of metallic compounds testifies to a comparatively low temperature? Are these stars giants or dwarfs among the glowing suns of our wonderful universe?

With the exception of the hydrogen stars, which resemble the Orion stars in being intensely hot and brightly luminous stars averaging one hundred times more luminous than our own sun, but with a greater range of individual brightness, we find a most remarkable division of each type of stars into giants and dwarfs.

This separation of each class into two distinct groups is not so marked in the yellowish-white calcium class but it becomes more pronounced among the cooler types until in the class of red stars (known as type M) there is a sharp division into two groups of dwarfs and giants with a complete gulf between the two groups, wherein no stars of intermediate size and brilliancy appear. Dwarf red stars have only one ten-thousandth part of the brightness of the giants of the same class on the average. As the similarity in the color and spectrum of all red stars shows that unit for unit of surface area they radiate with equal intensity, this difference in luminosity is due to an actual difference of ten thousand fold in *surface area* or *ten million fold* in volume. Red dwarfs of class M, therefore, have only one-millionth of the volume, or one-hundredth of the diameter, of giant red stars of the same class.

So far as can be judged from data which are as yet very meagre, stars differ one from another very little in their masses or the quantity of matter they contain. The known range in masses of the stars is from one-sixth that of our sun to twenty times that figure, while in intrinsic luminosity some stars are known to differ from others *ten million fold.* This great difference in luminosity must be chiefly due, therefore, to a difference in the *density* and *volume* of the stars.

(*Continued on page* 650)

This Picture Shows Our Own Sun at Sunset Time, and Is Merely Printed as a Contrast to the Picture Above.

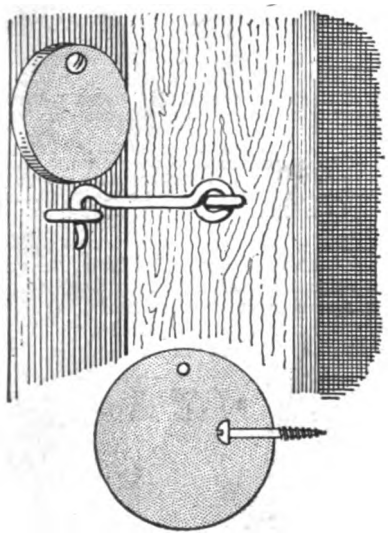
Home Mechanics

Conducted By WILLIAM M. BUTTERFIELD

AUTOMATIC HOOK LOCK.

ON screen doors generally thruout the country a common hook and screw eye is used for a lock, people often depending upon this simple device at night as a means of protection. It is the easiest thing in the world to unhook such a fastening from the outside with a bent hairpin or wire stuck thru the netting —which acts as a support for this simple house-breaking device. It is just as easy to stop the possibility of such light-fingered proceedings. The device here shown is automatic in its operation, always locking the hook by itself whether one remembers to do this or not.

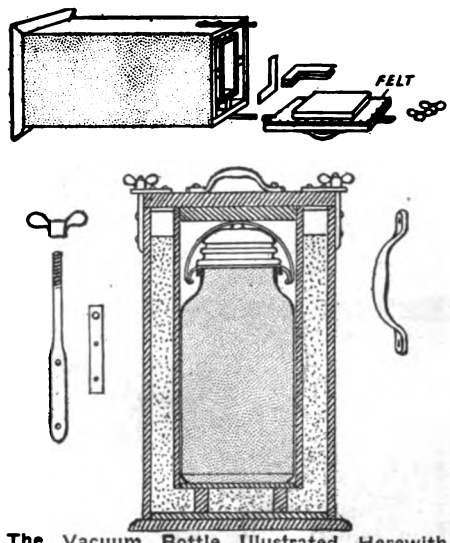
It consists of a round disk of wood or metal, 2½" in diameter and ½" thick, screwed to the door frame just over the screw eye in such a way that it swings loosely like a pendulum. It will be seen from the drawing that this disk secures the hook when placed in the screw eye and falls into position of its own weight once the hook is thus placed. It cannot be swung back from the outside.



The Ordinary Hook Lock Affords No Protection Whatsoever, So Simply Can It Be Opened From the Outside of the Door With Either a Hairpin or Bent Wire. The Device Here Shown Prevents This, Always Locking Securely By Itself.

A HOME-MADE THERMOS BOTTLE.

Our bottle consists of a glass container, such as a fruit jar, that is water-tight at the top, and a wooden sheath with an air-tight cover. The size of the container regulates the size of its sheath, of course, which consists of two oblong boxes, set one within the other as shown, and held apart by suitable cleats—the smaller one just fitting the container in a loose manner at the sides and 1⅛" longer on the inside for the cover. There should be a space of 1½" between the boxes on each side and at the bottom for the insulation of sawdust, bran or chopt hay. The cleats hold the boxes flush at the top. All nailed joints must be made air-tight, using tarred string or oakum driven into the cracks, just as tho caulking a boat. The insulation must be tampt down firmly in a compact mass and retained with the four tin squares shown in the upper illustration, using small nails driven part way into the wood around their upper surfaces. The cover is made of one-inch wood and consists of two parts, one fitting snugly into the top of the inner box, the other covering



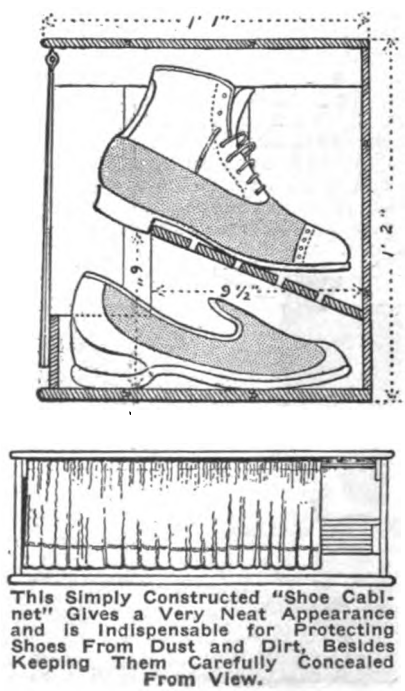
The Vacuum Bottle Illustrated Herewith, Can Be Made With Very Little Trouble and Expense.

the outer box in the manner shown; both are nailed to each other and secured to the outer box with bolts and thumb-nuts. The top is provided with a handle for carrying the bottle. Along the under surface of the cover, over the boxes, a square of heavy felt makes the top airtight, like a fruit-jar. The outside of the sheath is stained or painted if desired.

HANDY SHOE AND RUBBER CABINET.

At Fig. 1 we show a home-made shoe and rubber case that has the advantage of being easily made either for the bottom of a bedroom closet, or when more pretentiously or carefully constructed, as a window seat. In either case, the foot coverings are protected from dust, allowed sufficient air to dry, and from their position in the case, kept in their original shape.

For the closet form the proportions should be about as given on the drawing, using lumber of the kind known as sheathing (¼" thick and 4" or 5" wide) with tongue and groove, the length to be governed by the requirements of the maker. The ends are

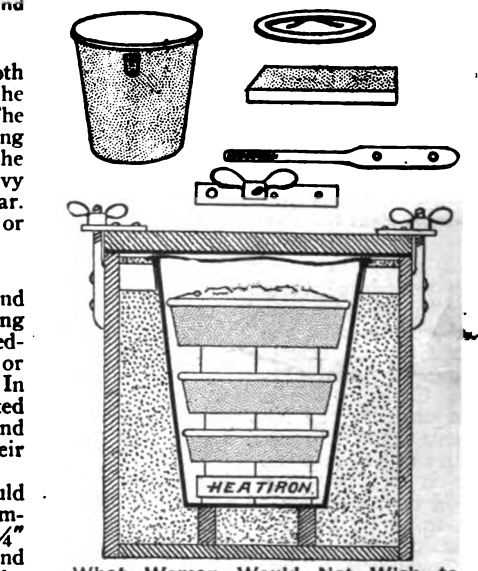


This Simply Constructed "Shoe Cabinet" Gives a Very Neat Appearance and Is Indispensable for Protecting Shoes From Dust and Dirt, Besides Keeping Them Carefully Concealed From View.

made first with the board held together at the top by cleats of ½" lumber, and at the bottom by the pieces holding the shoe-rack. also ½" thick and 9" wide. Top, bottom, back, front-rail and rack are nailed to the ends as shown. An ordinary curtain-rod is used to hang the screen or curtain. If the case is designed as a window seat, the lumber should be ½" for the top and bottom and 1" for the cleats and rack holders. Such a seat, covered with creton, will make a very presentable cabinet for "milady's" thirty-dollar boots and pumps.

A FIRELESS COOKER.

The cooker consists of a galvanized pail and cover with the bail or handle removed and the handle-holders on each side bent down below its top edge; a square wooden box 2" wider at the sides than the diameter of the pail and 1¾" longer; a wood cover 1" thick, and fastenings, cleats and insulator as shown. The pail is the ordinary one commonly found at hardware and grocery stores. The box is constructed of ½" lumber made tight at the joints by caulking with



What Woman Would Not Wish to Possess a "Fireless Cooker" Which Does Its Work Well? This Fireless Cooker Can Be Constructed at Home at Small Cost.

tarred twine or oakum; the under surface of cover is lined with heavy felt and the insulating material is sawdust, bran or chopt hay.

In order that the pail can be taken from the box for cleaning, a jacket of cardboard roofing or tin is first fitted and wrapt around the pail loosely and held with a cord; between this jacket and the box the insulating material is put in round the pail and rammed into a compact mass, forming a permanent pocket to contain the pail and hold the insulating body in place. The two sustaining cleats at the bottom, and those at the four sides, are adjusted and fastened before the insulator is installed; to prevent its spilling it is covered at the top edge of the box by tin or cardboard fitted to the pail and along the edges of the box as shown, held by small nails driven part way into the wood above the upper surface. Squares of sheet iron are used between the dishes and under the *heat iron;* this iron may be one or more stove griddles piled one above the other.

To use this fireless cooker, heat the *heat iron* or stove griddles over a hot flame or fire; then place the iron and dishes in the position shown, and fasten the cover down either with bolts or weights.

The "Loaded Line

By CHARLES S. WOLFE

I GAZED in frank curiosity at the man seated across from us. Of modest stature, plain featured, quietly drest, this man was of the type that blends into the mob. And yet, as president of the local traction company, he had dragged that concern from a very violent flirtation with the sheriff to its present impregnable position. Truly, here was a book not to be judged by its cover.

Davidson and I were sitting thru the recital in attentive silence, while Fenner probed at his pleasure with an occasional question or two.

"This matter, gentlemen," Forbes, the traction man, was saying, "may not seem to you to require the services of the police. I thought at first that a little searching on the part of the linemen would clear the thing up. But I am convinced now that this is no ordinary leak.

"Every morning at 1:45 there comes this extraordinary call for power. At this time practically every thing is off our lines but the freight cars. When we first noticed it I attributed it to *grounding*, but the regularity with which it occurs — considering, too, the unusual hour—forces one to abandon that theory.

"The linemen found several small *grounds* and removed them. This had no effect whatever on this mysterious drain. Then I gave the engineers a try at it. They have been unable to eliminate it or account for it.

"Of course, the story leaked, and it has been going the rounds at the barn. And this is really the reason that I have sought police aid. For the affair threatens to assume unsuspected proportions. You see, the men superstitiously attribute the thing to supernatural agencies and the theory that we are being warned of a catastrophe is gaining a serious following. A few men, rather than risk flying in the face of fate, have quit their jobs already, and I realize that it is only a matter of a short time when a general walk-out will ensue.

"Chief Davidson here has brought you to me as a man qualified to handle the matter by reason of your knowledge of electrical matters," I must urge you, Mr. Fenner, to bend every effort to the speedy ending of this peak, and I can assure you that the company will pay well for a successful solution.

"All our resources are at your disposal. Here are passes over our lines, and should you need aid of any kind at any time you have only to use the telephone. From this you will understand the importance we attach to the affair."

"Superstition is a force against which even the rifle is helpless," acquiesed Fenner. "I will do my best to bring to light the real cause of this power loss in time to avert trouble with your employes. Let us review the facts in the case. To begin with about a month ago the men in charge at your power house noticed a sudden and severe call for power about 1:45 each morning."

Forbes bowed in silence. Fenner proceeded.

"And how, Mr. Forbes, was their attention called to this unusual call?"

"By the peak in the power curve," responded the traction magnate.

"The peak in the power curve?" echoed Davidson, blankly. "What in thunder is that?"

Both Fenner and Forbes smiled.

"You see, Chief," Forbes explained, "we make our generators keep a record of their output. By means of a simple electrically actuated writing arm, or stylus, we cause them to trace on squared paper a record of the day's activities. This tracing—this record is—is known as the *power curve*. Clear to you?"

"Well, I get the general idea," admitted the Chief, slowly, "but I'm hardly up on the details."

"Later you'll see more of it," Fenner interposed. "Let us resume. You have had your linemen go over your circuits with a fine tooth comb, Mr. Forbes, and they have found no leak that would account for the loss. Also your engineers can find no clue to its cause."

Forbes nodded.

"Have you, personally, a theory?"

Forbes seemed uncertain. When he spoke it was hesitatingly. "Well—I hardly know. I did have a sort of a suspicion, to be frank with you, but honestly I don't think it will hold water."

"In confidence, then, Mr. Forbes," Fenner was pleasantly persuasive, "let us have your suspicion. It can do no harm to air a personal opinion."

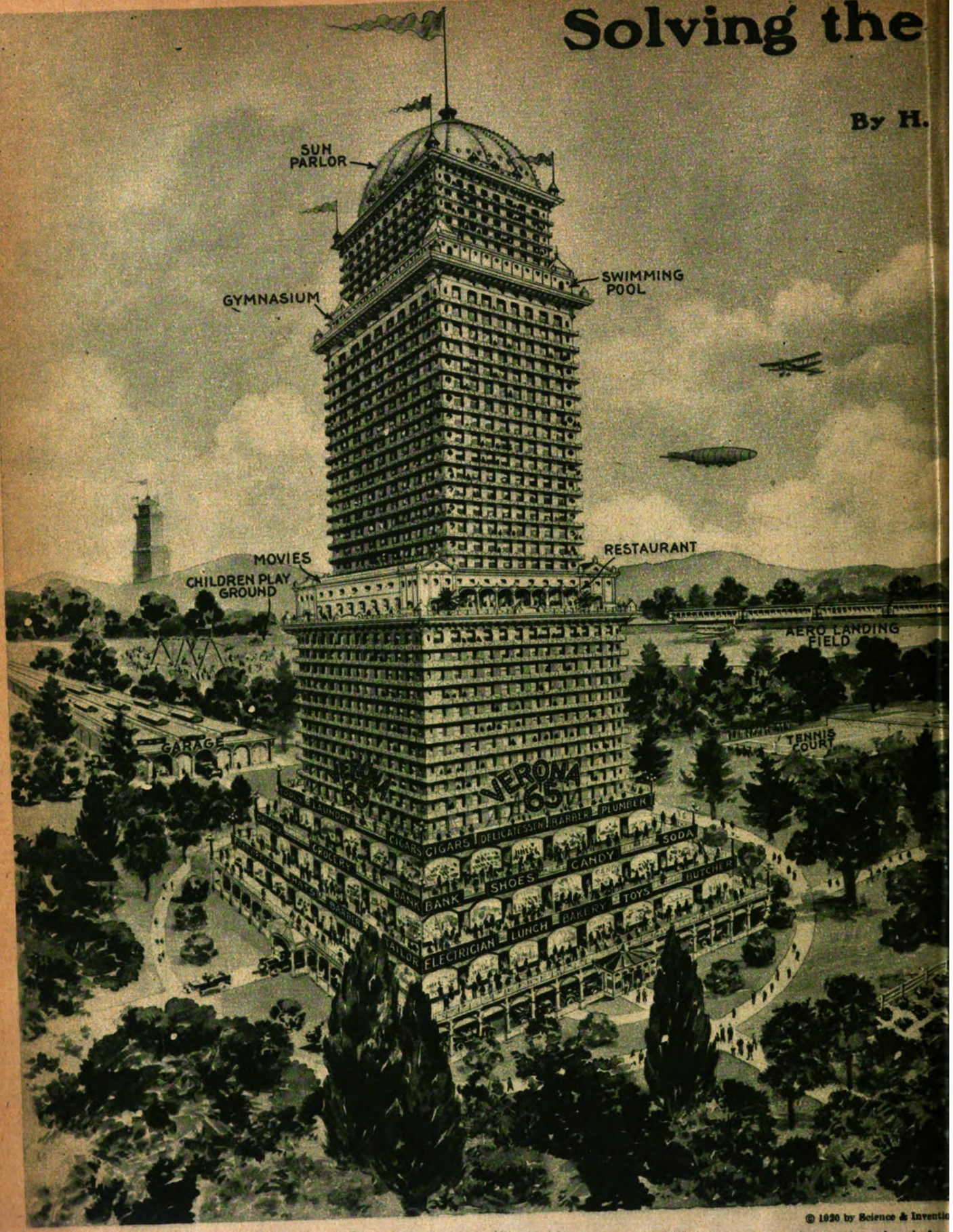
"Well, when I realized that we were up

(*Continued on page 672*)

"... Heavy Breathing and a Blacker Bulk Moving in the Blackness Before Us. With Bated Breath I Watched Its Shadowy Movements. Fearful of Even the Sound of My Own Breathing, I Was Half Stifled From An Effort to Live On a Minimum of Air. Then the Bulk Retreated Toward the River, and Presently, Silhouetted in the Moonlight At the Clearing's Edge, We Got a Glimpse of the Man's Form."

Solving the

By H.



WE need hardly go into a lengthy explanation about the housing problem which confronts the majority of people at this time. It is not only a condition that prevails in the United States, but is universal all over the globe. Due to the war no new construction to speak of has taken place while the population has increased anywhere from ten to twenty per cent, depending upon the various nations. A condition has been created thereby which has become well nigh intolerable. Neither houses nor apartments are to be had, and those that may be had are prohibitive in price, indeed.

The average human being prefers the country to the city. He does not live in the city because he likes it, but because he has to for business and economic reasons, as well as for the sake of convenience. The man who lives in the country gets fres

Housing Problem

GERNSBACK

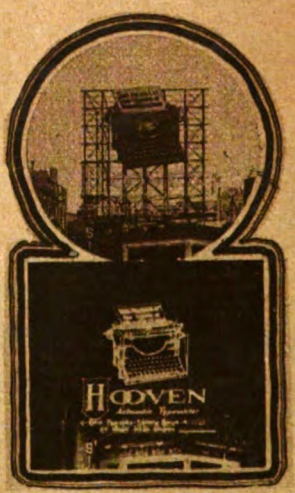
air, and fresh produce, while his children have ample room to play; moreover he has more room than his city brother. Against this it is charged that he has no convenience to speak of. He has to attend to his furnace, he has trouble in getting his coal, and he cannot buy all the things he requires in the little village or country place in which he resides. This makes for expensive transportation of small quantities of goods or other necessities. Moreover, in the average country town, there are few amusement places where a man may take his family. In the larger villages, to be sure, we have moving picture houses and the like, but in this case the village approaches again to the city size with all its congestion, high rent, etc. Moreover, many of life's necessities cannot be bought in the village, and are usually brought in from the city by the

(*Continued on page* 683)

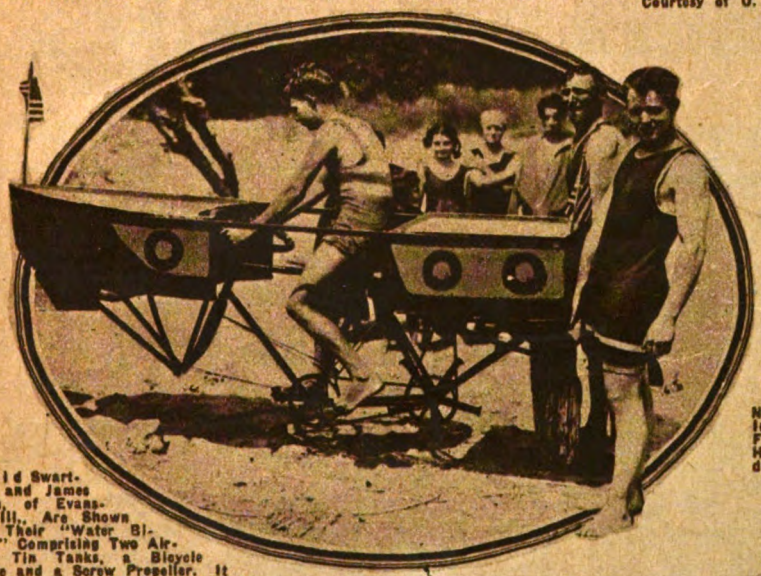
Science News

Makes Milkmen Fear Water! The "Cryoscope," Which in Eight Minutes Enables One to Tell Just What Amount of Water Has Been Added to a Sample of Milk, Until the Invention of This New Testing Apparatus, Which Is Based on the Principle of the "Freezing Point" Test, No Suitable Rapid Method for Detecting Dishonest Milk Dealers Had Been Perfected.—Photo by Gilliams Service.

The Paddle Boat Affords the Aquatically Inclined Young Woman All Kinds of Sport on Pond, Lake, or Placid River. It Works on the Same Principle as the Old-Fashioned Mississippi River Steamboat, Only the Side Paddles Are Hand-Propelled. Lots of Girls Are Just Crazy About It!—Photo by Gilliams Service.



Day and Night Views of Huge Electric Typewriter Sign in New York City. The Keys of the Machine Operate in a Very Realistic Manner and the Letters Appear on the Paper as They Are Printed Until the Story Is All Told. The Typewriter Measures 28 by 35 Feet; 1,578 Ten-Watt Lamps Illuminate the Display.—Photo Courtesy of O. J. Gude Co.

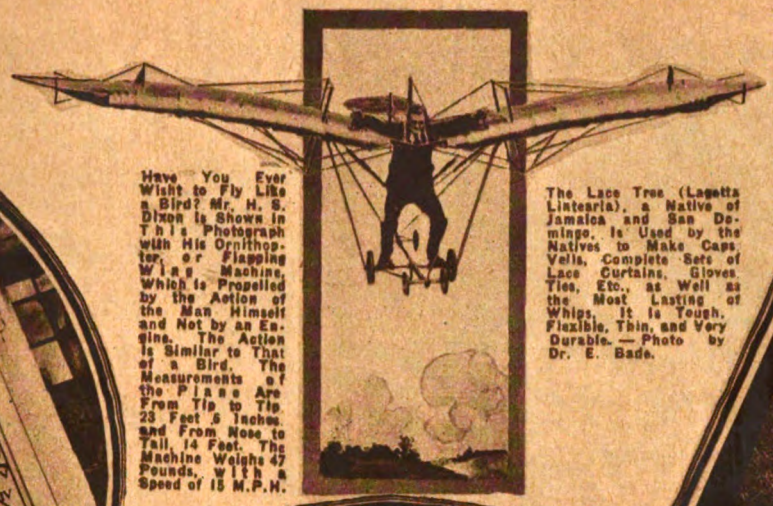


David Swarthour and James Smith, of Evanston, Ill., Are Shown with Their "Water Bicycle," Comprising Two Airtight Tin Tanks, a Bicycle Frame and a Screw Propeller. It Can Make Eight Miles an Hour with One Passenger, or Six Miles with Two.—Photo © by Underwood & Underwood.

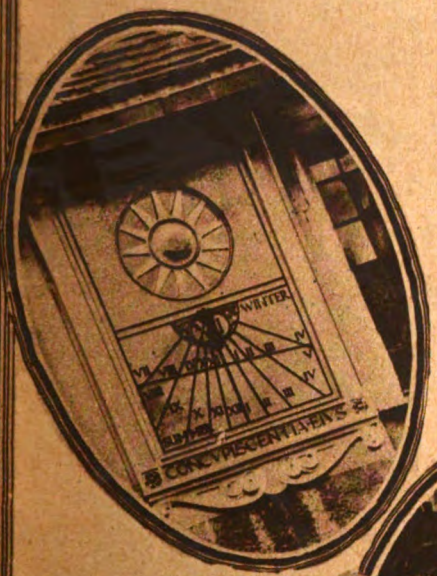
New Non-Sinkable Sea Safe? Mannetti Nanni, Chicago Inventor of a Non-Sinkable Safe, Was Locked in His Five-Ton Steel Box and Lowered to the Bottom of Boston Harbor—and Three Minutes Afterward the Giant Cylindrical Tank Shot Up to the Surface.—Photo © by Underwood & Underwood.

"Punching" Harding or Cox on the Voting Machine! That's What New York Women Will Do Next November—Punch the Names of Their Chosen Candidates on the Voting Machine. Under the Name of Each Candidate Is a Knob, Which When Punched Registers the Vote and Number of the Voter and Does Away with the Tedious Work of Ballot Counting.—Photo by Gilliams Service.

In Pictures

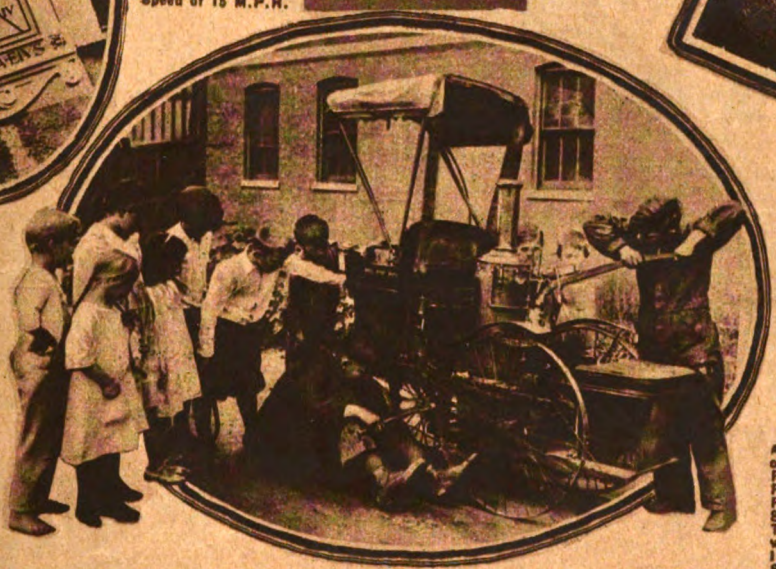


Have You Ever Wisht to Fly Like a Bird? Mr. H. S. Dixon is Shown in This Photograph with His Ornithopter, or Flapping Wing Machine, Which is Propelled by the Action of the Man Himself and Not by an Engine. The Action is Similar to That of a Bird. The Measurements of the Plane Are From Tip to Tip 23 Feet 5 Inches, and From Nose to Tail, 14 Feet. The Machine Weighs 47 Pounds, With a Speed of 15 M.P.H.



View of the Corpus Christi College's New Sun Dial, the First in Europe to Record Summer and Winter Time. Recent Renovations at This Cambridge College Disclosed Old Fragments of a Sun Dial in the Wall in the Old Court. This New Sun Dial Is Erected in the Same Place and Is on One of the Oldest Quadrangular Buildings—1330 A. D. In This Court the Poet Marlowe Wrote His "Tamburlaine," and Here John Richardson (Organizer of the "Pilgrim Fathers' Voyage to New England") Lived.

The Lace Tree (Lagetta Linteraria), a Native of Jamaica and San Domingo, Is Used by the Natives to Make Caps, Veils, Complete Sets of Lace Curtains, Gloves, Ties, Etc., as Well as the Most Lasting of Whips. It Is Tough, Flexible, Thin, and Very Durable. — Photo by Dr. E. Bade.



A New Stove, the Invention of a British Army Officer Promises to Solve the Coal Problem for a Great Many People. It Consists of a Small Stove and Container. The Container Is Filled with Sawdust Which Is Ignited and Placed in the Stove. Once Lighted, It Requires No Attention for Twelve Hours.—Photo by Gilliams Service.

Here Is the Original Automobile Which First Appeared on the Streets of Chicago in 1892. It Was Recently Demonstrated in Chicago Streets Again. It Employs a Steam Engine and Boiler Operated on Oil Fuel. Photo © by Underwood & Underwood.

"Nightie Bunnie"—the Latest Addition to Children's Toys. He Has Luminous Radium Eyes 'neverthin'. There is a Whole Family of "Nightie Bunnie's" Friends, All Blest with Radium Eyes That Shine in the Dark. A Fine Idea for Children Who Are Afraid to Go to Sleep in the Dark. Photo Courtesy Society for Electrical Development.

An American Jules Verne

ALTHO not generally known, there lived some forty years ago a personage known to thousands of readers by the *nom de plume* of "Noname." These were the days of the nickel novels when the Nick Carter series, Jesse James stories and Old King Brady were the talk of the day. For a nickel you bought a complete 32-page novel on closely printed pages in small type. These novels were always hair-raisers in more than one respect, and many of them have gone down as classics.

Lu Senarens, known to tens of thousands as "Noname," was perhaps the most prolific of these writers, and one of the most prophetic. Not only did he turn out a host of these wonderful stories, but he wrote over one thousand of them, each one of them containing from 35,000 to 50,000 words. Each of these stories were complete and had no continuations. The hero of most of the stories was Frank Reade, Jr., "the boy inventor," who supposedly invented all the many marvelous scientific wonders of that day.

Naturally, these were the days before t trolley car, the telephone, the submarin the aeroplane, and many another mode invention. Mr. Senarens, a true geniu the same as Jules Verne, had one of t most fertile imaginations. He was not technically-trained man nor even an eng neer. His scientific knowledge was o tained solely from reading books and oth scientific publications. His inventions we of course nothing but pure fiction a existed only on paper.

Lu Senarens "invented" some of the most astonishing submarines, airships, war machines and other world beaters, but the strangest part about it is that in those days no one believed that either the submarine or the aeroplane would ever be actually invented. As a matter of fact, they were considered as physically impossible, not only by Senarens himself, but by leading scientists who lived in the early 70's and 80's. It is not generally known that Senarens corresponded regularly with Jules Verne, who encouraged the American writer and read his stories as well.

The illustrations which we are publishing herewith give but a faint idea of the stories which appeared in the early 80's, almost forty years ago. We have among others the "Electric Tricycle"; then we have the "Steam Man of the Plains; or Terror of the West," a most marvelous imaginative piece of machinery which was supposed to take the place of a horse and could draw an iron-clad wagon over the prairies. The "Sea Serpent," as its name implies, was a most ambitious submarine; then we have the "Electrical Horse," an adjunct to the steam man which is propelled similarly. The "Electric Thunderer" (armored war car) is suggestive of the recent modern war machines and quite as formidable. The "Electric Submarine Boat," which may be noted, digs its path under an ice field and is worth our attention, because only three years ago Simon Lake, the inventor of the modern submarine, proposed the identical scheme to travel to the North Pole underneath the ice. The "Greyhound of the Air" approaches the modern airships, while the "Deep Sea Diving Bell" is only little different from those actually used today.

Note particularly the "Electric Air Monitor" engaged in an aerial bombardment. If you substitute the aerial monsters which were in use during the war and which bombarded the various cities, you have here a prophecy that is not far wrong. One of the most curious inventions of Mr. Senarens is undoubtedly the "Flying Submarine" as shown in one of our illustrations. This was a flying machine and submarine combined, and altho we have nothing like it in existence today, who dare say that it will not be in use at not a too distant date? Then again we had the "Electric Warrior," a war chariot used against Indians, the "Electrical Dragon," the "Terror of the Seas" and many others.

Nine-tenths of Lu Senarens' pictured predictions have actually come true. Even the helicopter arrangements in some of his air-

(*Continued on page* 665)

The Electric Shoes

By J. MAC-RICHARD

THE Brussels-Paris express was entering the Compiègne station, the last stop before reaching Paris.

It was 4 o'clock in the afternoon. Two passengers were seated in one of the first-class compartments—a gentleman of forty, who had got on a Tergnier, and your humble servant.

We had exchanged some commonplace remarks. My companion spoke with an English accent.

Scarcely had the train stopt when one of the doors was opened violently. A gust of wind blew in. My companion made a wry face. But the door remained open, held by some one on the outside.

This impolite person was a young man, with a military air. We supposed, at least, that he belonged to the army, since he had a cavalry sword strapt to his valise.

The gentleman opposite me arose and slammed the door.

The officer opened it again. Try as my companion could, he wasn't able to force it shut.

"How ill-bred!" he growled, as he returned to his seat.

We heard an oath outside. The valise was pitched into the compartment and the owner followed it.

He was just in the nick of time. The engine whistle blew. The guard locked the door and the train got under way.

There was a tense silence, presaging a violent outburst, as the newcomer lifted his bag into the rack.

I don't know what was passing in the gentleman's mind. But looking at his placid figure one would have thought that he was not in the least affected by the young officer's nervous movements and bellicose attitude.

* * *

"It seems to me," said the latter, looking at each of us in turn, "that I heard some one in here use the expression 'ill bred.'"

"That word was used," answered my companion, unhesitatingly.

"To whom was it applied, may I ask?"

"To you."

These last words had hardly been spoken when the officer's hand described a semicircle and struck the gentleman's face. I expected to see the latter spring on the soldier.

He did nothing of the sort.

He made a slight movement with his left foot. It was almost imperceptible. But it produced an effect which made an ineffaceable impression on me. Nobody could describe exactly the transformation which the officer underwent. But the vigorous, aggressive, quarrelsome man of the minute before became suddenly an automaton, without power of resistance, without will.

He was now being subjected to some mysterious torment, affected by some brain disturbance almost as violent as madness. His limbs jerked convulsively; his eyes almost started from their sockets; his teeth chattered; inarticulate sounds escaped from his throat.

I felt sorry for him and got up to aid him. But the English gentleman motioned me away. With a smile on his lips he ordered me to take my seat.

"Don't be disturbed," he said in a friendly voice. "There isn't any danger. His sufferings will stop whenever I want them to stop."

"Mercy!" exclaimed the unfortunate young man, giving the Englishman a supplicating glance.

The latter smiled sardonically.

"Mercy!" the officer repeated. "Mercy!"

"So be it," said the Englishman, at last. "I pardon you. But don't start anything again with me."

The mysterious traveler withdrew the foot which I had seen him press against the officer's a few moments before.

"The Man Made a Slight Movement With His Left Foot. It Was Almost Imperceptible. But It Produced An Effect That Made An Ineffaceable Impression On Me. Nobody Could Describe Exactly the Transformation Which the Officer Underwent. But the Vigorous, Aggressive, Quarrelsome Man of the Minute Before, Became Suddenly An Automaton, Without Power of Resistance, Without Will. He Was Now Being Subjected to Some Mysterious Torment, Almost As Violent As Madness . . ."

The officer fell back in his seat, put his head between his hands and seemed completely prostrated.

"Was it a dream or was it real?" he murmured.

"It was real enough," said the Englishman. "You will remember Sir John Mextone, I think, as long as you live."

"I certainly shall."

"Well," continued Mextone (as he called himself), "I am going to explain my system to you. Will you come a little closer, my dear sir (addressing me)? It's well worth your while."

Mextone crossed his legs and showed us the tip of one of his shoes.

"You see those two points?" he asked.

"Yes."

"That is where my power comes from. Don't touch them."

"Ah!"

"They are the extremities of an electric current, fed by a battery concealed in the heel. The shocks which this gentlemen felt were merely discharges produced by a connecting of two poles, thru his body. It is the greatest invention of our age, worth all of Edison's. I have with me two similar pairs of shoes—in this package. One was made for the King of the Belgians and the other pair for the King of Italy."

So our companion was only a common commercial traveler!

But common isn't the right word. As we had just seen, he carried on his trade with the adroitness of an artist.

"What do you charge for those shoes?" I asked, still marveling at the demonstration he had given us.

"Two hundred francs. That's hardly anything."

"It's cheap enough," said the officer. "But why couldn't I buy a pair ahead of the King of the Belgians?"

"And why couldn't I buy a pair," I said, "ahead of the King of Italy?"

"Well, I don't see why you can't," replied Sir John Mextone, "on condition, of course, that you don't make any use of them for several days. I want to have a chance to offer these crowned heads a real novelty."

* * *

When we arrived in Paris the officer and I each possest a pair of electric shoes. We took leave of Sir John Mextone.

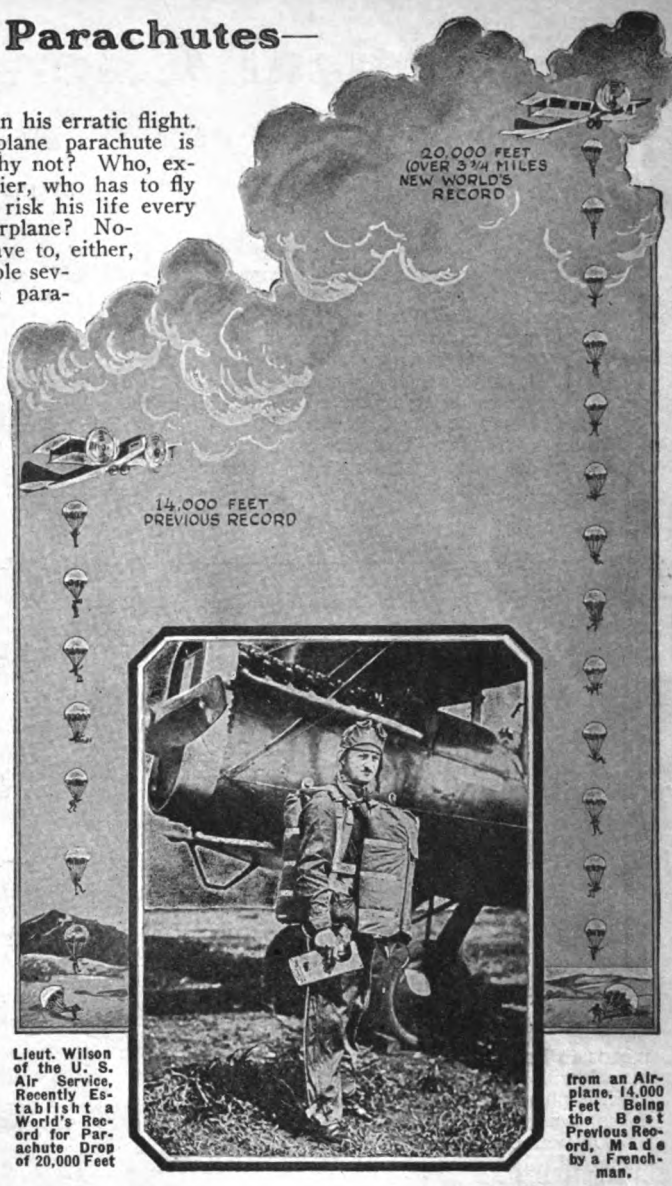
I was walking home with my precious

(*Continued on page 699*)

Drops 19,800 Feet With Two Parachutes—World's Record

Lieut. John H. Wilson—"Dynamite," his friends call him—photographed at Kelly Field, San Antonio, Texas, June 8th, a few moments before he "took off" on the flight which ended with his world-record-shattering parachute drop. He leaped backward from the plane when 19,800 feet in the air with a parachute in each hand. The descent occupied seventeen minutes and he drifted about 10 miles, narrowly missing a church steeple at the end. The former American record was 8,000 feet, and the world's record, made by a Frenchman, 14,000 feet. Lieut. Dunton, who piloted the plane, followed Wilson in his erratic flight.

The day of the airplane parachute is dawning rapidly—and why not? Who, except an army or navy flier, who has to fly under orders, wishes to risk his life every time he goes up in an airplane? Nobody—and they won't have to, either, for there are now available several successful airplane parachutes which are being supplied as regular equipment on many standard planes being sold on the market.



Lieut. Wilson of the U. S. Air Service, Recently Established a World's Record for Parachute Drop of 20,000 Feet from an Airplane, 14,000 Feet Being the Best Previous Record, Made by a Frenchman.

Why Only a Few Understand

As soon as Dr. Einstein's theory and law of relativity began to attract public notice, an eminent scientific person blandly announced that only a dozen people in the world—of whom he, of course, was one—could understand any explanation that anybody might make of these momentous achievements. That, naturally enough, inspired considerably more than a dozen people to attempt the task that had been decared hopeless, and unnumbered thousands of us did our best to help the new expositors prove that the first man was wrong, says the New York *Times* editorially.

The offered explanations were marked by a common peculiarity—they all began with illustrations and analogies that were beautifully simple and within anybody's comprehension, but the passage from them to relativity as Dr. Einstein views it always involved the leaping of a chasm wider and deeper than the Grand Cañon of the Colorado.

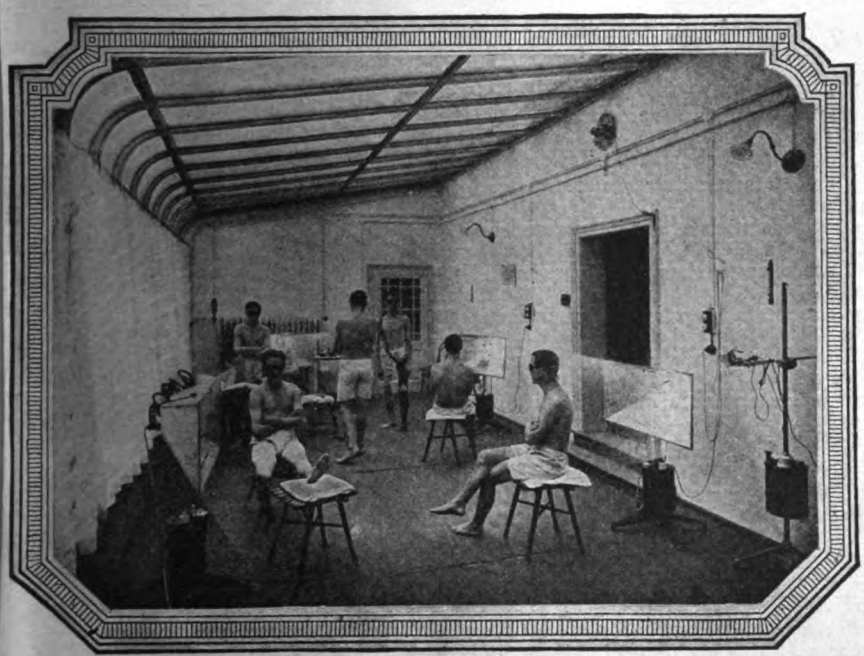
It helps a little toward the soothing of ruffled tempers and prides to learn just why Dr. Einstein is so hard to understand. That secret is revealed in the report of a joint meeting in London of the Royal Society and the Royal Astronomical Society, called to give the members of those famous organizations information as to the results attained by the two expeditions sent to observe the solar eclipse of last May. After that had been done there was a discussion in the course of which Sir Joseph Thomson of the Royal Society made this enlightening statement:

"The weak point in the Einstein theory is the great difficulty in expressing it. It would seem that no one can understand the new law of gravitation without a thoro knowledge of the theory of *invariants* and of the *calculus of variations*."

Now we know! Anybody without the equipment mentioned will waste his time in trying to understand the new relativity.

Artificial Sun-Baths for Curing Tuberculosis

By DR. ALFRED GRADENWITZ



Here We See Convalescent Soldiers and Others Being Treated With Artificial Electric Sun-baths, Which Have Proven Particularly Efficient It Is Claimed, In the Treatment of Severe Inflammation and in the Healing of Wounds, as Well as the Curing of Tuberculosis of the Lungs.

The light of quartz tube mercury arc lamp, contains the chemically active radiations of sun light (ultra-violet rays) to which the wonderful curative effects of sun-baths are due. Such lamps have therefore been used in German military hospitals to promote the healing of wounds, and excellent results have lately been obtained in the curing of tuberculosis of the lungs.

An artificial sun-bath hall, according to Prof. Jesionek, as represented in our picture, consists of a spacious room connected up to the central heating plant. The light is supplied by several lamps each of which mainly consists of a quartz tube 16 centimeters long, containing the mercury, and a rectangular housing with slanting reflecting magnalium walls open in front, the lamp being lighted by tilting the housing thru the agency of a handle at the lower edge.

The walls, floor and ceiling of the room are lined with some fabric reflecting ultra-violet rays, aluminium bronze and a plain bluish-white lime coating being used for the walls and ceiling, whereas a lining of coarse linen is sufficient for the floor. The patient walking to and fro in front of the lamps immediately passes from one cone of light into the other. He, of course, should protect his eyes by means of smoked auto goggles. His skin soon becomes sunburnt as under the action of actual sun-baths, this being an outward symptom of a successful cure.

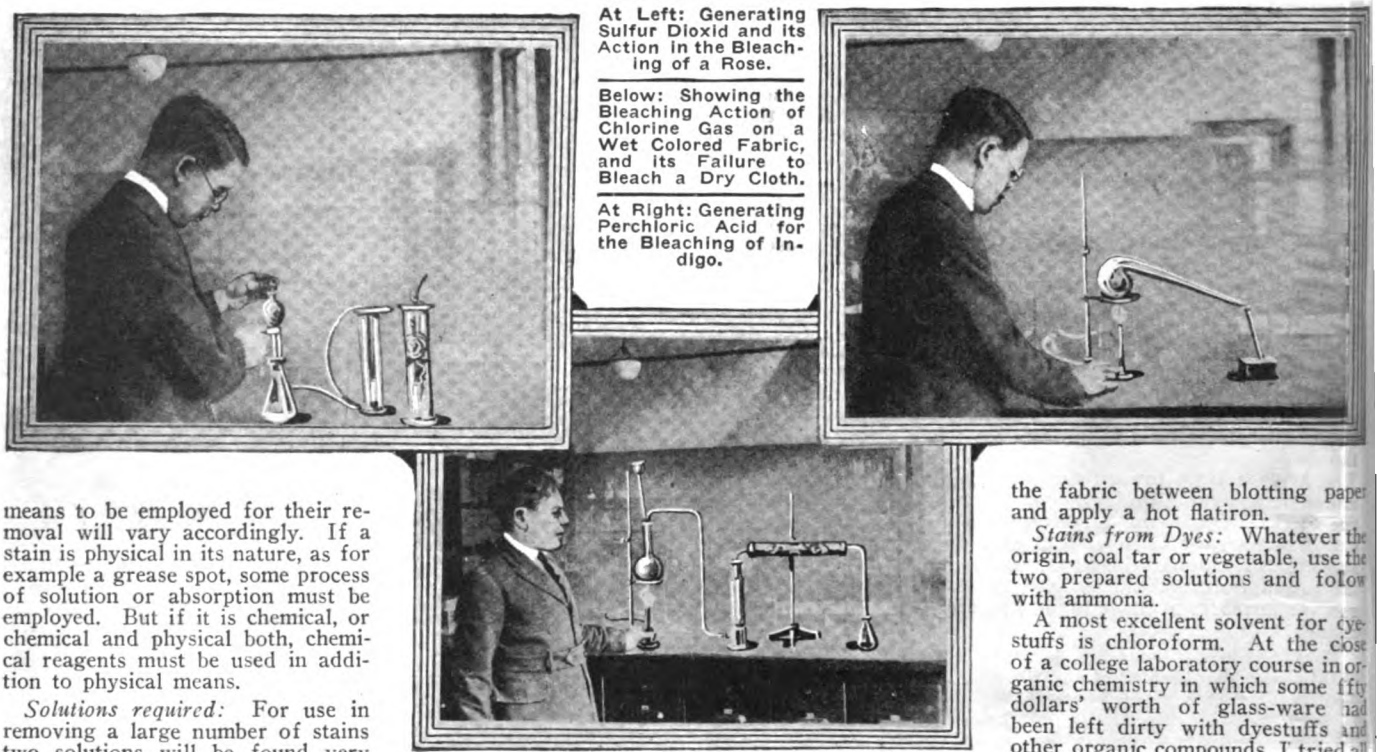
Practical Chemical Experiments

By PROF. FLOYD L. DARROW

STAINS AND BLEACHES

SOME of the most interesting and practical applications of Experimental Chemistry have to do with the removal of stains and the bleaching of fabrics. Such experiments are not quite so spectacular as fireworks and explosions, but they are usually of more practical importance. In this article I shall take up these phases of chemical work.

Nature of Stains: The subject of stains is a very deep one. Stains may be either physical or chemical, or both, and the means to be employed for their removal will vary accordingly. If a stain is physical in its nature, as for example a grease spot, some process of solution or absorption must be employed. But if it is chemical, or chemical and physical both, chemical reagents must be used in addition to physical means.



At Left: Generating Sulfur Dioxid and its Action in the Bleaching of a Rose.

Below: Showing the Bleaching Action of Chlorine Gas on a Wet Colored Fabric, and its Failure to Bleach a Dry Cloth.

At Right: Generating Perchloric Acid for the Bleaching of Indigo.

Solutions required: For use in removing a large number of stains two solutions will be found very efficient reagents. They are:

1. Tartaric or oxalic acid—20 grams to 100 cc. of water.
2. Five grams of bleaching powder (ordinary chlorid of lime). Boil this in 100 cc. of water until a pink color appears, then filter and add 50 cc. of cold water.

Most of the common ink eradicators consist of these two solutions. In order to test their power to remove ink, coffee, tea, fruit and dye stains select some such stain and treat it first with solution No. 1 and then with solution No. 2. After wetting the spot with the first solution, absorb the excess of liquid with a blotting paper and then apply the second solution. Rinse with water and if necessary repeat the operation. Sometimes a persistent yellow spot remains after the color has been removed. This is especially true of woolen goods. In such a case rinse the goods thoroly and then apply fresh hydrogen peroxid. This will oxidize the yellow coloring matter and remove it.

Removal of Acid Stains: The removal of the common mineral acid stains is a very difficult matter. Hydrochloric acid does not usually leave a stain but in order to prevent injury to the fabric the acid should be *neutralized immediately* with ammonia water.

Sulfuric acid, if strong at all, will char cloth and very quickly make a hole. This action is due to the very great affinity of sulfuric acid for water. Most fabrics contain the elements, hydrogen and oxygen, in proportion to form water and therefore the acid extracts these elements leaving a charred spot of black carbon. There is no remedy for such a spot, unless the presence of the acid is noted as soon as it falls upon the fabric and can be neutralized by the application of ammonia water. Ammonia is pre-eminently the base to use in such cases, because it is not strong enough to injure the fabric itself, and it will neutralize even the strongest acids.

To show the *action of sulfuric acid* in such cases apply a drop of the concentrated acid to a piece of cotton goods and note the charring effect. Repeat with woolen goods.

To show this affinity of the acid for oxygen and hydrogen still more, prepare a concentrated solution of cane sugar and into 25 cc., of it in the bottom of a beaker pour a few cubic centimeters of strong acid. Immediately the contents of the beaker will begin to steam and turn brown and presently it will boil up and a black mass of carbon will overflow the sides. See Figure 1. A piece of wood thrust into a test tube of the acid will char and disintegrate thruout.

The yellow stains of *nitric acid* are very troublesome and persistent. As soon as discovered wash the spot thoroly with water and then apply solutions Nos. 1 and 2. Nitric acid is a strong oxidizing agent and the substitution of oxalic acid, a reducing agent, for tartaric in this case is advisable. But the removal of nitric acid stains is very nearly impossible.

For the removal of any *other acid stains*, such as fruit acids for example, apply cold water, also alcohol if possible and then follow with solutions Nos. 1 and 2.

Grease: Among the most common and troublesome stains are grease spots. As everyone knows, gasoline is an excellent solvent for grease. In addition the following solvents are excellent: Carbon tetrachlorid (ordinary "Pyrene" of the fire-extinguishers), chloroform, ether, carbon disulfide, ammonia water and soapsuds. When grease spots are fresh, the application of French chalk will frequently absorb them.

For *paraffin* there is no ready solvent. The best procedure in such cases is to place the fabric between blotting paper and apply a hot flatiron.

Stains from Dyes: Whatever the origin, coal tar or vegetable, use the two prepared solutions and follow with ammonia.

A most excellent solvent for dyestuffs is chloroform. At the close of a college laboratory course in organic chemistry in which some fifty dollars' worth of glass-ware had been left dirty with dyestuffs and other organic compounds, I tried all sorts of solvents in my efforts to remove them. But more efficient than the strongest acids and bases or any of the common organic solvents was chloroform. It dissolved practically every residue.

A most difficult substance to remove usually is *gum*. But either chloroform or carbon tetrachlorid will loosen it with perfect ease. Carbon tetrachlorid in composition is very similar to chloroform. Both are substitution products of the hydrocarbon methane. In the former case all four of the hydrogen atoms in methane are replaced with chlorin, while in the latter only three of them are.

Iron Rust: Iron rust is red oxid of iron and is easily soluble in a dilute acid. Prepare a moderately strong solution of oxalic acid, warm it and then apply with a soft sponge. Wash with water.

Silver Stains: Stains from silver nitrate and some indelible inks containing silver salts are exceedingly persistent. A ten per cent solution of potassium cyanid, however, will readily dissolve such stains. But, since potassium cyanid is a *deadly poison, it must be used with the greatest care!*

Iodine Stains: The yellowish brown stains of tincture of iodine are very common. To remove them use a dilute solution of washing soda (sodium carbonate) or a ten per cent solution of potassium iodid. Wood alcohol may also be employed.

Paint and Varnish Stains: For these stains use turpentine, carbon tetrachlorid or gasoline. Follow with soap and water. Some varnishes are easily removed with alcohol, particularly shellac varnish.

On any of the ordinary stains not included in this list use the two solutions prepared, and follow with thoro washing.

BLEACHING.

A most important branch of the textile industry is that of *Bleaching.* This subject is also of importance in the household and therefore a knowledge of the chemistry of it is desirable. The two fundamental chemical processes employed are *oxidation* and *reduction.* The bleaching agent employed must be selected in accordance with the material to be bleached. Wools and silks will not stand the action of chlorin while cotton will.

Bleaching with Chlorin: Chlorin as is well known from previous articles in this series is a greenish gas, heavier than air, poisonous and very active. It was one of the earliest bleaching agents to be used and is still indispensable for this purpose.

To show its action arrange apparatus as shown in Figure 2. Generate the gas by action of manganese dioxid on concentrated hydrochloric acid. Pass it thru a drying tower containing lumps of calcium chlorid and then thru a three-fourths' inch tube containing a piece of wet colored cloth and a piece of dry cloth of the same material, separated from each other by calcium chlorid held in place with small quantities of glass wool. Let the excess of chlorin bubble thru a strong solution of potassium hydroxid. Cloth dyed with turkey red is excellent for this experiment.

Now start the generator and pass the gas. In a few moments the wet piece of cloth will have been entirely bleached while the dry cloth will be entirely unaffected. The chemical action is this: The chlorin unites with the hydrogen in the water on the cloth and liberates oxygen in what is called the *nascent state,* i. e., a very active state always characteristic of elements at the instant that they are formed. The oxygen unites with the color substance and changes it to a colorless compound.

In case you are unable to provide apparatus similar to that just described you may perform the experiment with cylinders of the gas. Fill two cylinders by allowing the gas to pass downward into the cylinders and displace the air. In one of the cylinders place a piece of wet colored fabric and in the other a dry piece. In a few moments the wet piece will be entirely decolorized, while the dry piece will remain unchanged.

Bleaching Inks: In one bottle of chlorin place a piece of paper having on it ordinary ink and in another a piece of printed newspaper. Both pieces should be moistened. The ordinary ink will be quickly bleached, while the printers' ink will remain unchanged. The reason is this: Printers' ink is largely carbon and it will not oxidize readily.

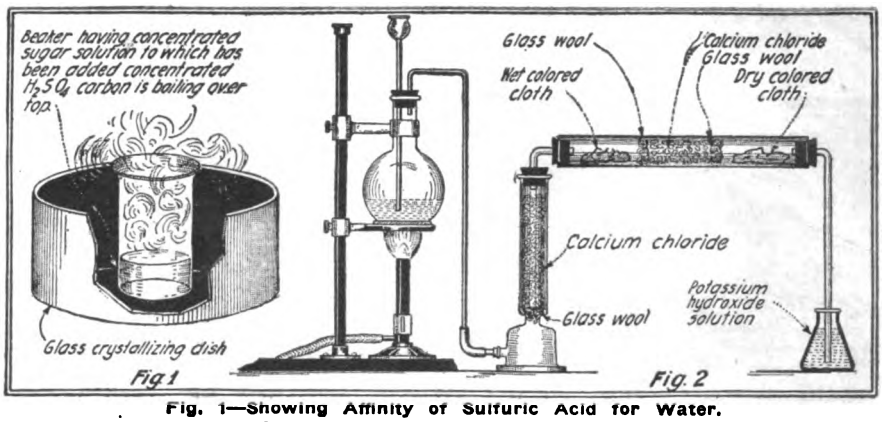


Fig. 1—Showing Affinity of Sulfuric Acid for Water.
Fig. 2—Bleaching Cotton Goods with Chlorin.

Bleaching with Hydrogen Peroxid: Hydrogen peroxid is another substance depending for its bleaching power upon the liberation of nascent oxygen, and yet there is nothing about the reagent itself that will injure the article being bleached as there is in the case of chlorin.

To show the bleaching action of the peroxid to good advantage prepare a solution of aniline red by dissolving a very little of the dye in 100 cc. of water. To this solution add a few cubic centimeters of fresh hydrogen peroxid and upon boiling the color will be discharged. Should this fail to happen it will indicate that the peroxid is acid. In that case add a little sodium hydroxid and the color will instantly disappear.

If the hydrogen peroxid is made very slightly alkaline in advance it will discharge the color even in the cold. This reaction also affords a good stage experiment. In the bottom of a tumbler place a few cubic centimeters of the alkaline solution of peroxid and pour into it from a pitcher containing a solution of aniline red.

Bleaching with Sulfur Dioxid: Sulfur dioxid is a bleaching agent very extensively used to bleach woolens, silks and straws. To show its action prepare a cylinder of the gas using apparatus as diagrammed in Figure 3. In the flask place dry sodium sulfite and in the dropping funnel concentrated hydrochloric acid. Allow the acid to drop slowly on the sulfite and large volumes of the gas will be generated.

Into a jar of the gas lower a bright red rose. The color will very rapidly disappear. The color may then be restored by placing it in a cylinder of chlorin gas or by holding it in the vapor of fuming nitric acid. With a jar of each gas prepared in advance these two experiments make an excellent stage demonstration.

The color may also be restored by immersing the rose in a 50 per cent solution of sulfuric acid.

Bleaching with Hydrosulfurous Acid: Indigo which is not bleached by sulfur dioxid is bleached by hydrosulfurous acid. To prepare this acid bubble sulfur dioxid, generated as already described, thru 100 cc. of water until a saturated solution is obtained. Then place in the solution a small quantity of zinc dust and allow the mixture to stand for a time; the zinc reduces the sulfurous acid to hydrosulfurous, which remains in solution.

Place 50 cc. of indigo solution in a beaker and add some of the hydrosulfurous acid. It will be decolorized as will also a solution of litmus.

Turning Wine into Water: A very striking color change can be had by the bleaching action of sulfur dioxid on a wine-colored solution of potassium parmanganate.

Fill a cylinder with sulfur dioxid gas and cover it with a glass plate. In another similar cylinder prepare a dilute solution of potassium permanganate. Upon pouring the permanganate solution into the apparently empty cylinder of sulfur dioxid it will be immediately decolorized and changed to "water."

Bleaching Action of Perchloric Acid: To prepare perchloric acid arrange a retort and test tube as shown in Figure 4. In the retort place 5 grams of pure potassium perchlorate and pour on to it thru a funnel introduced into the neck of the retort 12 cc. of concentrated sulfuric acid. Heat gently with a small flame and a few drops of an oily, fuming liquid will distil over and can be collected in a test tube. This is *perchloric* acid.

Allow one drop of this acid to fall into a test tube containing 3 or 4 cc. of water. When this solution is added to a solution of indigo, the latter is immediately bleached.

Bleaching Cotton Goods: A solution for bleaching cotton fabrics can be made as follows: In a gallon of water dissolve 3 pounds of sodium carbonate crystals. Place this on a stove and boil for ten minutes. Then add the contents of a can of ordinary chlorid of lime. Stir the chlorid of lime into the hot solution and strain thru fine muslin or cheese cloth in to a large bottle. Keep this bottle tightly stoppered.

Into a kettle of white cotton goods which are to be bleached pour water and a small quantity of the prepared solution. Upon boiling, chlorin will be liberated and this is the active bleaching agent. Then thoroly rinse the goods and dry.

Bleaching Wool: One method of bleaching woolens makes use of sulfur dioxid as follows: Prepare a 5 per cent solution of sodium bisulfite and a one per cent solution of sulfuric acid. First wash the fabric in the bisulfite solution and follow it with the acid bath. This liberates sulfur dioxid in the fiber of the goods and this does the bleaching.

Sometimes the wool is simply washed and suspended in the atmosphere of sulfur dioxid obtained from burning sulfur. It is then washed in water containing a little bluing.

(*The next installment will appear in the November issue.*)

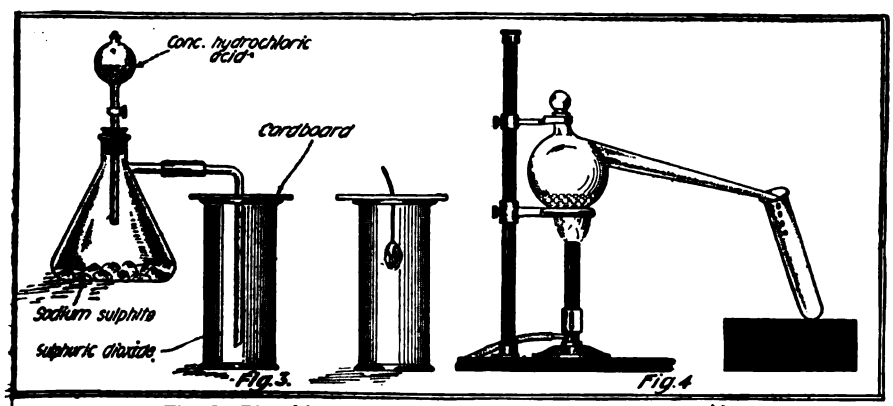
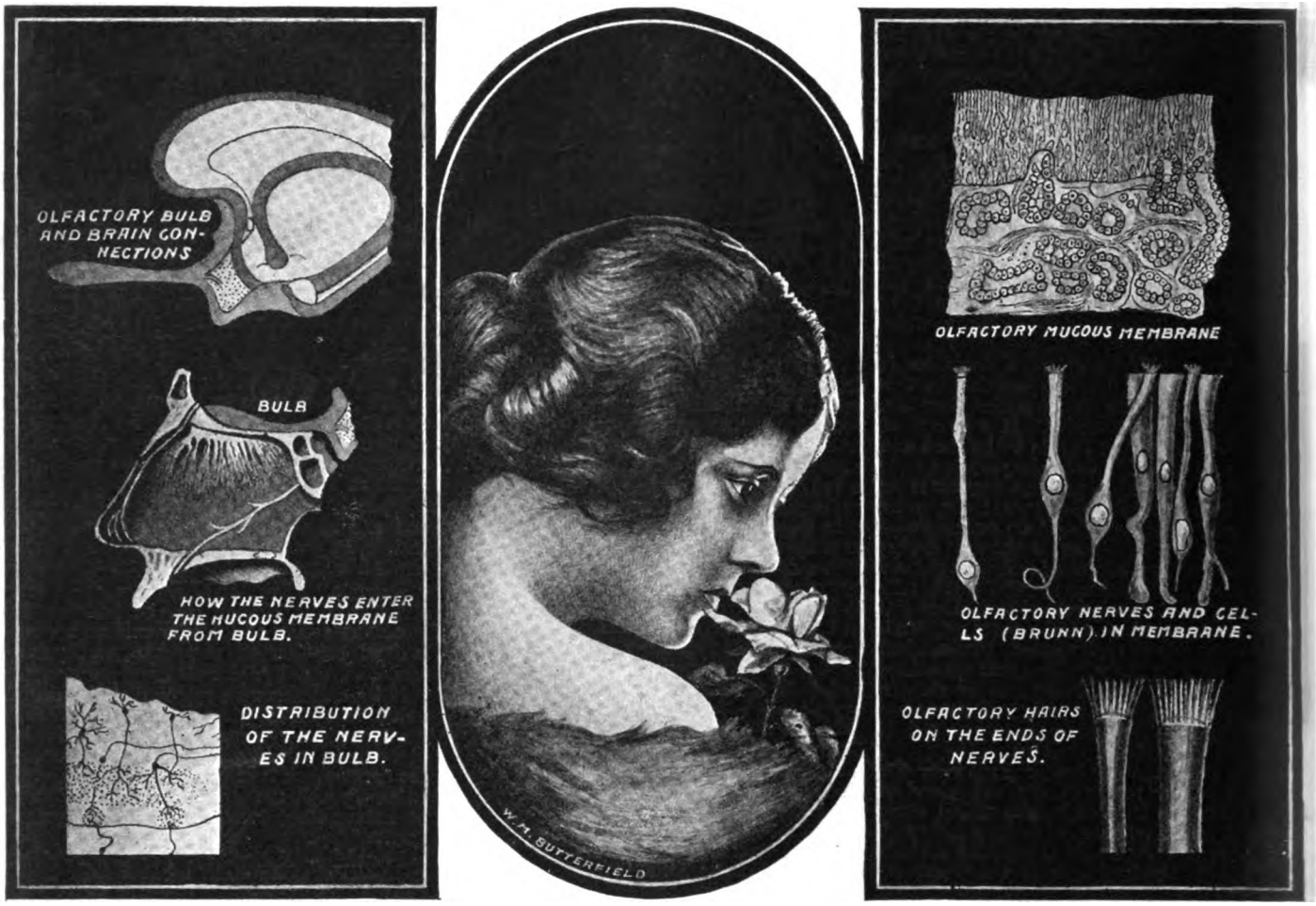


Fig. 3—Bleaching a Rose by Immersion in Sulfur Dioxid
Fig. 4—Generating Perchloric Acid for the Bleaching of Indigo.

How We Smell

By JOSEPH H. KRAUS



In the Upper Left Is Shown the Olfactory Bulb, a Process of the Brain Projecting Forward Which Lies Directly Above the Bony Roof of the Nose. Very Fine Nerves Passing from the Mucous Membrane In the Nose Penetrate the Bone and Enter the Bulb as Shown In the Middle Diagram and at the Bottom Is Shown the Way the Nerves Join or Anastamose with Each Other and Then Enter the Brain to the Region of Smell. At the Upper Right Is a Cross-Section Thru the Organs of Smell, Also Showing Sections of the Glands Which Secrete the Watery Content Found Therein. At the Lower Right We See the Nerve Cells with the Olfactory Hairs Upon Them as Brunn Describes Them. All These Organs Working Correctly Will Give Us a Keen Sense of Smell.

OLFACTORY or sense of smell sensations are rendered difficult of analysis because this function is so closely allied with the sense of *taste,* and because of the fact that it plays but a very small part in man's life. Before we delve into the realm of smell, let us first determine what the conditions of smell really are and just what an odor is due to.

Odors are emitted upon the vaporization of a substance which diffuses in the air, finally disseminating to the nose, where it strikes a number of cells in what the physician calls the olfactory epithelium (skin lining inside of the nose). The skin here is of a yellow color, mostly composed of cells having a peculiar column-like shape. But lying between these cells are also found a large number of spindle-shaped cells, otherwise known as *olfactory cells,* which consist of a bulb-like portion and a fine hair-like process called the *olfactory hair,* as shown in the illustration.

From the other end of the cell is seen the nerve which passes upward thru the bone into the skull and there trails into a projection of the brain called the *olfactory bulb.* The nerve in this bulb then couples with another nerve, which latter proceeds to the brain area of smell. The coupling of the nerves is clearly shown in the lower left corner of our illustration, and the olfactory bulb and how the nerves enter it is shown above this.

We have the lining of the nose or epithelium, so-called because of the nature in which the cells therein are arranged and classified. This lining is also and more aptly called a *mucous membrane,* because of the fact that it contains many glands which constantly secrete a watery-like substance and keep the lining in the nose constantly moist.

A small section from this mucous membrane cut transversely is shown in the upper right-hand corner of our illustration. The large peculiar shaped inclosures are sections of the glands and immediately above are seen the hairs and cells which associate with the nerves, thus giving us the sensation of smell.

According to Brunn, the olfactory cells are in reality *nerves* which have hair-like extremities. Up to the present time neither view has been definitely determined. So much for the anatomical part of this sense.

Let us now see how this function acts. Experimentaly we know that if a greater or smaller amount than normal of fluid should be present in the upper part of the nose, the sense of smell is very seriously affected, being impaired in both instances. Altho *the air which enters the nose rarely, if ever, passes any of the sensitive cells which lie near the top of the nasal cavity,* the readiness with which odorous substances diffuse in air enables us to determine their smell.

In other words, we can assume that the nose is similar to an hour-glass, and air constantly circulates in the lower bulb of the hour-glass. Ordinarily, no air can be forced into the upper part, but fine particles of the odorous substance will diffuse into this part and finally a *smell* is also noticed there.

Altho the following order is rather imperfect, smells seem to arrange themselves in the following manner: First—ethereal smells, these consist of fruit and other ethers, bees' wax and aldehydes. Second—aromatic smells, composed of spicy smells, camphor, anise, lavender, lemon, rose and almond smells. Third—balsamic smells, in which are included orange blossom, lily-like and vanilla smells. Fourth—the amber and musk set. Fifth—what are known as allyl cacodyl smells, in which class are found fishy smells, halogen (chlorine, bromine, etc.), and hydrogen sulfid. Sixth—burning smells, toast, tobacco, smoke and the phenols (carbolics). Seventh—caprylic ordors, in which class are cheese, sweat, etc. Eighth—repulsive smells comprised of narcotics and the odors of certain bugs, and Ninth—putrifying bodies.

Certain individuals, however, are unable to detect any odor; many are unable to determine certain odors, chiefly vanilla and violet, and the third type have hallucinations of smell and are constantly smelling a certain type of odor. Generally this sense is very easily fatigued, but the effects of a certain odor when fatigue occurs, do not seem to affect the cells to such an extent that they will not notice other foreign odors.

Hence a person may be sitting in an inclosed room all day and never notice the foul air, but by an outsider it will instantly be perceived. An odor is also very easily disguised, and for that reason perfumes have come to have a predominant use the world over. Likewise a different odor presented to each nostril may completely disguise the effect, forming a non-odorous sensation or produce an entirely different sensation than those presented, our nose being

(*Continued on page* 690)

THE CONSTRUCTOR

How To Make a Simple Stereoscope

By DR. E. BADE

The Successive Stages to be Followed in Constructing the Home-Made Stereoscope Here Described by the Author, Is Clearly Shown in the Progressive Series of Photographs. The "Modus Operandi" of the Apparatus Is Shown Clearly In the Diagram at the Extreme Right. The Photograph or Picture to Be Viewed Stereoscopically Is Placed Under the Bottom of the Box Adjacent to the Opening Thru Which the Necessary Light for Illuminating the Picture Passes. The Eye Is Placed Before the Lens Opening, as Shown, and the Reflected Image of the Picture in the Mirror Mounted at an Angle in the Top of the Case Causes the Details and Objects in the Picture to Stand Out In Relief, the Same as in the Regular Double-Lens Spectroscope Requiring Special Duplex Photographs. The Present Instrument Uses Any Photographs or Pictures You May Have. Many Pleasant Hours May Be Spent with the Use of This Simple Home-Made Apparatus, Which Costs Practically Nothing to Build.

A SIMPLE one-lens stereoscope affords just as much pleasure and is just as instructive as a similar binocular instrument. The principal parts involved in its construction are a heavy cardboard box, an old or part of a broken mirror and a convex lens with a focus of about ten inches. The cardboard is cut as shown in the photo, the exact dimensions depending on the focus of the lens. The focus can be easily gotten by holding the lens against the sun, and measuring the distance between the lens and the smallest circle of light thrown upon a piece of paper.

The peephole, which is made 1/8 of an inch smaller than the lens so that a small strip of paper will glue it in place, is made at the upper part of the box and is about an inch below the focus of the lens. The mirror is attached to the slanting side and lies directly opposite the peephole. It should be attached at an angle of 45 degrees so that the line of sight is deflected to the bottom of the box. (See sectional view at right.)

After the mirror has been fastened with strips of paper, close the box and be sure to leave a large opening in the back at the bottom. When the box has been neatly finished, photos or pictures cut from magazines are placed in the opening at the bottom. If one now looks thru the lens the pictures will appear to stand out in relief. Only one picture of each subject is needed for this instrument.

Novel Electric Lamp Flasher

This flasher if constructed properly should light red, white and blue lamps consecutively, then extinguish and light all together, following which the same red, white and blue are flashed over again respectively.

This flasher is constructed as follows: Take a large cartridge fuse about two inches in diameter and two and one-half inches long between caps, as per Fig. 1. Holes are then drilled in the center of caps so that shaft can fit. Three strips of thin sheet copper or brass are needed, three-eighths of an inch wide, for each of the following lengths: 3 strips one and one-quarter inches, one two inches and one one inch. These are to be put on in the fashion illustrated in Fig. 2. The three strips one and one-quarter inches long should be fastened in line about one-half inch apart. These are laid over a strip connecting these strips to cap.

On the other side of the cylinder or fuse are fastened the other three strips. These are so fastened that when the cylinder rotates the three inch strips or red light is connected first, then the two inch, or white light, followed by the one inch or blue light, succeeding which all the lights go out at once.

These strips are also connected to cap. The fuse which is soldered to shaft by the caps, is supported on an axle or shaft with a support at each end connected with the binding post. Three more strips are used for brushes. These strips are not to be connected to each other in any manner.

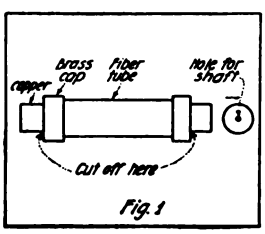


Fig. 1

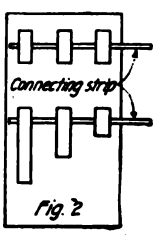


Fig. 2

A Very Effective Electric Lamp Flasher Is Shown In the Accompanying Drawing. It Is Made from a Discarded Fiber Fuse Shell.

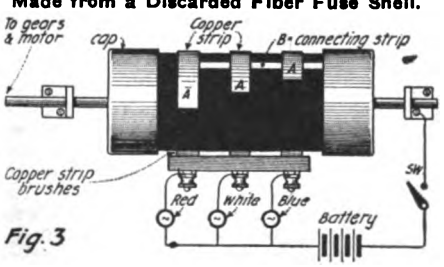


Fig. 3

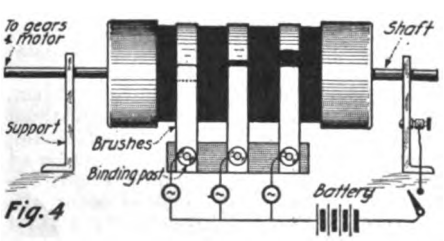


Fig. 4

They are fastened to a small fiber block by the side of the cylinder. The cylinder is rotated by means of a small electric motor operated on two batteries with a worm gear on its shaft and a small gear wheel on the shaft of the flasher.

A small rheostat is used to regulate the speed of the motor. The worm gear, shaft and gear wheel from a Mysto erector set work very well. There are three 3½-volt colored lamps used, red, white and blue respectively. The connections are shown clearly in the diagram. The flashing mechanism can be put in a small box and the lamps in a store window or on the wall. This makes an attractive little patriotic display which no doubt will win the approval of everybody.

The detail and general idea so far outlined for constructing a novel electric lamp flasher from a discarded fiber fuse tube, is just the beginning of a whole host of practical ideas which the electrical experimenter or embryo electrician will be able to readily work out. Some of the prettiest effects imaginable are readily obtainable at little expense by means of home-made switch flashers of this type. The flasher drum need not be driven by a battery motor, if you are using battery power to light the lamps, and thus exhaust the battery owing to the notoriously low efficiency of battery motors,—but instead, the switch drum may be rotated by an old alarm clock spring motor or by any other form of mechanical motor.

Contributed by HAROLD L. OSTERBY.

Building "Your Own" Phonograph

PART 2

Full Details Describing How to Build Tone Arm and Reproducer

IN the first part of this article describing how to build your own phonographs, the important details of motors and speed regulators, as well as sound chambers or horns, were described in complete detail. In the present article, we will concern ourselves with one of the most vital parts of the talking machine, namely, the tone-arm and reproducer, or, as it is sometimes called, the *sound-box*. In this category also comes the consideration of modulators or sound mufflers, for regulating the strength of the sound transmitted thru the horn or amplifying chamber to any degree desired.

THE SIMPLEST REPRODUCER.

For those interested in the experimental side of phonography, reference may be had to Fig. 1, where two of the simplest talking machine reproducers are illustrated. The one at the left comprises an ordinary wooden shingle, the harder the wood the better, and in one corner of which is pushed an ordinary steel phonograph needle. The writer has tried this with very interesting results, the entire shingle vibrating with sound and giving very articulate reproduction of the music. The shingle may be held between the fingers at the upper corner, or else suspended and balanced carefully on a thread or string, when it will be found that the groove on the record will propel it across the latter as the turn-table rotates.

One of the earliest forms of reproducers and sound amplifiers is that shown at Fig. 1, and this may still be found on some of the cheap phonographs sold on the market today. Here the horn is suspended or pivoted so as to move freely across the record when propelled by the needle in the groove, while the diafram, composed of mica or fiber, etc., is firmly clampt between two rings, or else spun into a ring, at the smaller end of the horn. A suitable stylus arm is usually fitted in the manner shown and standard needles are used.

SPEAKING OF TONE-ARMS.

Figures 2, 3, and 4 show three distinct, yet different, ideas in the construction of tone-arms. One of the most important features to be watched in any phonograph tone-arm is *the weight exerted on the stylus needle*, and in turn upon the record groove. This must not be too great, or the records will soon become "choppy," owing to the breaking up of the grooves, and also due to wear and scratching. Some tests made on a number of standard phonographs by the writer, brought out the following facts, which will be of interest to all phonograph enthusiasts, whether for operating a standard machine, of which there are 40 or 50 different makes and more on the market just now, or building one of their own.

The average pressure exerted on the stylus needle of the best commercially built phonographs today, such as the Victor and Columbia, is about 4½ ounces; as these companies have spent a "King's ransom" in perfecting the phonograph to its present stage, we can rest assured that with standard records, this is the optimum pressure and one which should not be exceeded, except by a small amount in certain cases, perhaps.

Where an extra large sound-box is used with a large diafram, say, one having a diameter of 2¾ inches, as is the case with several commercial machines, the excessive weight exerted on the stylus and on the record may be counterbalanced with a counter-weight or else by a spring fastened to the base of the tone-arm and arranged so as to counteract the pressure, which in one case measured 8 ounces, so that eventually the pressure on the stylus when measured by a postal scale placed under it, measured but 4½ ounces, the average standard pressure.

At Fig. 2 is shown the extreme simplicity of the Columbia tone-arm, which provides the usual two degrees of movement, that is, vertical and horizontal. The moving joints are made to have a very good mechanical fit, and the degree of movement is limited by a set screw threaded thru the outside collar, usually, and the tip of this screw caused to move back and forth in a slot in the smaller end of the arm in each case—all of which is clearly shown at Fig. 2. This diagram also shows the horizontal movement A-B of the tone-arm when the latter is centrally located with respect to the turn-table on the average machine. As will be seen, this movement is not so great as might be imagined, and simplifies the construction of the arm if you are building one yourself.

A standard form of tone-arm which is sold by many of the phonograph houses supplying parts for the building of home-made machines, is shown at Fig. 3. With the Victor and Columbia machines, it is not possible to reverse the sound-box or throw it over as in some of the other machines, in order to play *hill-and-dale* records such as the Pathé. However, there has recently been put on the market several attachments, selling as low as one dollar, with a saffire ball complete, by which Pathé or other *hill-and-dale* records can be played on a Victor or Columbia machine. Several of the machines on the market, including those fitted with the tone-arm of the type shown at Fig. 3, play any style of record. The two positions of the sound-box and needle holder are shown clearly in the figure. When playing hill-and-dale records, a round saffire ball point must be used, and this costs but sixty cents and fits in any standard needle holder.

A saffire ball possesses the advantage over the pointed steel needle in that it will play as many as 1000 records, without scratching or injuring the record surfaces, as a scientific test of the stylus of this machine has demonstrated. A new steel needle should be used for each record, or one needle used for playing the two sides of the record; and if you should want to be real careful about it, it is best to preserve your record by using a new steel needle for playing each side.

The construction of the tone-arm illustrated at Fig. 3, is evident from the drawings. The diameter of the throat at the base of the tone-arm where it fits over the opening in the wooden shelf, is about 1¾ inches on the average, and from this diameter it slowly tapers or decreases downward to the point where it enters the sound-box, and here it may have a diameter of about ½ inch to ⅝ inch. In the Columbia and Victor tone-arms, the arm itself is made of drawn metal, usually brass, and expands progressively from the sound-box to the base of the arm. The trouble with a great many of the cheap tone-arms is that they are made of cast metal, and also their joints are poorly fitted. The greatest criterion whereby to judge the efficiency of any tone-arm, no matter of what make, as pointed out by Prof. D. C. Miller of the Case School of Applied Science, of Cleveland, in a recent conversation with the writer, is that it shall be *thoroly air-tight*, in order that the vibrations set up by the column of air within it shall undulate, swell and amplify as they progress down into the sound chamber in a faithful and natural manner. This cannot be the case when there are bad *air leaks*, due to poor joints along the length of the tone-arm at any point, and on certain notes, harmonics may make their presence severely noticeable, or, in other words, some of the notes will be harsh or perhaps "flat", depending upon the position of the leak hole and the record being played.

One of the latest developments in tone-arms are those made entirely of wood, which gives a very faithful and mellow reproduction, especially on musical selections. These are supplied on one of the best commercial machines and are also available from phonograph parts companies. Due to their weight they should be mounted in ball bearings in all cases, at their base, and if necessary be very careful and keep it balanced so as not to exert excessive pressure on the stylus or needle. If you are ingenious, you can make one yourself out of good hard wood such as mahogany or walnut. The method used in one commercial tone-arm for swinging the reproducer over and off the record by means of a tubular valve is clearly shown at Fig. 4. The position of the ball bearing ring at the base of the pivot tone-arm, when used, is also indicated.

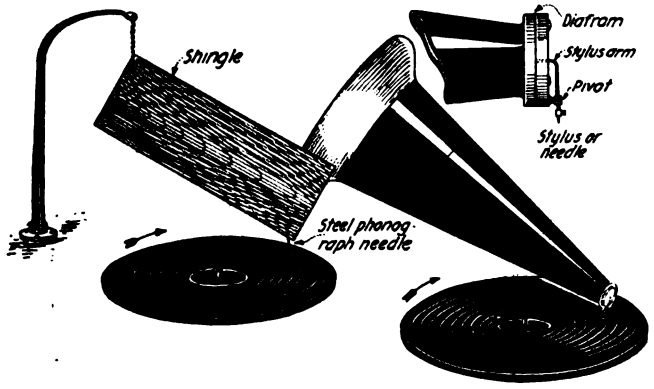
CONSTRUCTION OF SOUND MODULATORS.

Three distinct and more or less efficacious types of *sound modulators* or *mufflers* are shown at Fig. 5, A, B and C. The one shown at A is used on several machines, including the Conried phonograph. It is simply a sliding valve affair, the valve being made of a piece of wood with a circular hole cut thru it. Sliding this hole into register with the tone-arm and sound amplifier chamber gives a maximum sound, while if this valve is moved to the right, the opening becomes smaller and smaller until the sound is a minimum. Movement of the valve is transmitted thru a small metal rod with a button on it, extending thru to the outside of the cabinet.

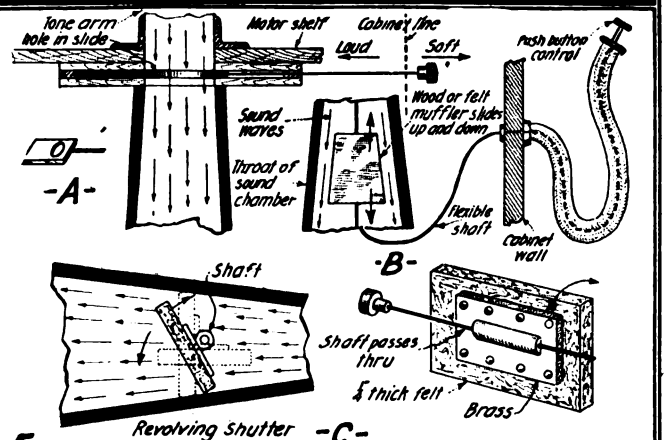
The arrangement shown at "B" is used on one of the well-known commercial machines, and those desiring to have a flexibly controlled cord, three to four feet long, extending from the side of the phonograph cabinet so that they just push the button on the end of the cable and modulate the tone, can utilize this or a similar principle. A flexible shaft explains the way this trick is worked, the inner end of the shaft moving the wooden or felt covered conical plunger or valve up and down in the throat of the amplifying chamber; when this valve is all the way up, it blocks off the chamber completely. This style of valve has the advantage that it reduces the area of the sound chamber evenly in any position and not unsymmetrically or all on one side as is the case at A.

(*Continued on page* 698)

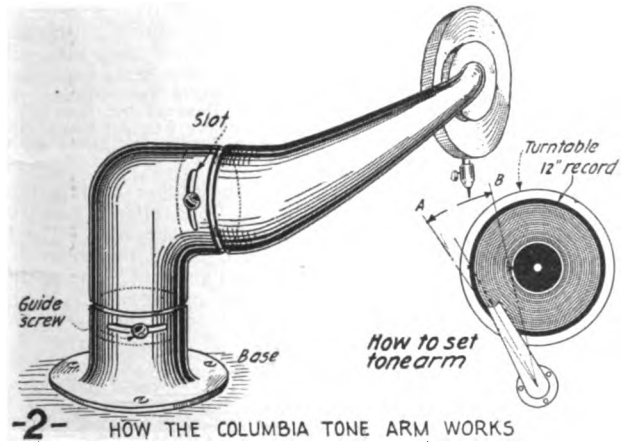
HOW TO MAKE "YOUR OWN" PHONOGRAPH



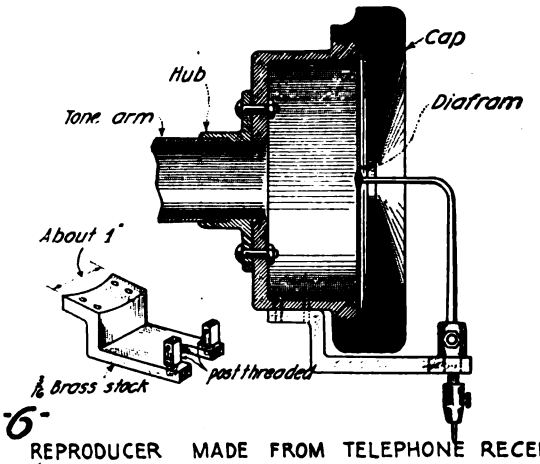
-1- SIMPLE REPRODUCERS



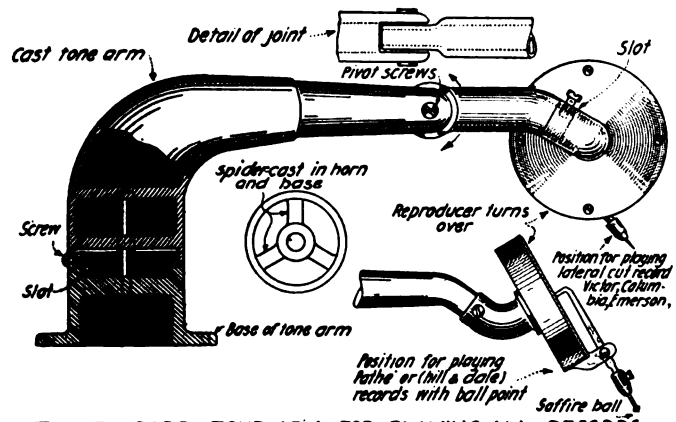
-5- THREE TYPE OF SOUND MODULATORS



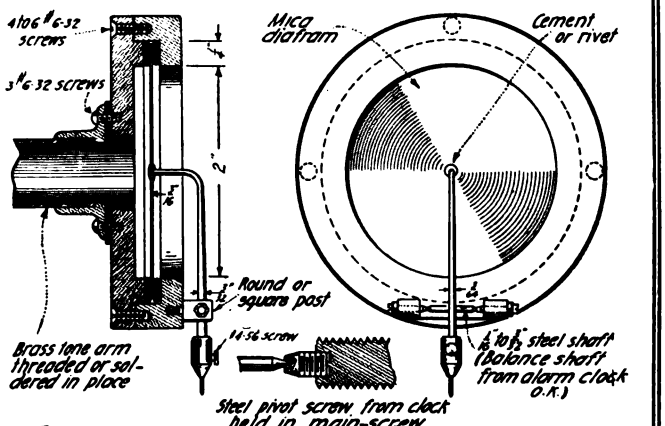
-2- HOW THE COLUMBIA TONE ARM WORKS



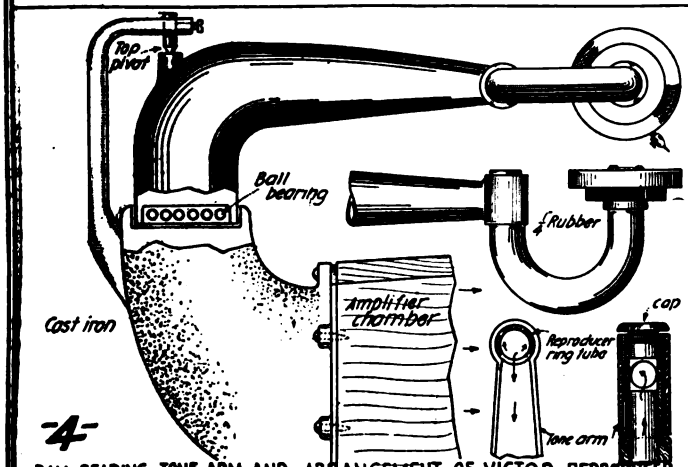
-6- REPRODUCER MADE FROM TELEPHONE RECEIVER



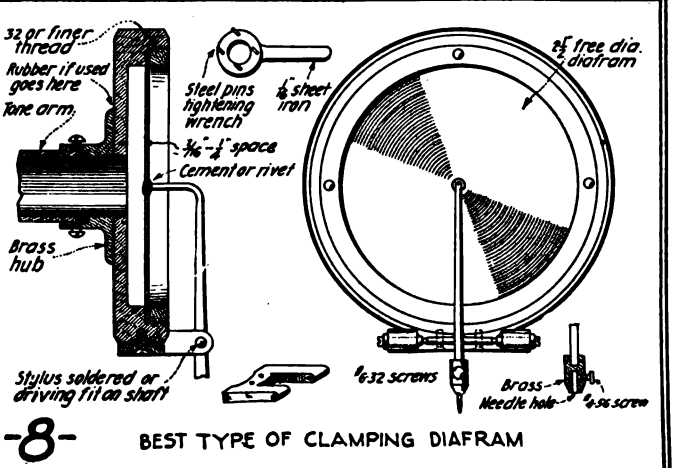
-3- STANDARD TONE ARM FOR PLAYING ALL RECORDS



-7- STANDARD METAL TYPE OF REPRODUCER



-4- BALL BEARING TONE ARM AND ARRANGEMENT OF VICTOR REPRODUCER

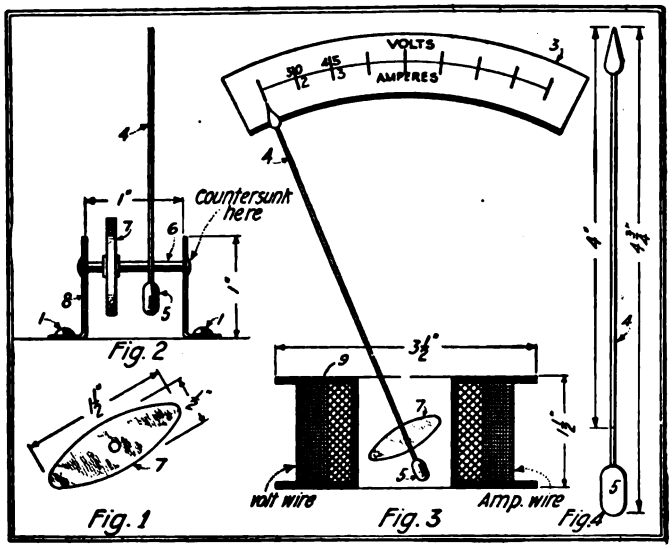


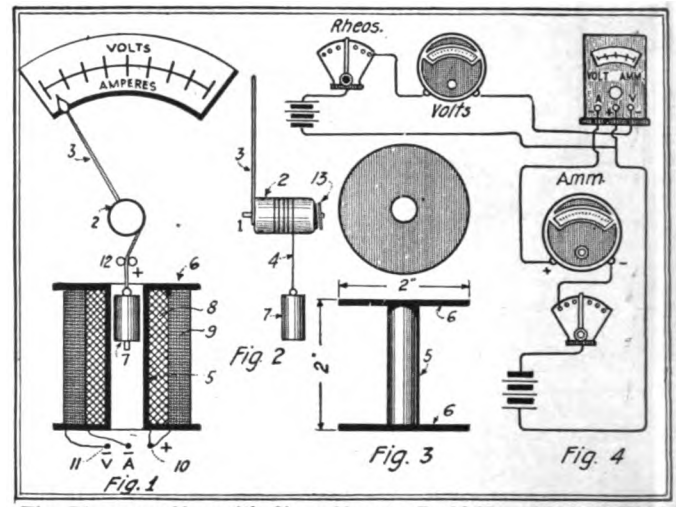
-8- BEST TYPE OF CLAMPING DIAFRAM

A Home-made Volt-Ammeter

By EVERHART TURNER

Here is a description of my home-made volt-ammeter. For the first type a brass box is made for the windings, top and bottom ends, 1½" x 3½", as shown in Fig. 3; the inside portion to fit core is 1" x 1¾" and 1" deep. When finished it is first wound with three layers of bell wire. When that winding is complete, a coat of shellac is applied and when dry five layers of No. 38 cotton-covered magnet wire is wound, leaving about five inches of wire for connection as shown in diagrams.





The Diagrams Herewith Show How to Build Two Distinct Types of Volt-Ammeters. These Instruments Possess the Distinct Feature of Simplicity and Very Good Accuracy For All Experimental Requirements, Especially If They Are Carefully Calibrated With a Standard Meter.

It is then tested with a compass and the negative end of the coil turned down. The hand is then made of aluminum 4¾" long with a piece of brass, No. 7, fastened at the end, ¾" up from the weight 5. An axle is soldered in place. This axle must be made of aluminum, No. 6, 1" long and 1/16" in diameter. On the axle a piece of steel (to be magnetized) is also fastened. It is 1½" long by ½" wide, ¼" thick. Bearings, No. 8, are then made of brass. There are two supports 1" high and 1" wide, countersunk on both sides so that the axle 6 will swing easily between them. It is then placed in the middle of the coil as shown in Fig. 3 and held in place with two brass screws, No. 1. It is put in a suitable box and three binding posts connected to it as shown in the diagram. The meter is then ready for calibration, as plainly shown in Fig. 4, for design No. 2.

VOLT-AMMETER NO. 2.

Here is the description of volt-ammeter No. 2. First we make a bobbin; Fig. 3 clearly illustrates the same. The ends are of hard rubber No. 6 and the brass tube, No. 5, is then fastened in place. It is wound with two layers of bell wire and on top of that we wind five layers of No. 38 gage insulated copper magnet wire. It is connected to the proper binding post as shown in Fig. 1. The roller is constructed of wood and placed on the axle. The hand is placed on the front of the roller. It is made of aluminum and is 4" long as shown in Fig. 2. A spring No. 13 is fastened to the roller to hold it in place and to register on zero when no current is applied to the meter. A piece of silk thread is placed on the roller No. 4 and fastened to it. On the other end a piece of steel No. 7 is fastened. It is then placed in a box and two pins are fastened in place to guide the thread and weight into the core hole. The apparatus is then ready for calibration as shown in Fig. 4. The diagram is all that is necessary for the instruction.

Making a Hand-Type Telephone

By JORDAN BAUER

I give herewith a description of a hand-type telephone, which can be made with the help of a small wood lathe, or, if a lathe is not available the shells and flanges may be made square instead of round in shape.

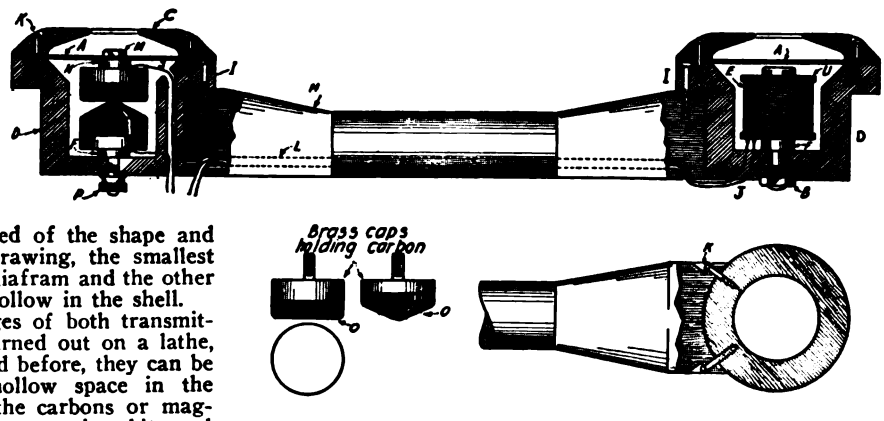
The diafram of the receiver is made of tin-type tin, while the diafram of the transmitter is made of either tin-type tin or mica.

In making the transmitter instead of using carbon granules the tops of two old battery carbons are used of the shape and size of those in the drawing, the smallest being attached to the diafram and the other to the bottom of the hollow in the shell.

The shells and flanges of both transmitter and receiver are turned out on a lathe, or, as I have mentioned before, they can be made square. The hollow space in the shell, which contains the carbons or magnet, is made with an extension bit, and should be large enough to hold the carbons or magnet without touching the sides and deep enough so carbons or magnets fit as illustrated in the drawing.

The core of the magnet is made of an annealed iron bolt with fiber washers spaced ¾ inches apart, the bolt being about 5/16 in. in diameter; a magnet of this size should be wound with 375 ft. of No. 33 B. & S. gage wire, which gives 75 ohms resistance (the right resistance for a telephone receiver). This wire should be insulated. The finished magnet is attached with a rubber washer between it and the shell as shown in the drawing.

The handle connecting the transmitter and receiver is made entirely of wood.



We Often See the Hand-Type Telephone Similar to That Used in European Countries, But the Experimenter Does Not Usually Care to Pay the Price Asked For This Type of Instrument. The Writer of the Present Article Shows a Clever Way to Build This Type of Telephone, Complete With Microphone and Receiver, All From Wood. Here Is the Way to Build Such a 'Phone in a Very Simple Manner. The Simple Carbon Microphone Shown May Be Used, But Best Results Are Invariably Obtained by Using Standard, Polished Carbon Granules in a Carbon Cup, as Shown in All Telephone Hand-Books.

For carrying on conversation, two of these hand-type telephones of the pattern illustrated and described are used. To make a first-class job of this instrument, the microphone should be made somewhat after the fashion of the standard types with which the reader is undoubtedly familiar, or which can be found described in any telephone handbook. One of the principal things which the young telephone experimenter will find when building his own telephone apparatus is that it does not pay to monkey around with "crushed" carbon particles. Buy some polished carbon granules from telephone or electric companies

Hammering Electrons Out of Matter

By HAROLD F. RICHARDS, Ph.D.

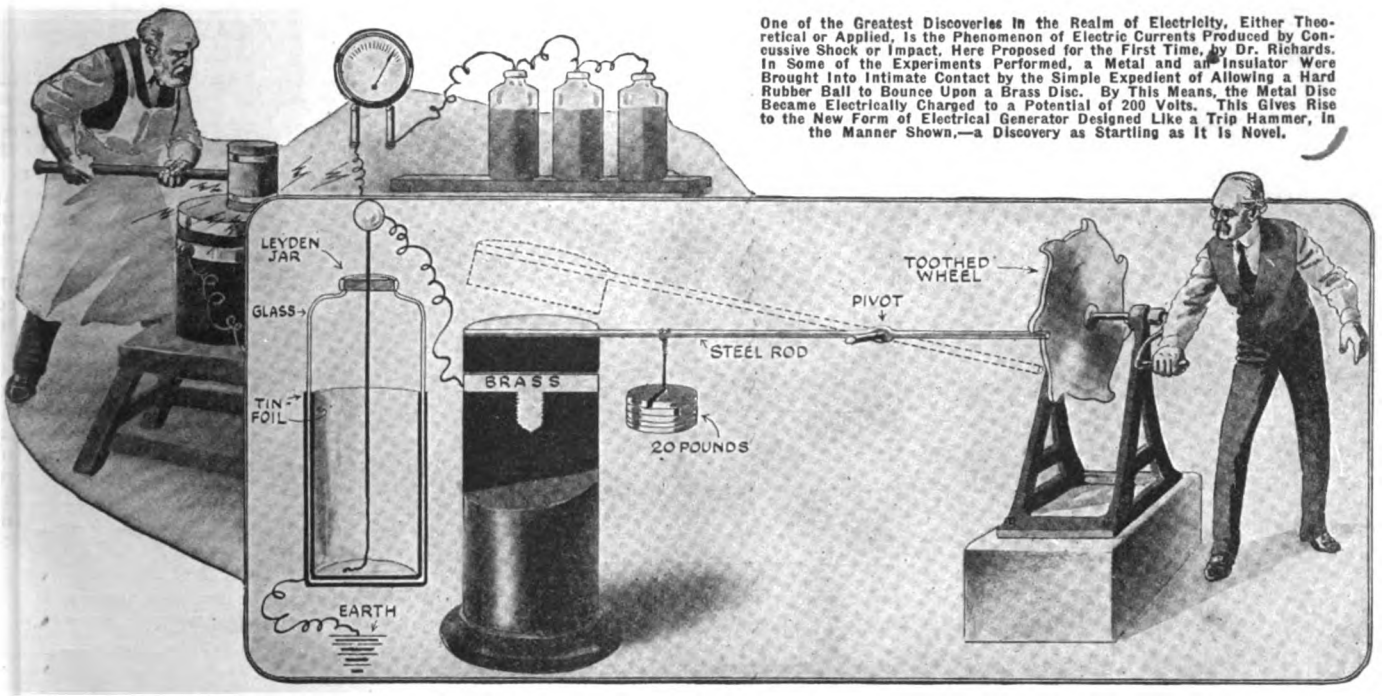
STRANGE it is that the oldest known electrical phenomenon is the last to be explained. The spinning wives of ancient Phoenicia knew that their amber spindles, rubbing against feminine garments, generated a strange power by virtue of which they clutched up threads and leaves as if by invisible talons. As early as 1730 the Wizard Bose set up in Germany a huge glass globe revolved rapidly against leather pads, and with the electricity thus generated knocked over at one crash twenty of Frederick's best soldiers. He invited guests to a banquet table, and filled them with amazement as they saw electric flames break forth from every dish and flower and wine glass. He had insulated the table on cakes of pitch and connected it to his enormous friction machine operating in an adjoining room. He introduced his guests to a fair forerunner of Theda Bara, whom he had insulated with rubber soles and electrified with his friction machine. When a handsome gallant essayed to kiss the lady's enticing lips, the electric shock which he received must have caused him to conclude, as Kipling did later, that "the female of the species is more deadly than the male."

WHY RUBBING PRODUCES ELECTRICITY.

Since the days of Bose, induction, X-rays, radioactivity, wireless and countless other electrical phenomena have been discovered and, after a fashion, explained, yet at the present time electrification by friction is little understood either by scientists or by laymen. Many people believe that friction will produce electricity upon only a few substances, such as amber, glass and hard rubber, but the fact is that *any* substance will be electrified if rubbed with any *other* material, provided only that one of them is an *insulator*. Whittling a pencil, sweeping the floor, grating chocolate, polishing furniture and bowing the strings of a violin all generate electricity. Even metal can be electrified by friction if it is held by an insulating handle and rubbed with a dry insulator, as silk, leather or rubber.

Until recently scientists themselves have been almost as much at sea as the public regarding the nature of electrification by friction. It is well known that if two *dissimilar metals* are placed in contact, and then separated, they will be found to be electrically charged, *even if they have not been rubbed together.* The difference of potential is in some instances nearly a volt. It was formerly held that this electricity was due to a chemical action occurring between the two metal surfaces and whatever gas they had absorbed from the air, just as in a primary battery, and there are many who still entertain this view. At present, however, the electrical energy of this *contact effect* is considered by most writers to come from the motions of the *free electrons,* which are in a vibratory state inside the metals. These are the same electrons whose free motion in metals, under the action of an applied voltage, constitutes the electric current, which produce X-rays by their collision with the target in a Coolidge tube, and which are known as beta rays when they are spontaneously shot forth from radium. If copper, for example, has more free electrons in a cubic inch than zinc, there will be a greater *electron pressure* in the copper than in the zinc, and, if these two metals are placed in contact, electrons will pass from the copper to the zinc, so that the copper will become positively charged and the zinc negatively. This diffusion will continue until enough negative electricity has accumulated on the zinc to repel any more electrons that may be urged towards it by the electron pressure. Since the substance which possesses the greater concentration of free electrons is the better electrical conductor, a metal always becomes positively charged when placed in contact with a metal *that is a poorer conductor than itself.*

Attempts have been made to apply this same theory to the problem of the electrification of insulators by friction, on the assumption that the rubbing merely serves to bring the molecules of the two substances *into closer contact.* The electrons in an *insulating* substance do not move freely, so that the rubbing is necessary to bring the two surfaces sufficiently close together to permit the passage of electrons from one to the other. According to this view, a metal ought always to become positively charged when rubbed with an insulator, for the metal has an enormously greater number of free electrons than the insulator, and, therefore, ought to lose electrons to the latter. But experiments have shown that this is not always the case, and the results are clouded by erratic variations, so that certain experimenters have concluded that electrification by friction is entirely different in nature from the contact electricity of metals, and the view has been advanced that in some manner part of the energy of friction is *directly transformed into electrical energy.*



One of the Greatest Discoveries in the Realm of Electricity, Either Theoretical or Applied, Is the Phenomenon of Electric Currents Produced by Concussive Shock or Impact. Here Proposed for the First Time, by Dr. Richards. In Some of the Experiments Performed, a Metal and an Insulator Were Brought Into Intimate Contact by the Simple Expedient of Allowing a Hard Rubber Ball to Bounce Upon a Brass Disc. By This Means, the Metal Disc Became Electrically Charged to a Potential of 200 Volts. This Gives Rise to the New Form of Electrical Generator Designed Like a Trip Hammer, in the Manner Shown,—a Discovery as Startling as It Is Novel.

It occurred to the writer that this puzzling question—why rubbing produces electricity—might be answered if *another means* could be found of obtaining on the same surfaces an electrical charge of the same magnitude as that due to friction. The problem seemed to resolve itself into the question of finding whether there is a *natural tendency* for a metal to give up electrons to an insulator. If the electron, or *contact,* theory of frictional electricity was true, it seemed evident that if we could get the two substances, say a piece of brass and a piece of hard rubber, sufficiently close together, then it ought to be possible to obtain the same electrical charges *without friction* as are obtained *with friction.* If this effect could be found, then there would no longer be any doubt that electrification by friction is of exactly the same nature as the contact electricity of metals, and the electron theory of the constitution of matter and electricity would be further strengthened.

POUNDING ELECTRICITY OUT OF MATTER.

In order to test the truth of this idea,

(*Continued on page* 656)

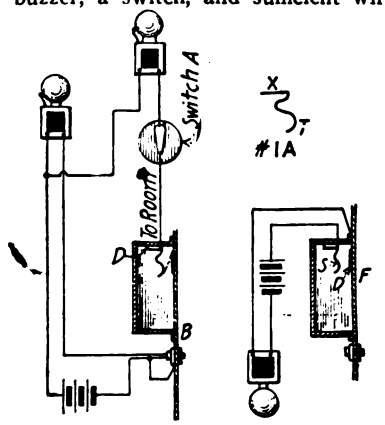
HOW-TO-MAKE-IT

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

FIRST PRIZE, $5.00

AUTOMATIC "MAIL" SIGNAL.

All that is necessary is a flat brass or German-silver spring about 2 or 3 inches long and about ⅛ inch wide, a vibrating bell differing from the sound of the house bell, or buzzer, a switch, and sufficient wire to



The Accompanying Photograph Shows in Detail the Method for Constructing An Automatic Signal for Notifying One That Mail Has Been Dropt Into the Letter Box.

reach from the letter box to the room where bell is to be installed.

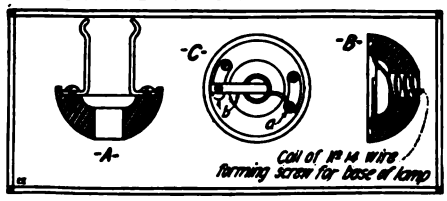
The spring is bent as in Fig. 1A with two holes as in 1B. The spring is then fastened to the top of letter box as in Fig. 1 at S, with end T (Fig. 1A) 1/16 inch from drop shutter D. When the shutter is pushed in the circuit is closed.

Fig. 2 shows how to connect alarm on house battery. The house button battery wire is grounded to letter box frame B. A wire is then run from spring D to switch A, which may be conveniently placed next to door-opener push button. Switch A is connected to one binding post of special bell. The other binding post is connected to corresponding binding post on house bell.

Contributed by LOUIS J. ALBERT.

MINIATURE LAMP SOCKET FROM SEPARABLE PLUG CAP.

Herewith is a description of a lamp socket made from a separable attachment plug cap as shown at A. One of the lugs is cut off and the other is bent down, as shown at B. A piece of No. 14 copper wire is coiled around the base of the lamp so that the lamp may be screwed in and out. One end of the wire is fastened un-



This Lamp Socket Is Made From a Separable Attachment Plug Cap, Full Description of Which Is Given in the Above Article.

der a screw head as in B. C shows the bottom view of the completed socket. Connecting wires are fastened under screw heads A and B.

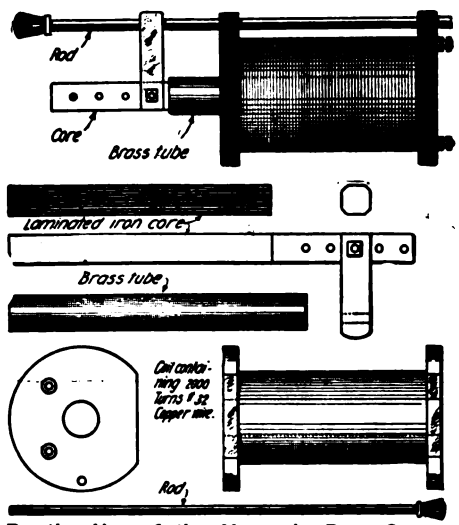
Contributed by HORACE R. BROKAW.

SECOND PRIZE, $3.00

YALE LOCK DOOR OPENER.

The accompanying drawings show a very simple and accurate method of constructing a magnetic door opener for door equipt with a Yale lock. Procure a piece of brass tubing 6 inches long by 15/15 inches. Two pieces of wood cut as per drawing one—the straight side to fasten on door and to be screwed on. Let brass tube extend 2 inches outside of spool on one end. Make iron core from old bail band iron or stove pipe, using fifteen pieces and extend same out 1½ inches with holes.

Rivet all together and file to fit tube, putting long strip with holes in center or core. Make rod out of old No. 4 wire. Use a rod between the core and iron. An old dry cell nut may be employed. Make hole in wood block large enough to slide freely on iron rod. Use No. 32 cotton covered wire; put on 2,000 turns. First wind on 1,000, then give a coat of shellac. Let dry for ten hours, then shellac again. Finally cover with black paper.



By the Use of the Magnetic Door Opener Here Shown, It Becomes a Simple Task to Open Any Door Fitted With a Yale Lock.

Bore 3/6-inch hole in finger bolt of lock at bottom and ½ inch to right of center. Put in wire hook. Tie strong string to holes in core. For binding post use old dry cell binding post. Wind all wire in the same direction. Then hook on 110-volt line. Wire to door bell.

Owing to the simple construction and low operating cost of this magnetic Yale lock opener, it ought soon to win popularity. Those desiring to use this magnetic door opener on battery current, can wind it with considerably heavier wire in order to adapt it to the lower voltage. If the spool is wound full with about No. 22 B. & S. gage cotton covered or enameled magnet wire, it will give a good strong pull on 8 to 10 volts battery current. The pushbutton for controlling the solenoid can be located wherever desired.

I have used one like this for two years and have found it very satisfactory.

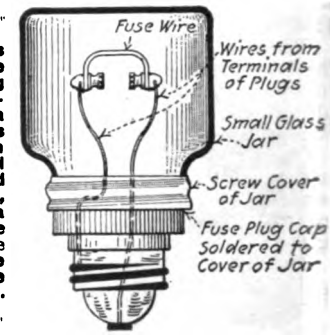
Contributed by BERNARD McGEE, E.E.

THIRD PRIZE, $2.00

A "RENEWABLE" FUSE PLUG.

Take a fuse plug that has been burned out and carefully remove the brass cap, mica and pieces of wire. Now get a small glass jar with a screw top. One that has contained vaseline will do very well. Cut a hole in the cover the same as the one in the cap of the plug. Solder the cover

This Shows a Renewable Fuse-Plug Which Consists of a Small Glass Bottle With Its Metal Top Turnod Downward, Cutting a Hole in the Cover the Same Size as the One in the Plug.



to the cap as in the drawing. Solder two pieces of well insulated wire to the terminals of the plug as shown and slip the brass cap and cover over them and fasten as originally. Now solder two of the zinc binding posts of a dry cell to the free ends of the wires and connect them with a piece of fuse wire of the desired size. Screw in the glass jar which acts as a cover and use as an ordinary fuse plug. When burnt out, put in a new piece of fuse wire. 'At's all!

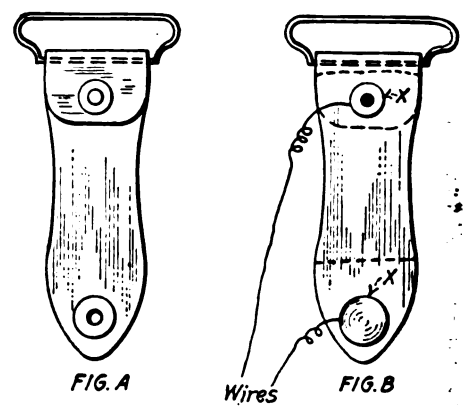
Contributed by O. P. MEAKER.

"SNAP" SWITCH FROM OLD SUSPENDERS.

The accompanying drawing shows a simple snap switch, with the accent on the simple, made from parts of an old pair of suspenders, and which I have found very handy in connecting wire to various instruments, etc.

Fig. A shows part as taken from suspender. In figure B leather part is cut out along dotted lines, and wires are soldered to metal parts at points X. To connect circuit, snap one to the other. It's a snap!

Contributed by JOHN J. SPAULDING.



This "Snap Switch" Consists of a Wire Connected to Each Suspender Button, the Dotted Lines Indicating the Points Where the Leather Is Cut Out.

$10.00 Prize—"Perpetual Motion" Again

By A. d'ABRO

IN your February issue you publisht different answers to your "Perpetual Motion Prize Contest."

The first prize is allotted to Mr. Burgin, who claims that your first perpetual motion device will not work because of the buoyancy of the rubber chambers being the same on either side.

According to Boyle's law, this would mean that the pressure of the imprisoned air is the same whether the weight be crushing the rubber cylinder down or whether it be stretching it lengthwise.

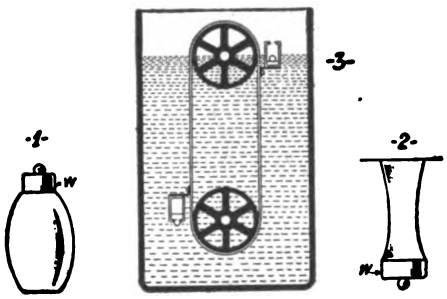
Surely this is incorrect. Assuming that the cylinders contain air at atmospheric pressure and are immersed in the atmosphere, when the weight presses down the top of the cylinder the walls bulge out and the cylinder assumes the form of a barrel—when a state of equilibrium is reached. (See Fig. 1.)

The pressure of the imprisoned air on the top surface of the cylinder is sufficient to counteract the push of the atmosphere, plus the push of the weight—thus the pressure of the imprisoned air is increased.

On the other hand, when the weight is suspended at the base of the cylinder the tendency is to lengthen the cylinder; thus increase the volume of the imprisoned air and decrease its pressure. (See Fig. 2.)

The outside atmosphere will push in the walls of the cylinder and create a waist. Finally, when a state of equilibrium is reached, the interior push on the bottom of the cylinder will be equal to the atmospheric push on the bottom, minus the weight, thus the interior pressure is reduced.

I am assuming for simplicity's sake that the bottom and top of the cylinder are rigid and only the walls elastic.



Three Phases of the Recent Perpetual Motion "Water-Bucket Machine" Which Formed One of the Problems of the Prize Contest Some Months Ago. Mr. d'Abro Offers a Ten Dollar Prize ($10) to Anyone Who Can Give a Successful Explanation to the Questions He Here Propounds. All Answers Must Be in the Editor's Office by October 15, 1920.

In short, according to Boyle's law the buoyancy cannot be the same on both sides and the device must rotate—and yet, of course, it will not!

May I suggest a slight modification of your highly ingenious device? Instead of rubber pockets let us consider metallic cylinders in which pistons can run without friction, and let us fix the weights to these pistons and place rings at the extremities of the cylinders to prevent the pistons from slipping out. Let us suppose that the cylinders contain no air, and let us place the device in water.

When the weights press down the pistons toward the bases of the cylinder, the pistons will come in contact with the bases of the cylinders, since no air is interposed—when the weights pull the pistons down away from the bases of the cylinders the pistons will glide down to the other extremities of the cylinders until arrested by the rings. (See Fig. 3.) To obtain this result it will be necessary for the weights to be of sufficient magnitude to overcome the cumulative effect of the atmospheric pressure, plus the hydrostatic pressure—theoretically, at least, this is possible.

In this modified form the increase in volume and thus of buoyancy of the cylinders is manifest, and the device should undoubtedly rotate. If not, why not?

Could any of your readers explain the reason? I hereby offer a ten dollar prize for the best answer.

(ED. NOTE.—*Mr. d'Abro has deposited the* $10.00 *prize money with us. Send all letters of explanation to Perpetual Motion Editor,* SCIENCE & INVENTION, 233 *Fulton St., New York City.*)

Cutting Clock Gears

Being a "Bug" from way back, I am very much interested in the "How to Make It" department of your paper. Making an Electric Clock interested me considerably, since I made a Grandfather's clock some years ago. Even the wheels I cut, and the

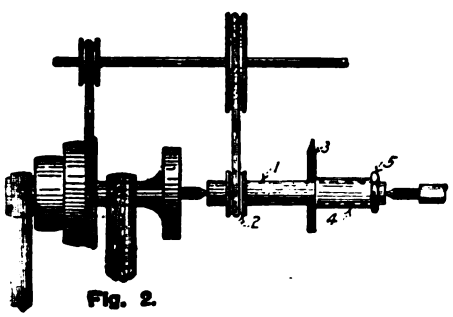


Fig. 2.

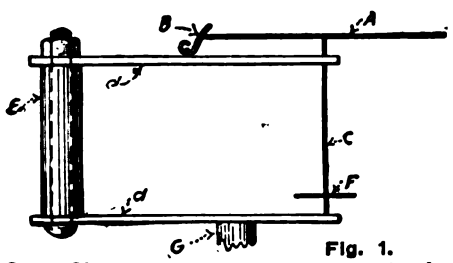


Fig. 1.

Some Clever Ideas Are Presented in the Accompanying Article by Mr. Richards, Describing How to Cut Home-Made Clock Gears. A Small Lathe Is All That Is Required in Order to Perform This Work in a Creditable Manner.

method I used is very simple, and if any of the other "Bugs" will follow my way of making them they will be pleased with the result, I am sure. I will say, to start with, that I have a lathe, one made by "yours truly," every bit of it, slide rest and all. It is not a beauty, I admit that, but it is rigid and the live center is true and in the right place, the most important thing.

From the family gas stove I took a round sheet-iron plate, seven inches in diameter, secured it to the face-plate and turned it true and drilled a 3/8-inch hole in its center. I drew a line across the plate thru the center, dividing it into two halves; on one of the halves I placed a protractor, carefully clamping it in place, and cut 180 notches in the rim, repeating the same operation with the other half. Now I had a guide plate with 360 marks; this plate will guide the cutting of any wheel from a grandfather's clock down to a one-flea-power wrist-watch.

Fig. 1-A represents the guide plate. B is a spring resting in a notch in the edge holding it rigid. C is an arbor moving freely in supporting arms. At d, d, are two short pieces of flat iron connected rigidly at E, by a bolt run thru a gas pipe five inches long. F is the block screwed securely to C, this whole guide frame to be fastened to tool post at G.

Fig. 2. This shows the cutting device. 1 is a piece of round iron 5 by 1 inches centered and turned true; a small wooden pulley is fastened at 2. The cutting tool, 3, is a piece of 3/16 round tool steel, 2½ inches long, filed flat at one end and then very carefully filed to the shape of a tail, hardened and tempered to a pale straw color. A 3/16-inch hole is drilled thru arbor with a loose sleeve, 4, forced against the tool by a nut, 5.

With a countershaft and two pulleys as shown a speed of several thousand revolutions per minute is easily obtained; the faster it runs the better it cuts. Feed slowly.

I bought sheet brass 1/8 inch thick for the big power wheel and a little less for the others. I cut a square with a hack saw, fastened the corners to the face plate and turned the blanks round.

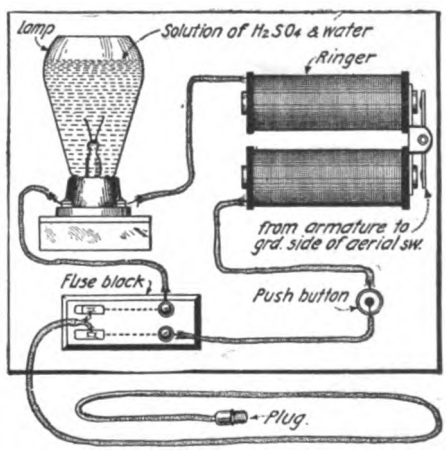
The escape wheel is three inches diameter, thirty teeth, controlled by a seconds pendulum. The hour, minute and second hands are all moved from the center; the second hand, being the largest, making big strides for each swing of the pendulum.

Contributed by G. RICHARDS.

High Frequency Buzzer

A base board is first prepared, about 6 in. x 6 in., upon which the instruments are to be mounted. An ordinary polarized bell ringer from a telephone set is strapt to the board and is to be connected to a fuse block, push button and current reducer.

The current reducer may be made by cutting the large end off of a burned out electric light bulb, and filling the remaining part with a weak solution of sulfuric acid and water. The lamp is then screwed into a porcelain socket and secured to the base.



The Drawing Above Shows a Novel Form of High-Frequency Buzzer Constructed From a Polarized Ringer Movement, Together with a Lamp Resistance Filled with a Dilute Solution of Sulfuric Acid and Water and Operated on A. C.

This buzzer may be operated on 110 volts alternating current and will give a high-pitched note in the receiver when used as a tester. It does *not* work on D.C. current.

If it is desired, the clapper may be filed off close to the armature. Connections to the receiving set are made from the armature to the ground side of the aerial switch.

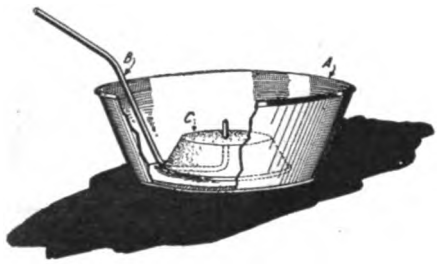
Contributed by W. F. CURRENT.

Wrinkles, Recipes Formulas

EDITED BY S. GERNSBACK

A PNEUMATIC TROUGH.

Take a flower pot saucer and drill a hole in the center of it, if there is not one there already. A slot must be cut in the side of the saucer wide enough for a glass tube to pass thru. The saucer is then placed in a pan and connected up as shown in the illustration. (A) is a pan



How to Make a Pneumatic Trough for Chemical and Other Experiments Is Here Shown in a Simple Manner.

which is to be filled with water, (B) is the delivery tube and (C) is the flower pot saucer.

Contributed by
FREDERICK REYNOLDS.

INK FORMULAS.

Inks that appear thru heat:

1. A solution of caustic potash.
2. A solution of hydrochlorate of ammonia, in proportion of 15 to 100.
3. A weak solution of copper nitrate becomes red when heated.
4. The juice of lemon, orange, onion or artichoke may be used.
5. Cobalt chloride solution can be used on rose colored paper.
6. Sulfuric acid, diluted, may be used. If too strong it will destroy the paper.
7. A slightly alcoholic solution of bromide of copper appears when heated and disappears when cold.
8. A very dilute solution of perchloride of copper becomes yellow when heated.
9. Digest 1 oz. of oxide of cobalt, at a gentle heat with 4 oz. nitromuriatic acid until no more will be dissolved; then add 1 oz. salt (Na Cl) and 16 oz. water. This becomes green when heated.
10. Put in a vial ½ oz. distilled water, 1 dr. potassium bromide and 1 dr. pure copper. This becomes brown when heated.
11. When a solution of acetate of protoxide of cobalt contains nickel or iron it is green when heated; when pure it is yellow.
12. Milk or buttermilk may be used as inks.
13. Boil oxide of cobalt in acetic acid. If salt is added the writing will be green when heated; if nitre it will be pale rose.
14. A weak solution of nitrate of mercury becomes black when heated.

Inks that appear thru light:

1. Chloride of gold forms characters which appear when exposed to daylight for one hour.
2. Write with a solution of 1 part silver nitrate and 1,000 distilled water. It becomes slate color when exposed to daylight.

Inks appearing thru Reagents:

1. Use a solution of acetate of lead and distilled water; the letters appear black when dipt in an alkaline sulphide solution.
2. Chloride of gold, as ink, becomes brown upon passing a solution of perchloride of tin over it.
3. An ink of gallic acid becomes black thru a solution of sulfate of iron, and brown thru some other bases.
4. When starch is used as ink and iodine vapor is passed over it the writing becomes blue. It disappears under the action of hyposulfite of soda in proportions of 1 to 1000. Iodine in solution may be used.
5. Characters written with a 10 per cent solution of nitrate of protoxide of mercury becomes black when moistened with liquid ammonia.
6. Characters written with a weak solution of soluble chloride of platinum or iridium becomes black when the paper is submitted to mercurial vapor.
7. Potassium iodide 1 part, water 8 parts; to develop apply a solution of mercuric chloride; the writing will appear red.
8. Boil starch and a small amount of potassium iodide. Chlorine vapor or ozone (O_3) will develop it.
9. Write with a solution of ferrocyanide of potassium; develop by placing a blotter moistened with a solution of copper nitrate upon it.
10. Write with a dilute solution of tincture of iron; develop with tea on a blotter.
11. Mix one part linseed oil, twenty parts of water of ammonia, one hundred parts water. This will appear when immersed in water and disappear when dry.
12. Characters in sulfate of copper can be developt by ammonia. They appear blue.

Contributed by LE ROY ASHLEY.

TO COAT CHARCOAL WITH GOLD.

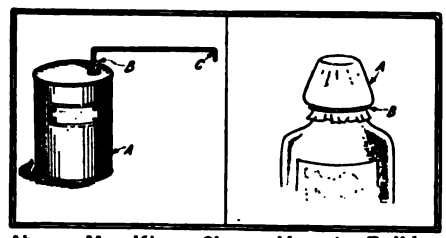
Pour half an ounce of diluted muriate of gold into a drinking glass and immerse in it a piece of very smooth charcoal. Expose the glass to the rays of the sun in a warm place, and the charcoal will soon be covered over with a golden coat. Take out with forceps and enclose it in a glass for show when dry.

Contributed by W. W. HOLLISTER.

HOME-MADE RETORT.

"A" is a can with a stopper B that screws on. A brass or iron tube C is soldered around a hole punched in the stopper B. The retort can be easily cleaned and also the tube by unscrewing B.

Keeping Dust from Bottles—To keep the dust from accumulating around the necks and between the necks and stoppers of bottles in the laboratory I put a paper A with a rubber band B as in the diagram.



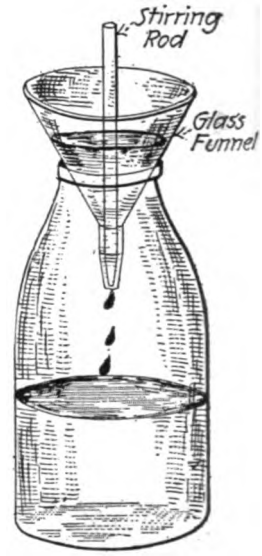
Above, Mr. Klaus Shows How to Build a Home-Made Retort at the Left; and, at the Right, a Good Method of Keeping Dust From Chemical Bottle-Tops.

When the bottles are wrapt with tissue paper I cut it off at the top of the neck and put this on, making it neater.

Contributed by HENRY KLAUS.

AUTOMATIC MIXER FOR SULFURIC ACID.

Quite recently I had occasion to mix sulfuric acid and water together, and found that it was a very slow and messy job, so I devised an apparatus to do the mixing. In the neck of a milk bottle I placed a glass funnel and then inserted a stirring rod into the funnel. When the acid was poured into the funnel it fell into the bottle a drop at a time. Hope that some other experimenter will find this "dropper" useful.



If You Have Occasion to Mix Sulfuric Acid and Water Together, Which Is Always a Slow Job, You Will Find This Automatic Mixer a Great Time-Saver.

Contributed by H. W. WILSON.

AN AID TO THE STUDENT OF CRYSTALLOGRAPHY.

Many experimenters refrain from the study of crystallography because of the lack of a microscope with which to enlarge these minute bodies to a size clearly visible to the human eye. This difficulty may be partially overcome by the use of a Mirroscope, a Balloptican, or any one of the other patent post card projectors, and plates of glass upon which substances are crystallized being inserted in the place of the postcards. Pieces of different colored papers placed behind the plates will bring out various details of the crystal.

A most beautiful color spectacle can be arranged by mounting various different colored crystals on one plate, projecting them on a white screen.

One of these projectors may be procured for about two dollars at any second-hand store, if not already in the possession of the experimenter. This is somewhat cheaper than the cheapest microscope which costs about ten dollars, besides making the object visible to both yourself and visitors at the same time.

A Noisy Fulminating Powder.—A noisy fulminating powder is made by mixing in a mortar three parts potassium nitrate (powdered) with two parts potassium carbonate and one part of sulfur. The whole being thoroly mixed by grinding, forms the powder in question. Grind each separately and mix carefully with spatula.

When a small quantity of this mixture is placed on a shovel and heated gradually, until the sulfur begins to inflame, it explodes, giving a loud report, and leaving the ears hardly in a state to hear anything more for several hours, or if a very large quantity was ignited, for a whole day. Not more than *fifteen or twenty grains should be set off* at one time, as there is some danger of bursting the ear drums.

Contributed by O. R. COBLENZ

Radio Power Transmission

By SAMUEL COHEN

IT is rather surprising to learn just how little has been done in the direction of *radio transmission of energy* ever since the art was begun by our real father of radio, Dr. Nikola Tesla. If our average individual or even our engineers should stop for a moment to think of the nature of this problem he would soon realize the complexity of it. It is by no means unsolvable, yet to some it would seem that the carrying out of such an undertaking to a successful finish would be beyond the realms of human endeavor.

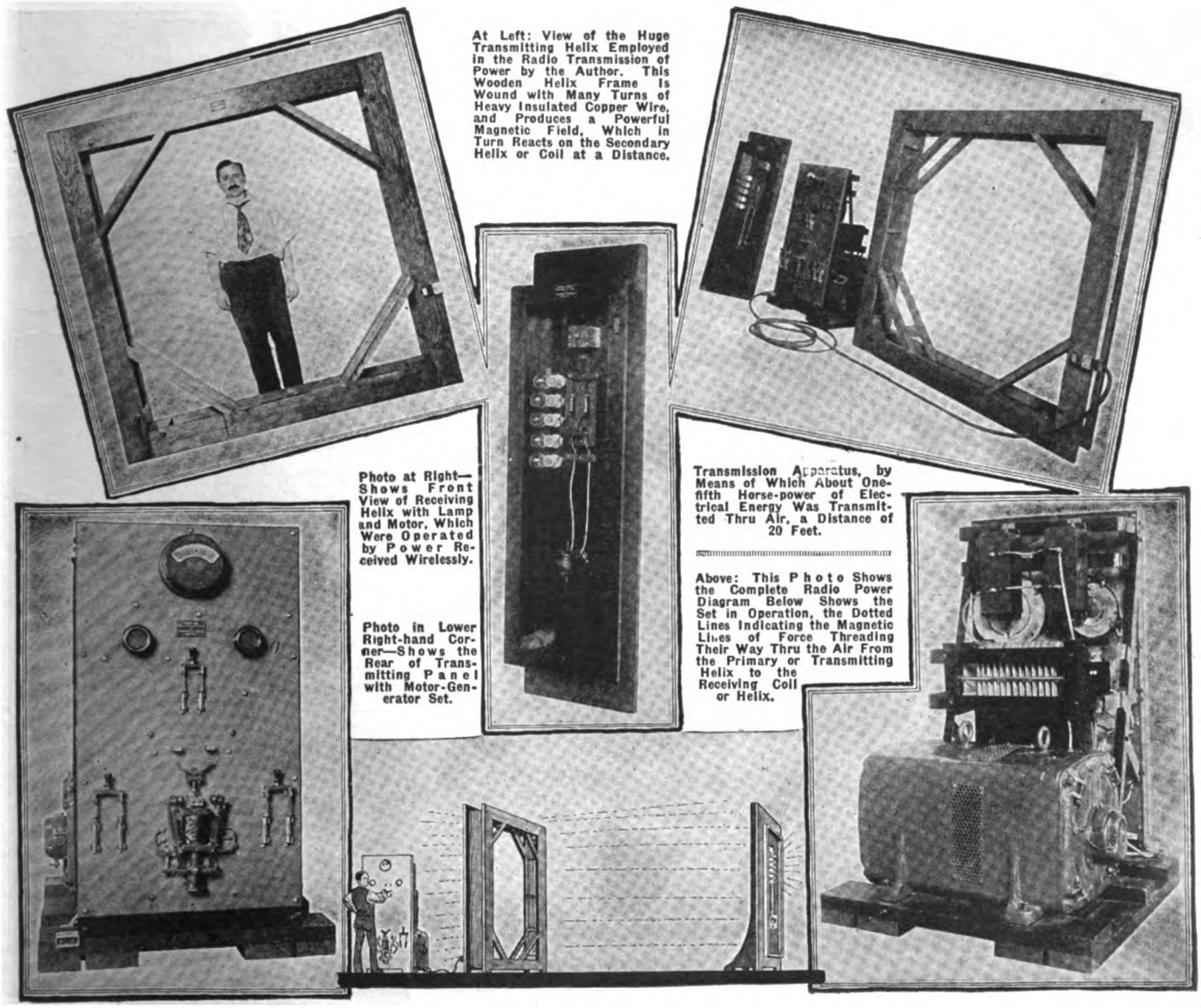
WHY RADIO POWER TRANSMISSION DEVELOPS SLOWLY.

The reason for the slow progress in this field is mainly due to the lack of interest on the part of financiers in giving their aid to the scientists who are in a position to develop this most important enterprise. Insofar as records go, it is certain that Dr. Nikola Tesla has done more in this direction than any one person or group of individuals in this country or abroad. His master pioneer work in the field of energy transmission has been fully recognized. His most important work has been conducted in Colorado and in his plant at Shoreham, Long Island. The cost of the erection of this latter plant ran into the hundreds of thousands of dollars. This will give the reader at least some idea of the progress made by him in the direction of completing his world-wide radio transmission system. The writer feels quite certain that the final steps in the development of the equipment for the radio transmission of energy will at least depend upon the fundamental principles laid down by Dr. Tesla.

The question whether transmission of energy thru the *ether*, without the use of a metallic conducting medium, is more economical than the present method of electrical energy transmission, is a point to be considered. Will a system of this nature be more flexible and will the initial cost of the equipment warrant the use of the same? These are only a few of the numerous questions that the financier will ask before he can or will attempt to promote an enterprise of this sort.

From an engineering point of view, the final system must be so designed so as not to discard the present equipment used in factories, etc. It is quite certain that the final accomplishment of the system for the radio transmission of energy will require the use of high frequency currents and that at the receiving side it will be necessary to utilize some form of efficient frequency converters for the transformation of the high frequency currents into currents of

(*Continued on page* 687)



At Left: View of the Huge Transmitting Helix Employed in the Radio Transmission of Power by the Author. This Wooden Helix Frame Is Wound with Many Turns of Heavy Insulated Copper Wire, and Produces a Powerful Magnetic Field, Which in Turn Reacts on the Secondary Helix or Coil at a Distance.

Photo at Right—Shows Front View of Receiving Helix with Lamp and Motor, Which Were Operated by Power Received Wirelessly.

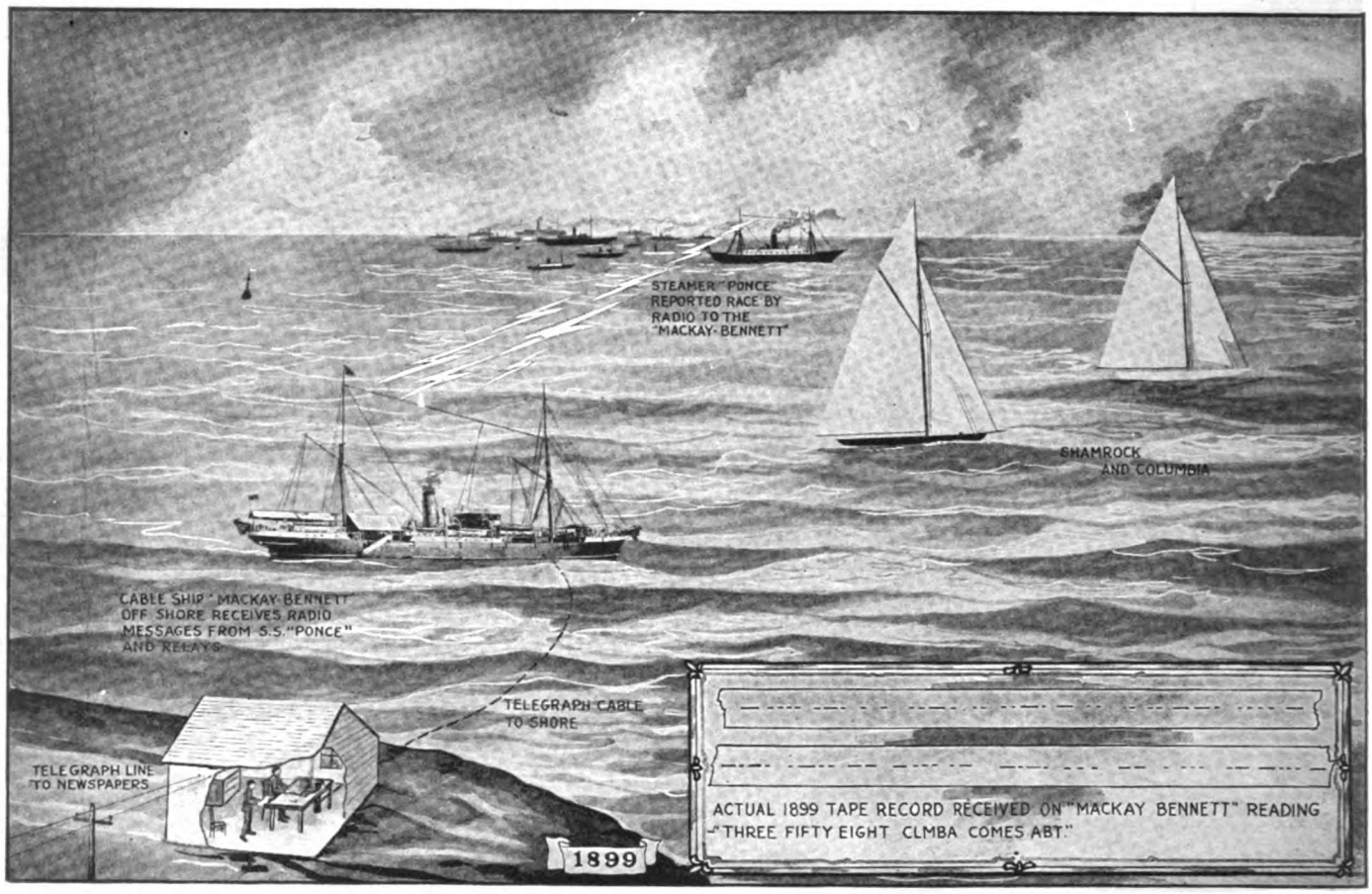
Photo in Lower Right-hand Corner—Shows the Rear of Transmitting Panel with Motor-Generator Set.

Transmission Apparatus, by Means of Which About One-fifth Horse-power of Electrical Energy Was Transmitted Thru Air, a Distance of 20 Feet.

Above: This Photo Shows the Complete Radio Power Diagram Below Shows the Set in Operation, the Dotted Lines Indicating the Magnetic Lines of Force Threading Their Way Thru the Air From the Primary or Transmitting Helix to the Receiving Coil or Helix.

Reporting Yacht Races via Radio

By DONALD McNICOL



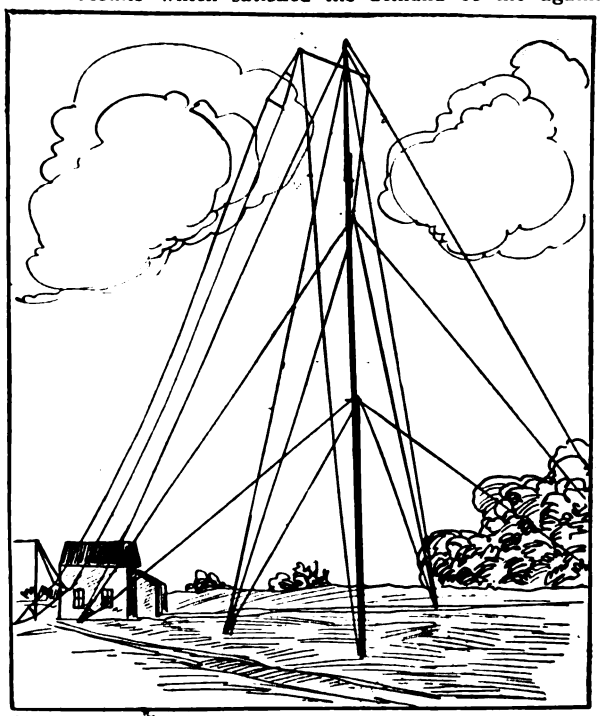
The First Yacht Races Reported by Radio to Newspapers Were Those of 1899, and the Method of Furnishing the Radio Signals from the S. S. "Ponce," Out at Sea, to the Cable Ship, "Mackay-Bennett," Is Clearly Shown. The Received Radio Signals Indicating the Progress of the Yachts "Shamrock" and "Columbia" Were Relayed by a Cable Running From the "Mackay-Bennett" to a Telegraph Station on Shore, and Thence by Telegraph to the New York City Newspapers. The Insert Shows an Exact Copy of the Radio Tape Record Received From the "Ponce."

When the old coherer sputters and the decoherer kicks,
And the tape begins to show the signs of talk;
You can bet—no chance of failing—
That it reads "Columbia's trailing
In the wake of Good Sir Thomas' Shamrock."

THIS is what one of the British wireless men thought the day before the International Yacht Race began in the year 1899, while he was engaged fixing up wireless apparatus off Sandy Hook to receive reports of the progress of the races as sailed. But the radio man was a better poet than prophet, for on the following days Sir Thomas Lipton's first attempt to capture the much prized cup with the original Shamrock proved a failure as did the later attempts of 1901 and 1903.

It was during the yacht races of 1899 that wireless telegraphy was first used to supply instantaneous reports of the progress of the contending racers. In telegraph and newspaper circles the undertaking was regarded as a revolutionary innovation in methods of news transmission.

Since the year 1870, when the first International Yacht race was sailed off New York Harbor, there had been a demand for quicker reports of the progress of the yachts from the time the starting gun was fired. Carrier pigeons, long range telescopes, swift motorboats, wig-wag signals and all other methods of communication employed on these occasions failed to give results which satisfied the demand of the press and the public for "up to the minute" news.



One of the Earliest Commercial Stations in Radio History Was That at Jamaica, L. I., and Used in Reporting the Yacht Races of 1903.

In the year 1895, when Valkyrie III sailed against the Defender, the first attempt was made to establish telegraphic communication between a shore station and a station at sea from which the race might be observed over the entire course. On this occasion the Commercial Cable Company either laid a temporary cable, or "tapt" an existing cable, establishing an office at sea on board the cableship *Mackay-Bennett*. Observers and representatives of the press stationed on the cableship were enabled to transmit a continuous series of bulletins direct to newspaper offices in New York over the submarine cable circuit. The cable scheme, while a decided improvement over previous methods of reporting the yacht races, was rather expensive, and there was always the possibility that rough weather would blow the cableship around so that the cable end would have to be thrown overboard and communication abandoned.

In the British Isles in the year 1898 the Dublin *Daily Express* had used Marconi's wireless apparatus on the steamer *Flying Huntress* to report the events of the Kingstown regatta. In the following year, therefore, when the International races were to be held off New York Harbor, Dr. Marconi was commissioned by the New York *Herald* to come to America, prepared to set up wireless ap-

paratus by means of which the great race might be reported in a new way.

Those were the days of the "sputtering" coherer and the "kicking" decoherer, celebrated in the jingle at the head of this article. Operators who were experienced could read the incoming signals by the sounds made by the decoherer, but in order to have an unmistakable record of the message a recorder was connected in the relay circuit so that the signals would appear in the form of short and long marks representing the dots and dashes of the Morse code. The maximum range of the radio apparatus employed was about thirty miles and modern radio enthusiasts can easily picture the various and sundry marks which appeared on the strip of paper tape in addition to the markings of the transmitted signals—the former being due to interpolations of static.

On October 7, 1899, the steamer *Ponce* had been fitted up with a transmitting outfit consisting of a ten-inch induction coil, condensers, sending key, aerial, etc., and on board the Commercial Cable Company's cableship *Mackay-Bennett*, Mr. Marconi had installed an aerial and a set of receiving instruments consisting of coherer, decoherer, relay and tape recorder. The cableship was anchored offshore far enough to be in deep water and had a short length of shore cable connected between the ship and a land line telegraph office on shore. Fig. 1 shows a reproduction of a section of the tape as recorded on board the *Mackay-Bennett* during this pioneer demonstration of radio signaling. Those who understand the Continental code may recognize the signals as reading: "Three fifty-eight Clmba comes abt," the abbreviations being those used by the British telegraphers who were in charge.

The section of tape selected for reproduction is free from static markings.

In the year 1903 when the *Shamrock III* was pitted against the New York Yacht Club's *Reliance*, wireless telegraphy had made progress, and in the United States the De Forest Wireless Telegraph Company was making a bid for commercial work. There was at that time intense rivalry between the Marconi and De Forest interests. To cover the races this year the Associated Press arranged with the Marconi Company to set up apparatus on the speedy steam yacht *Chetolah*, so that communication might be kept up between the yacht and the Marconi shore station at Jamaica, L. I.

Radio men who were in the game at that time remember the excitement and the difficulties of the occasion. With two wireless companies attempting to operate in the same limited area, without prearranged agreement in regard to allotment of sending time, and without dependable tuning systems, there was no little confusion of signals. Indeed, there were open charges of malicious interference. One concern claimed that a rival company had chartered a brick schooner, equipt it with a transmitting outfit and anchored the schooner in proximity to the other company's sending station at sea, with instruments to send out a continuous series of unintelligible radio signals so that the opposition receiving operators would be unable to read intended signals.

The De Forest Company set up a station near the Navasink Highlands which was connected by land wire with New York City. At that time the De Forest Company's operators used the American Morse alphabet, while the Marconi operators used the Continental alphabet.

In the 1903 operations the Marconi Company still had in service the coherer and the tape recorder, while the De Forest Company employed a receiving device known as a "responder." The device consisted of a small tube containing an electrolytic compound sensitive to electromagnetic radiations. The responder was connected in circuit with a local battery and a pair of head telephones, the radio signals being read by ear instead of by sight, as when marked tape was used.

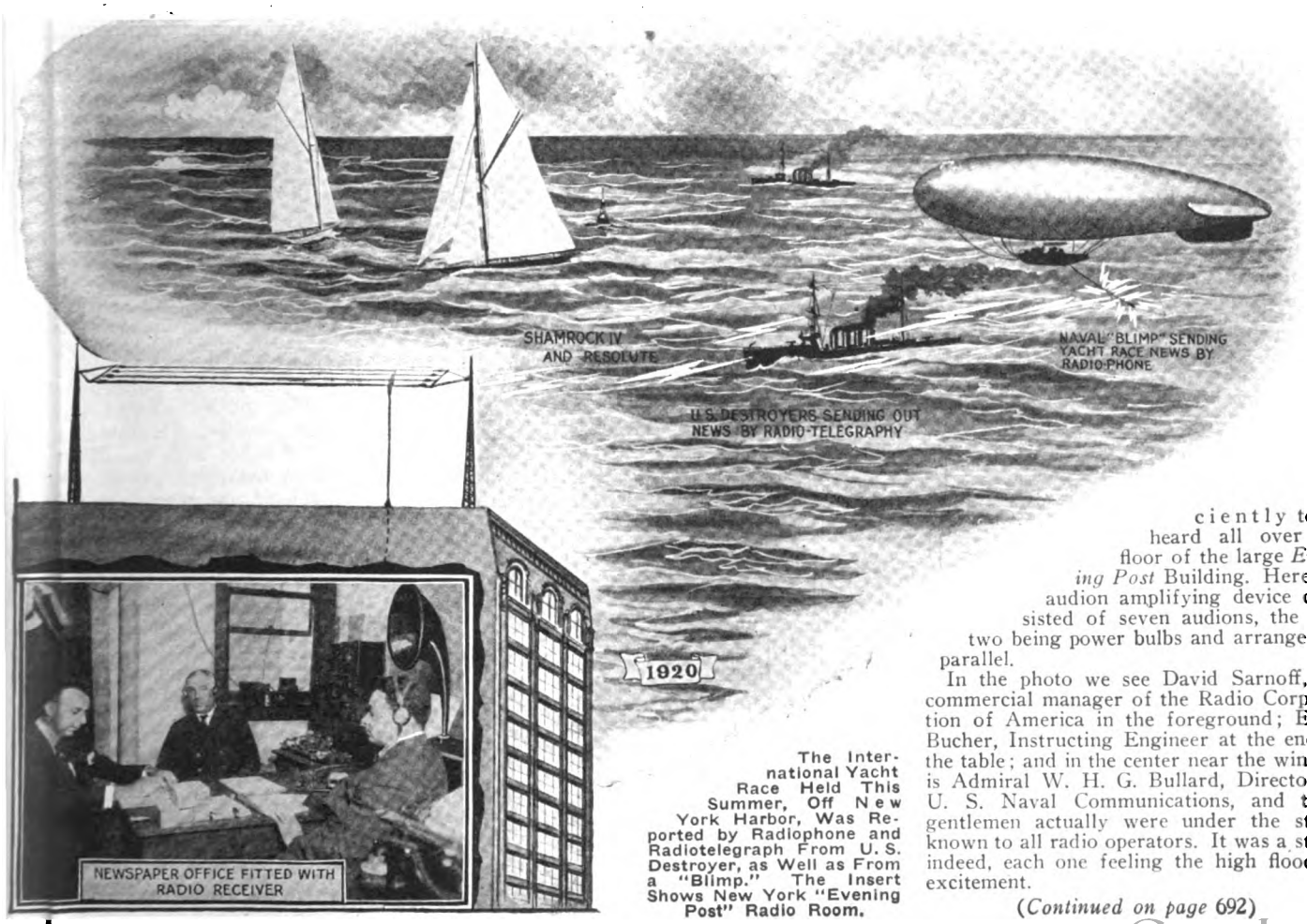
The foregoing history of the use of radio telegraphy in reporting the events of the International Yacht Races, in fact, constitutes a brief history of the introduction of radio signaling in the United States and present day radio enthusiasts are in a position to realize the vast strides that have been made in developing and perfecting the apparatus of radio, with the *coherers* and *responders* of the year 1903 as a beginning.

YACHT RACE REPORTING TO-DAY.

And now we have the modern method of reporting the yacht races *via radio*, as received in the pressroom of the up-to-date paper. Two stations installed at the New York *Evening Post* represented one of the most elaborate installations made for receiving these radio messages; one set for receiving from the destroyer U. S. S *Goldsborough*, and another apparatus not shown in the photo, for receiving the radio-phone messages from the naval blimp or airship.

This dirigible was transmitting at the time of the third race, on a wavelength of exactly 350 meters, with a General Electric set of five watts capacity, and the sending range was approximately ten miles.

With a bank of six audions, signals were sufficiently clear to allow the Blimp to be heard if other noises in the room were eliminated, but the most reliable sources of information were the radio telegraph methods of transmiting those signals. Both the Blimp and the U. S. S. *Goldsborough* were heard clearly in the receivers and with the loud-talker, the signals bellowed forth sufficiently to be heard all over the floor of the large *Evening Post* Building. Here the audion amplifying device consisted of seven audions, the last two being power bulbs and arranged in parallel.



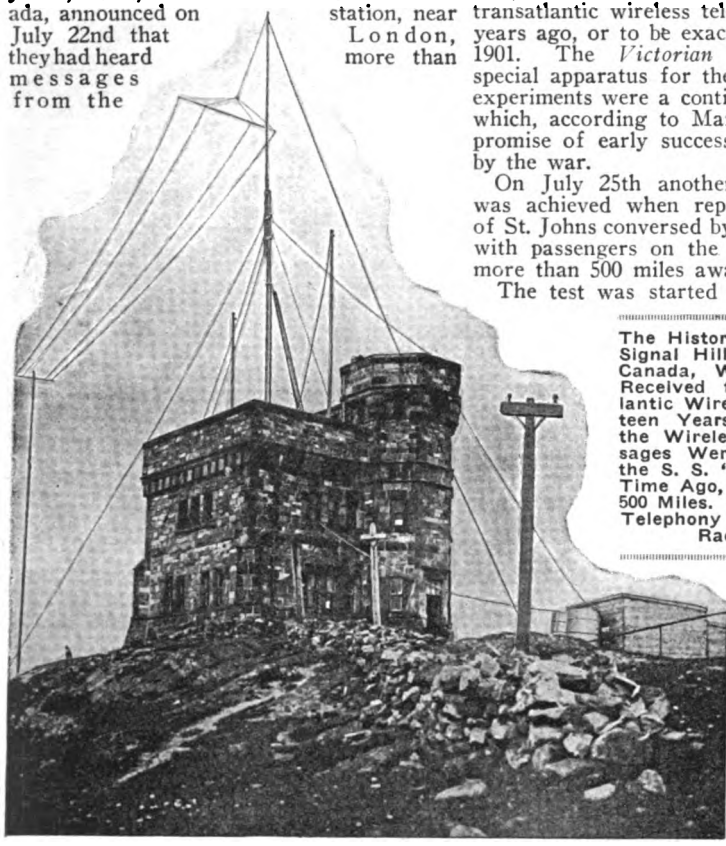
The International Yacht Race Held This Summer, Off New York Harbor, Was Reported by Radiophone and Radiotelegraph From U. S. Destroyer, as Well as From a "Blimp." The Insert Shows New York "Evening Post" Radio Room.

In the photo we see David Sarnoff, the commercial manager of the Radio Corporation of America in the foreground; E. E. Bucher, Instructing Engineer at the end of the table; and in the center near the window is Admiral W. H. G. Bullard, Director of U. S. Naval Communications, and these gentlemen actually were under the stress known to all radio operators. It was a strain indeed, each one feeling the high flood of excitement.

(*Continued on page 692*)

Ship's Radiophone Heard 500 Miles

EXPERTS from the Marconi Wireless Company, conducting experiments in long-distance wireless telephonic communication during July, at Signal Hill, St. Johns, N. F., Canada, announced on July 22nd that they had heard messages from the Chelmsford station, near London, more than 2,000 miles distant. They said that they recognized the voice of Capt. Round, the expert in charge.



The Historic Radio Station on Signal Hill, St. Johns, N. F., Canada, Where Dr. Marconi Received the First Transatlantic Wireless Message Nineteen Years Ago, and Where the Wireless Telephone Messages Were Picked Up from the S. S. "Victorian" a Short Time Ago, Over a Distance of 500 Miles. Transatlantic Radio Telephony Is the Goal of the Radio Experts.

The officials in charge also said they heard faintly messages from the steamer *Imperator* at their station when 500 miles west of Bishop's Rock.

The station was located on historic Signal Hill, where Dr. Marconi received the first transatlantic wireless telegraph message 19 years ago, or to be exact, on December 12, 1901. The *Victorian* was equipt with special apparatus for the experiment. The experiments were a continuation of a series which, according to Marconi officials, bore promise of early success when interrupted by the war.

On July 25th another scientific marvel was achieved when representative citizens of St. Johns conversed by wireless telephone with passengers on the steamer *Victorian*, more than 500 miles away.

The test was started on board the *Victorian* with a phonograph selection. Then the chief electrician called Lord Burnham, who spoke to the Hon. R. A. Squires, Prime Minister of New Foundland. The postmaster general (on behalf of the government and people of New Foundland) then welcomed the press conference aboard the ship to the Western Hemisphere.

Everybody in the radio room used the receivers during the test. Some of the messages were repeated owing to disturbances. The phonograph selection was distinctly audible not only to those with the receivers but also to those standing near the instruments.

The wide attention given the wireless conversations which the steamer *Victorian* has been holding from mid-Atlantic with both England and Canada is an indication of the slowness with which the new means of communication has been developed. In 1912 wireless telephony was successfully carried on in Italy over a range of 250 miles and inventors declared that it would soon be in general use. In 1915 the voice was carried by wireless from Arlington, Va., to Honolulu, 4,900 miles distant, and a little later from Arlington to Paris. In 1916, anticipating recent achievements in Europe, De Forest transmitted musical selections by wireless for distances of a score of miles or more. Two years later considerable telephone conversations were held between Canada and Ireland and Washington and Paris. Wireless telephony shared in the development that so many recent inventions received during the war and was extensively employed over short distances by sea, land and air forces. Nevertheless, its progress since 1912 has not been what sanguine people hoped. If it had been, the press would not be giving headlines to an account of how imperial press delegates on an English steamer talked over several hundred miles of waves with ease.

Wireless telephony will have come into its own when it is used on a large scale for commercial purposes and supplements wireless telegraphy as effectively as the latter now supplements the electric cable. That hour seems near. Marconi made his first fully successful experiments with wireless telegraphy in 1895, but it was not until 1907 that a public commercial service was establisht across the Atlantic. A little more time and conversations like the *Victorian's* will be too commonplace for notice.

Advice to Amateurs by One of Them

IF one will go to any of the numerous wireless stations in this (New York) city any night between the hours of 7:00 and 11:30 and put on a pair of head 'phones he will be greatly surprised, unless he is one of New York's amateur operators himself.

New York is the largest city in the United States. There are probably more amateur wireless stations in New York than any other city. As in every vocation and avocation, there will be found those who are taking it seriously, those who are just doing it to pass time, and sad but true, some who try to make the lives of the serious minded ones miserable.

Jamming, both intentional and thru carelessness or ignorance of the adjustment of the transmitting set, is the greatest evil among the large body of amateur wireless operators. I can think of nothing more exasperating than to be in the middle of copying a message and to have another station, in the neighborhood, or quite a distance away, with a decrement and wave far in excess of the stipulated allowance for amateurs, break in and ask some other fellow about his spark tone, wave, strength of signals, etc. I do not have to tell you, you have all had the same experience.

Again, so often you will call a station and before he has answered you another station will call you and start right in to tell you something. In the meantime the other station will have answered you and you will, in the majority of cases, lose what he says. Why do people do this?!! If I went out with a bunch of fellows and one of them asked another a question and, before he could answer, I butted in and said something else, a few things might be said in my absence about manners and proper bringing up. It is the same thing in wireless. Just because the persons engaged in conversing can not be seen is no reason for taking advantage of the fact that if you want to you can *break up* the converation. It is purely and simply a matter of *manners!*

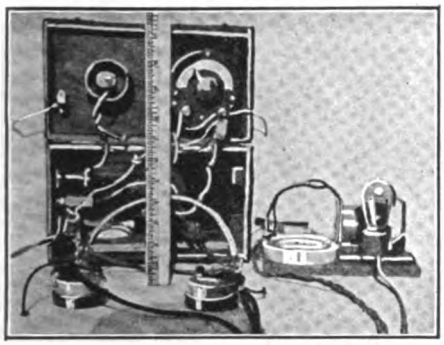
Then there are, of course, our well-known friends, *the little boys*, with the spark coils whose pitch varies from zero to 1,000 cycles, and who can understand nothing that is said to them, even if you "QRX" and "QRT" them a thousand times. Some do understand, but out of pure deviltry refuse to stop. Of course, we were all "Hams" once. I dare say, however, that we all would appreciate the suppression of some of the stations that maliciously interfere as they do nightly. The fact of the matter is that the Navy Department, having had so many complaints made to it lately, is, figuratively speaking, putting on the thumb-screws, and getting after the offenders. However, more for long wave length and for jamming other amateurs. What I would like to see done is the serious-minded amateurs of New York City form a committee representing the amateur body of New York City, and visit personally the houses of the offenders and have a little talk with them. I would be glad to hear from any who would like to co-operate in this plan and try and help out conditions in and around New York City.

If the few offenders who are nightly causing constant interference with the nearby commercial stations are not brought to an understanding quickly, the whole amateur wireless body thruout the United States will become jeopardized, as the Navy Department is becoming impatient with the number of complaints sent in. Why not start now and help bring matters to a state in which there need to be no fear of endangering the status of the amateur? I am sure that such a society as the Radio League of America would be only too glad to co-operate with us. Remember that a hint well taken will save a lot of trouble. The amateurs who have expended a lot of money on their apparatus and who are interested in the furtherance of the art, would surely feel pretty much hurt if they were forced to cease operations by the Government. Yet that is what we are surely coming to unless something is done quickly, and now is the time. What do you say?

Simplest Long Wave Receiver

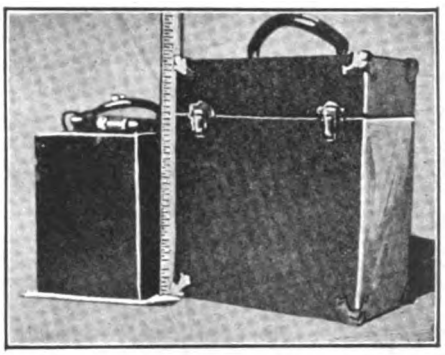
By ELLIOTT A. WHITE

FORMERLY INSTRUCTOR IN RADIO, AIR SERVICE SCHOOL FOR RADIO MECHANICS, CARNEGIE INSTITUTE OF TECHNOLOGY, PITTSBURGH



View of Long-Wave Radio-Receiving Set Lying on Its Side with Cover Opened, in Comparison with a One-Foot Rule.

Complete Details of a Set of Remarkable Compactness and Simplicity



View of the Long-Wave Receiving Set with Carrying Cabinet Closed, Compared with Rule. The Cabinet Measures About 14 Inches High and Is Fitted with Leather Handle and Snap Locks, Which Can Be Purchased From Any Trunk or Leather Goods Supply House.

PERHAPS radio amateurs find pleasure in the dozen or more adjustments which have to be made in tuning the long wave receiving sets of pre-war vintage, with either two or three tuned circuits (antenna, grid and plate), with a multiplicity of inductance coils and condensers, the former usually of the long single-layer type, and the latter usually variable. But aside from the pleasure of constructing and playing with a lot of unnecessary apparatus there is now no excuse for such sets as these. The tendency in modern radio is towards *compactness* and *simplicity!*

In the first place, there is practically no interference among long wave stations. This eliminates the loose coupler except during heavy summer static. Moreover, if sharp tuning is necessary, a series condenser in the antenna circuit acts the same as loose coupling, if it is small enough.

In the second pace, with an *ultraudion* hook-up or a *tickler feedback,* no plate circuit tuning is required. This eliminates all but a *single tuned circuit,* common to antenna and grid.

In the third place, fixt condensers and resistances are easily made to take the place of expensive and superfluous variable condensers and rheostats, with the added advantage of fewer adjustments.

In the fourth place, modern bank-wound, pancake-wound and honeycomb-wound inductance coils make the old-fashioned single-layer coils several feet in length look "foolish." Their advantage is compactness, cheapness and absence of the capacity effect which made the old type so delicate in adjustment and so annoying when they "broke" at the approach of the hand.

2,500 TO 20,000 METERS RANGE.

The set here described, which tunes from 2,500 to 20,000 meters, was constructed with these four considerations in mind and gives excellent results in flexibility of use, loudness of signal, extreme compactness, cheapness and great simplicity of tuning. It has only three, practically *one,* adjustment. Furthermore, either an open antenna or the loop antenna which is coming into favor, may be used. Figure 1 shows the connection for an open antenna, and Fig. 2 shows the connection for a loop antenna, the loop being inserted at A, in series with the inductance coil L, with the tuning condenser C1 across both coil and antenna. No other change in the set is necessary, so that the change can easily be made by throwing a *single* switch if so desired.

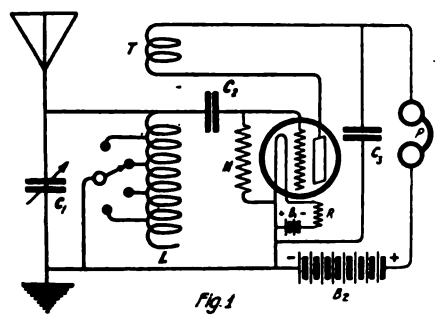


Fig. 1

Hook-Up of Long-Wave Radio Receptor, Including Single Tuning Inductance, Together with Tickler Coupling Coil "T," and Single Audion Employed.

The apparatus (Fig. 1) consists of one inductance coil L with from three to five taps; one variable condenser C1, the ordinary 43 plate with .001 mfd., capacity; one tickler coil T of fixt inductance but variable coupling with L; two fixt condensers—a grid condenser C2 of .00015 mfd., and a bridging condenser C3, of about .004 mfd.,

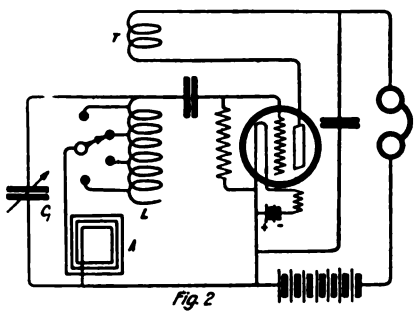


Fig. 2

Hook-Up of Long Wave Receiver Here Described in Connection with a Loop Antenna "A," Together with the Single Audion Used.

and one fixt resistance R, of a value depending on the kind of tube and the voltage of the filament battery; besides the ordinary vacuum tube outfit of filament and plate batteries, tube and phones, with a small switch for the inductance. Altho definite values are given above, it should be remembered that the builder can use whatever apparatus he has on hand, making due allowance for difference in inductance and capacity, and that the fixt condensers and resistance can vary considerably from the above values without interfering with the efficient operation of the set. For instance, if the builder has only one variable condenser, it does not have to be exactly .001 mfd., maximum capacity, but may be anything from half that, up. Again, instead of using the inductance coil here described he can use one of his own manufacture, provided that it is large enough, even one of the old single-layer type, altho at a great sacrifice of compactness. And in building the fixt condensers, only approximate accuracy is necessary.

THE TUNING INDUCTANCE.

The inductance coil L should be bank-wound, pancake-wound, or honeycomb-wound, the last being much the best. By using fixt loading condensers in parallel with the tuning condenser C1 it is possible to use a ridiculously small inductance coil—merely enough to permit coupling with the tickler. If they are used, each loading condenser should be of the same capacity as C1 or slightly smaller, and two or three of them may be used, up to a total capacity of say .005 mfd., which would allow an inductance to be used only a fifth as large as the one here described. Another way is to use loading condensers of .001, .002 and .003, which in various combinations, in conjunction with the variable of .001 mfd., will give any capacity up to .007 mfd. A set of these condensers which has been so used was made up in units of 4 and 5, 5 and 6, and 7 and 8 plates respectively (see paragraph below on C2 and C3), tho, of course, as will be noted later, the number of plates depends on their size and especially on the thickness of the mica, paper or other dielectric used.

If bank- or pancake-wound coils are to be used, dimensions may be found in various radio magazines, and text-books. The author used a six-layer bank (of No. 24 wire), 3 inches long on a tube 7 inches in diameter, with the condenser and other parts mounted inside, until he discovered the improvement detailed later. Another experimenter used a 4-layer bank, 6 inches long, of small "Litz" cable wound on a 5-inch tube with the *tickler* rotating inside. For the average small sized antenna any coil is suitable so long as it has an inductance of 125-175 millihenrys, with a .001 condenser, and no loading condensers. Of course the greater the capacity of the antenna the longer the wave length on smaller settings of the condenser C1; and with a loop antenna, the larger the loop and the greater the number of turns the longer the wave length; or the smaller L and C1 need to be for the same wave length.

(*Continued on page* 694)

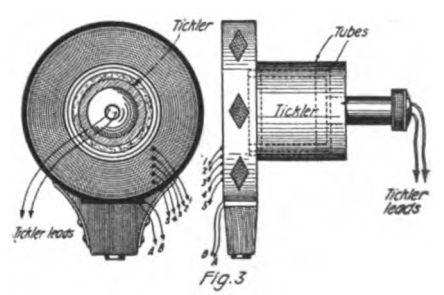


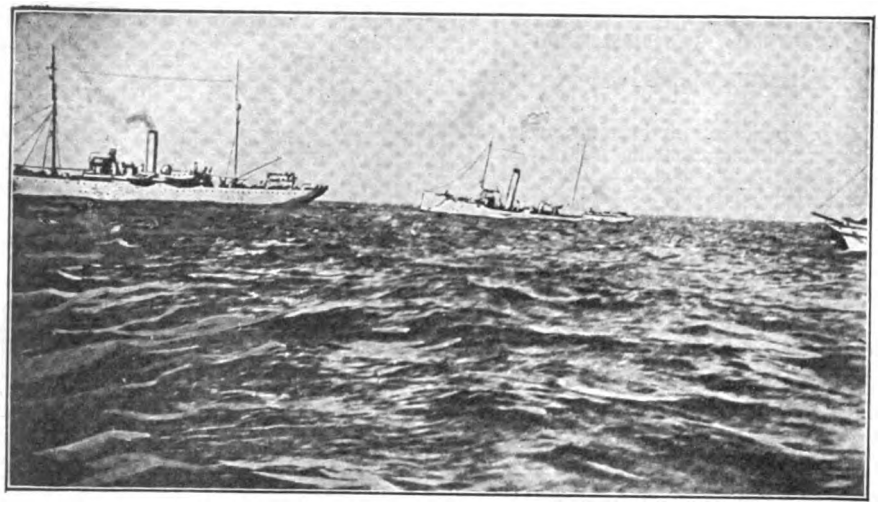
Fig. 3

Detail of Tickler Coil, Which Is Arranged to Slide in a Fiber Tube, Mounted in the Opening of a Honeycomb Inductance. The Latter Coil Is Supplied with Tap Leads, as Shown, For the Purpose of Close Tuning.

How to Become a Professional Radio Man

Part II

By PIERRE H. BOUCHERON



Actual Photo of Ship Sinking at Sea—Center of Photo. Help Had Been Summoned by Flashing the "S O S" Call—and Two Vessels Are Seen Standing By.

YOUR DAILY DUTIES

A GREEN operator setting out for the first time to battle with the *etheric waves*, often has visions of *heavy traffic*, meaning the sending and receiving of hordes of messages between land and ship each day. This is quite natural for he is cursed with an over-active fist, and his palm literally itches for key manipulation. Alas, a very small number of ships ever have occasion to send more than twenty-five messages each day, a greater number will not handle that many messages during a whole voyage, while a still larger number will handle exactly *two* messages between ports, one on leaving and one on arriving. The "speed king" operator, therefore, will spend the intervening intervals at the pleasing pastime of twiddling his thumbs, unless he finds himself "something to do" which will prove of more benefit to him. Of this we will speak later.

There are, of course, other things that enter into the operator's daily routine besides the actual *sending* and *receiving of messages*. Most Captains realize the value of radio in navigation and insist upon checking their chronometers by means of the radio time signals sent out by American and foreign government stations at noon and evening each day as well as securing radio compass positions whenever possible. While the first is comparatively an easy task, it does necessarily require *quickness of action* and *accuracy* in order that these time signals be of value to the skipper. Personally it took me several days before I had acquired the knack of conveying the final time tick to the captain's quarters, so that there was practically no lag between the radio signal and the blowing of a whistle or pressing of a key leading to the captain's quarters. I soon learned that the captain was not satisfied with a *half-second's* loss of time.

Then there are the weather reports which are also sent out by the various governmental and other coast stations. Masters of vessels invariably look for these with considerable interest and depend upon the radio operator's vigilance in keeping them advised of impending storms. Keeping the "gang" on board supplied with as many press news items as you are able to pick up is, of course, very essential in keeping every one on board in touch with the outside world.

On the whole, however, these duties are not what might be called over-strenuous and will hardly tax the endurance of the average operator.

Articles to Appear In October Issue of "Radio News"

A 15 k.w. Radiophone Set
The Crewless Battleship Controlled by Radio
Reporting News by Radiophone
Improved Circuits for Short Wave Communication By A. S. Blatterman
The Audion—Its Action and Some Recent Applications
By Lee DeForest
Code of the Wireless Man
By Erald A. Schivo
Portable Combination Receiver
By Russell H. Robinson

STATUS OF THE OPERATOR ON BOARD SHIP.

Under this heading I can start off in no better way, perhaps, than by quoting to you a section of the *United States Shipping Board Emergency Fleet Corporation* Contract with the radio companies, which has the following to say:

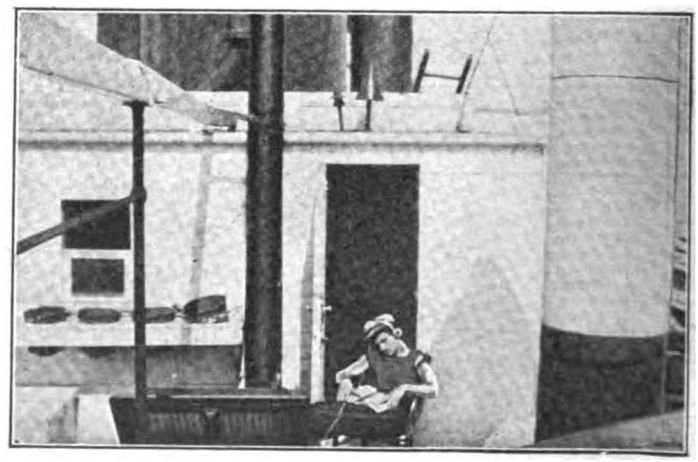
"Radio operators shall be treated as officers, but without executive authority, and shall be provided accommodations suitable for an officer."

This is indeed a pleasant little paragraph. It infers untold possibilities to the embryo Paul Jones. Think of it, you are drest up in a snappy blue uniform with brass buttons, and with a rakish cap having the seal of the United States Navy embroidered in a suitable manner directly above the visor. The senior operator rates two gold stripes on his sleeve, while the junior operator rates one. Lieutenants and Ensigns in the making!

Referring to the above quotation this means that the radio operator is accorded all rights and privileges of a merchant vessel officer, with the exception that he has not the authority to give executive orders to any member of the crew unless, of course, he has been specifically instructed to do so by the captain or other accredited officer of the ship. This is quite proper since the operator is really in a class by himself and is not supposed to be versed in the ship's executive routine.

The present increased wages of the operator, as well as the improved conditions of the profession, are destined to considerably improve the prestige and status of the operator. In the past there have been altogether too many boys in their 'teens who have entered the work during summer vacations, and in order to avoid paying the high prices of the Cook's tours.

That is where the European operator has the advantage. He is usually a well-seasoned, serious individual who remains on the same ship year after year and is comparatively much better paid than the American operator. Not only that, but he is actually accepted as one of the ship's high officers commanding the respect of those from the captain, down to the lowest member of the crew. Unfortunately, this cannot always be said of some of our American operators who have sown a path of bad reputations behind them.



Asleep on the Job, But Don't Get Caught Doing It—It Is Bad Business. In this Instance the Ship Is Lying at a South American Port Where Not Much Radio Work Is Possible and the Operator Evidently Has Succumbed to the Tropical Heat of the Noon Day Hour.

THE "PICKINGS."

The old days of the underpaid radio operator have past for good. Today he is a well paid member of the crew, and judging from present indications, bids fair to receive still better pay as we will shortly see. Personally I went to sea for $30.00 a month and by dint of hard application eventually reached the dizzy height of $50.00 per month.

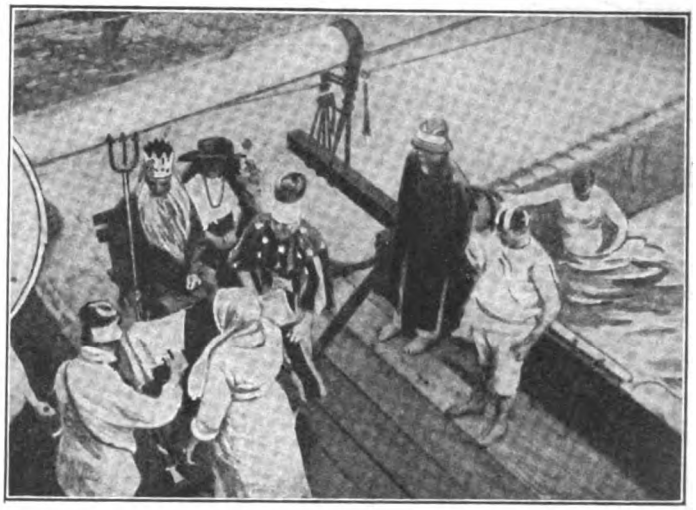
At the present writing a senior operator of any seagoing vessel is paid $125.00 per month, and the junior operator $100.00 per month. In addition to this is included his board and lodging which, with the present H. C. of L., easily amounts to an additional **$50.00 a month or more.**

There is also the possibility of securing a berth aboard a cargo vessel and acting as super-cargo in addition to radio duties. There are several steamship companies who offer these combination posts at $140.00 a month or slightly more. On other vessels there is also the opportunity of checking and guarding cargo when the ship is loading or unloading freight at foreign ports, particularly in ports where native talent is unavailable. This extra work easily falls to the lot of "Sparks," due to the fact that he has nothing else to do while the ship is at anchor. The remuneration for this sort of pastime is 30c per hour and upward.

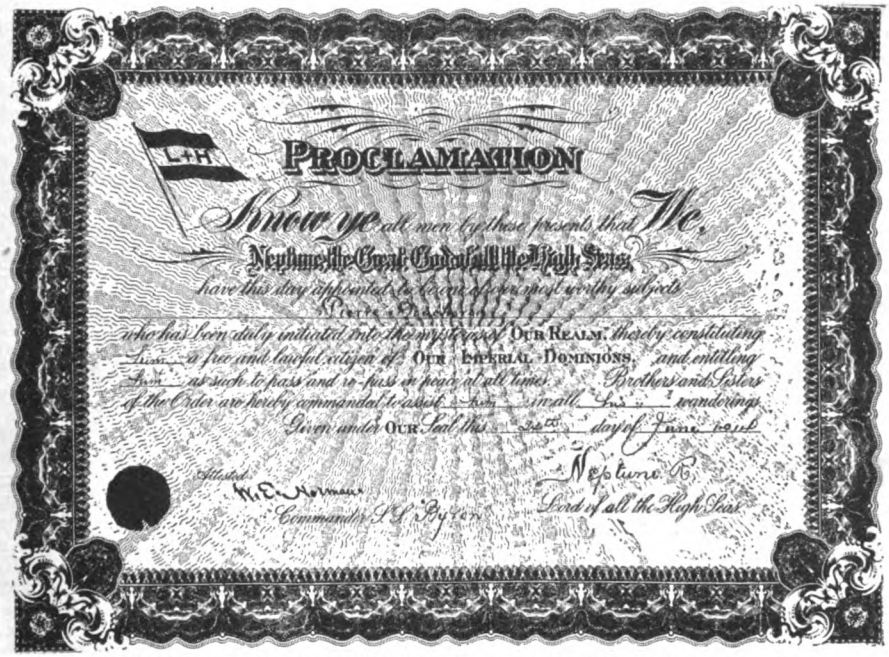
In the past many radio men have considerably boosted their incomes by means of various legitimate commercial ways, such as the representing of American business houses in foreign countries. This naturally brings into play salesmanship, which all of us practise, more or less, as well as the possible knowledge of a foreign language, such as Spanish for the Latin-American nations, or French and Italian for the European ports.

Considering the matter of wages again, at a recent meeting of Radio Association men in connection with the American Steamship Owners' Association, there was considered an increase in pay of $200.00 per month for the senior operator and $150.00 for the junior operator. It is expected that the demands of the operators will be approved without serious opposition.

It is also understood that when the ship is at the home port where meals are seldom served, an additional allowance of $3.00 a day for subsistence is allowed.



An Interesting Ceremony Which Takes Place on Many Vessels When They Pass the Equator. Father Neptune, Ruler of the Deep Seas, Comes Aboard and Assisted by His Able Staff Past the Zone at a Preally Initiates All Who Have Never Before Past His Domain. In This Case the Ruler's Privy Counsellor Is Examining the Credentials of a Lady Claiming to Have Passt the Zone at a Previous Time. In the Main Part the Initiation Consists of a Sound Dousing in a Tank Filled with Sea Water Purposely Erected for the Occasion. Afterward a Certificate Is Issued as Proof of Initiation so That Should the Person Chance to Pass the Equator Again, There Will Be No Need of an Additional Dousing.



Certificate Issued to the Author Showing That He Has Past the Equator.

These desirable conditions which considerably improve the standing of the radio operator are the result of the fact that radio operators on board ship have become almost as indispensable as the navigators and engineers and, therefore, should be paid accordingly. Organization, however, has probably been the greater factor in this change of affairs. The United Radio Telegraphers' Association is doing a great deal toward the improvement of the operator's lot. For that reason it is not a bad idea to join it at the very start.

There is, of course, a great divergence as to the quality and variety of the food and accommodations given operators by various steamship companies. On some vessels the operator is housed in a large roomy cabin close to his operating room, and usually on the top deck—a desirable position for a quick exit! On some of the older vessels the sleeping quarters of the operators are below decks. Invariably, however, the operating and sleeping rooms are combined in the same superstructure on the top side, as it is recognized that the radio apparatus should be the last part of a ship to slip beneath the waves after an accident.

The greater part of the steamship companies supply the best quality of food and quarters for the crews of their vessels and do their utmost to make the men contented, so that they will remain on the same ship trip after trip. On the large passenger ships, the radio men eat their meals in the saloon with the passengers, in some cases presiding at the head of their own particular tables, as do the Captains, Chief Engineers, Pursers and Doctors.

There are, however, one or two lines which are notoriously bad providers in the matter of food. Then again it is sometimes a hit-or-miss affair, depending upon the ability of the Chief Steward and his knowledge in purchasing the necessary quality and quantity of food supplies.

I shall never forget a seventeen day voyage on a diminutive tramp steamer. The

(*Continued on page* 663)

This Is the Way Things Look Inside a Ship's Radio Cabin. In This Case, You See a Pioneer Operator, Mr. E. D. Prey, Waiting for an "SOS" on Board the Palatial S.S. "Abangarez." By Way of Instruments, the Famous "Double Decker" or "I.P.76" Receiving Tuner May Be Seen to the Extreme Left. No, Young Man, the Desk Telephone on Top of the Tuner Does Not Connect to Shore Stations but Is for Direct and Instant Communication to the Vessel's Navigating Bridge.

WITH the AMATEURS

Our Amateur Laboratory Contest is open to all readers, whether subscribers or not. The photos are judged for best arrangement and efficiency of the apparatus. To increase the interest of this department we make it a rule not to publish photos of apparatus unaccompanied by that of the owner. Dark photos preferred to light-toned ones. We pay $5.00 each month for the best photo or photos and $2.00 to each "Honorable Mention." Address the Editor, "With the Amateurs" Dept.

"Amateur Electrical Laboratory" Contest

This Month's $5.00 Prize Winner—Clarence Glasman

WHO said that a fellow living in the wilds of Canada couldn't keep up with the World of Science? Here is proof that we have all the latest gogs for making gasoline and sugar.

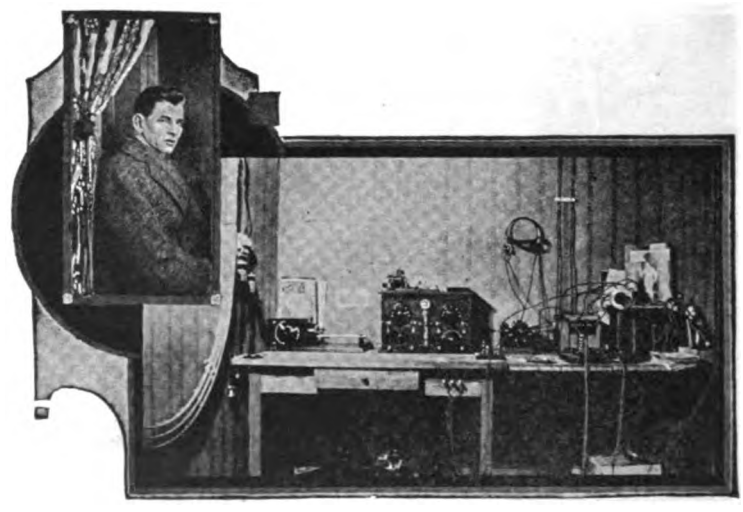
I indulge in all branches of science and have considerable apparata, mostly constructed by myself from articles and plans found in SCIENCE & INVENTION magazine and RADIO NEWS.

The photos are: my mechanical and electrical department; a view of an oscillation transformer made of copper tubing and porcelain knobs; a receiving apparatus showing a two-step amplifier and crystal detectors; a discharge from a 10-inch induction coil showing my hand in the spark (double exposure); and the "wheel of mystery" is a musical apparatus which displays colored pictures when in motion. It consists of a Bakelite disc ¼ inch thick and 18 inches in diameter and the music is produced by sparks jumping thru different series of perforations on the disc. The picture is seen from the sparks in a parabolic reflector behind the disc, and for each different tone made, a light of a different angle strikes the reflector, and as the tones are consecutive, a very weird effect is produced. I rigged up a number of army mess kits "strung up" like violins, and each instrument giving a different note. The tones are produced by little magnetic hammers on the finger-boards, and all instruments are controlled by one keyboard having 21 keys; these keys also operate the high tension switches which send the sparks thru the Bakelite disc. Both instruments cannot be played simultaneously, because the motor driving the disc is run by direct current from a Delco farm lighting system, and the speed is not constant, therefore changes in pitch and accompanying discords occur, but they produce good "jazz" music when played together, neither instrument being practical because their tones are not very loud or distinct.—Clarence Glasman, Russell, Manitoba, Canada.

Honorable Mention—A. E. C. Albrechtsen, $2.00 Prize

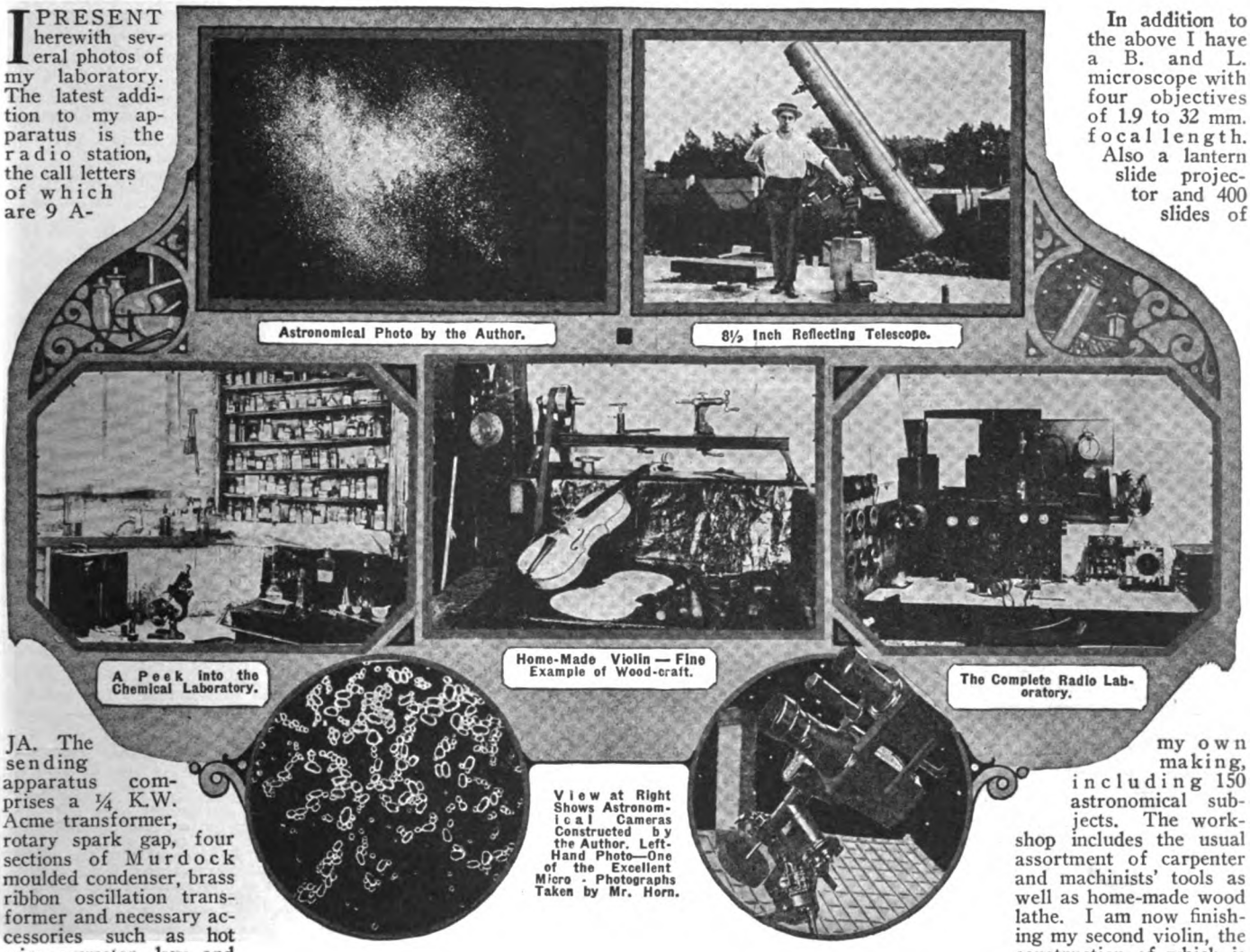
AS I am an Amateur, my radio set is naturally the work of an amateur. It consists of a home-made cabinet with two variable condensers, one comprising 43 plates and the other 17. It is also equipt with a set of Holtzer-Cabot phones, one Marconi V.T., and an Audiotron bulb. I can use either one by throwing the four switches that can be seen on the cabinet, also one rheostat and one receiving transformer with a wave length of 3,600 meters.

My transmitting set consists of a ½ K.W. Blitzen transformer, one Sayville rotary gap, 7,500 R.P.M., one oscillating transformer, one antenna switch, four sending condensers and a line protector. This set also includes one telephone transmitter which I intend to use shortly, and upon which I am now working.—A. E. C. Albrechtsen, 500 17th St., Detroit, Mich.



Astronomy, Radio and Chemical "Lab" of Elden F. Horn

Special Laboratory Prize $10.00



Astronomical Photo by the Author.

8½ Inch Reflecting Telescope.

A Peek into the Chemical Laboratory.

Home-Made Violin — Fine Example of Wood-craft.

The Complete Radio Laboratory.

View at Right Shows Astronomical Cameras Constructed by the Author. Left-Hand Photo—One of the Excellent Micro - Photographs Taken by Mr. Horn.

I PRESENT herewith several photos of my laboratory. The latest addition to my apparatus is the radio station, the call letters of which are 9 A-JA. The sending apparatus comprises a ¼ K.W. Acme transformer, rotary spark gap, four sections of Murdock moulded condenser, brass ribbon oscillation transformer and necessary accessories such as hot wire ammeter, key and switches. With full power and loose coupling this will put two amperes in the aerial, which is a small four-wire inverted "L" affair.

For receiving I use honeycomb coils, a three-step audio frequency amplifier and Baldwin or Brandes 'phones. "B" battery is of the regular lead plate storage type with pasted plates. I use a Tungar rectifier for charging and find it will charge satisfactorily against 20 volts of the "B" battery. My first radio station was put up in 1911, but was dismantled several years ago; however, as has been remarked before "they always come back." Much of the above apparatus is home-made, my method being to first figure out all sizes and then make a half size drawing with all details shown, then following this drawing exactly in the shop.

THE CHEMICAL "LAB"

The chemical department is furnished with all essential apparatus and chemicals for carrying on experiments in both inorganic and carbon compound chemistry. During the war, when the supply was cut off, I made my own developer, starting with phenol and finishing with amidol. All of my analysis is made by volumetric methods as I have no balance. A good assortment of standard flasks, pipettes and burettes are all that I use outside of the reagents. The reagents were standardized at Lane High School of which I am a graduate, class of 1916.

In inorganic chemistry I have prepared BeO from the mineral beryl, $Zr(SO_4)_2$ from the mineral baddelayite, etc. For the qualitative determination of minerals I use a blowpipe almost exclusively.

DABBLES IN "ASTRONOMY," TOO

For the study of *Astronomy* I have an 8½-inch reflector equatorially mounted. The mounting is fastened to a concrete pier which rests on the top of the brick wall of the house, a hole having been cut in the roof to allow it to pass thru. There are two slow motions and circles by means of which an object is easily found if you have its correct position. An old phonograph motor is used to drive the telescope in right ascension, the only drawback being that it requires rewinding every twenty minutes. For photographing I have two large portrait lenses which are used on wood box cameras. I have ground several telescope mirrors by hand including a 10½-inch of 54-inch focal length, but cannot get them perfect; hence the above mirror was purchased. At present I am carrying on the Saturday night program of the Dearborn Observatory, which includes measuring double stars and taking parallax plates. Their telescope is an 18½-inch refractor of high quality.

In addition to the above I have a B. and L. microscope with four objectives of 1.9 to 32 mm. focal length. Also a lantern slide projector and 400 slides of my own making, including 150 astronomical subjects. The workshop includes the usual assortment of carpenter and machinists' tools as well as home-made wood lathe. I am now finishing my second violin, the construction of which is a task I recommend to anyone caring to do neat and accurate work.

COLOR PHOTOGRAPHY

My photographic equipment includes a 3¼ x 4¼ Graflex with a B. and L. Tessar of F-4½ opening, also a large view camera mostly used for enlarging. I have taken several dozen autochromes, which is one of the best color processes now on the market. The present plates are better than those produced before the war.

ELDEN F. HORN.

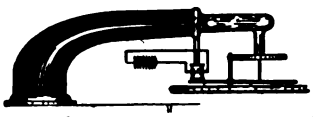
ARE SOUND WAVES VISIBLE?

Considerable interest has been shown of late with respect to the possible visibility of sound waves. A French scientific journal relates some curious incidents which seem to indicate that such waves are sometimes perceptible to the eye. A well-known authority on volcanoes, Mr. Perret, relates that after an eruption of Vesuvius he has hundreds of times observed the appearance of luminous and shadowy arcs above the crater subsequent to explosions, these arcs being visible before the arrival of the sound and disappearing rapidly. "The only explanation," says Mr. Perret, "which accords with the characteristics of such a phenomenon is the theory that we are here concerned with visible waves of sound, whose speed of propagation corresponds to that of sonorous waves."

LATEST PATENTS

Phonograph Attachment.
(1,344,186, issued to Ralph W. Morrison.)

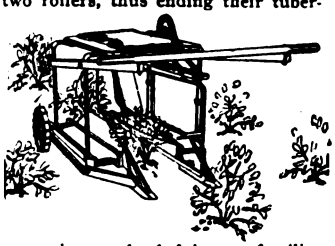
This device provides for a means of causing a constant pressure of a phonograph stylus against the disc so that the stylus will be maintained in the groove of the record, regardless of the inclination of that record. An electro-magnet is supported from the tone-arm or any other suitable



way and acts upon a cross-arm of the stylus, causing a pressure which can be regulated by a rheostat. In this way the device will be seen to be a particular advantage in instances where the grooves of a record are shallow or where the stylus is in the habit of jumping from one groove to another.

Potato Bug Trapping Machine.
(1,344,119, issued to James Monro Drake.)

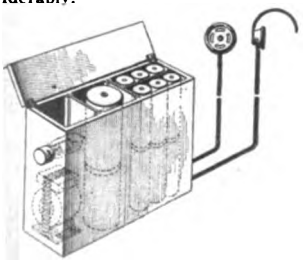
Altho this device is almost human, it is indeed very simple. A small wagon-like device is run over the potato vines whereupon two sliding mechanisms lift the foliage up and shake the plant, dislodging the bugs. These bugs can neither fly away, because they would be trapt in the top portion of the machine, nor can they escape and the bugs finally find themselves sliding on to an endless band, and as the cart moves along the bugs are crushed between the two rollers, thus ending their tuber-



ous existence by helping to fertilize the ground when they are thrown from the machine dead. A flapper-like arrangement does the shaking of the plants.

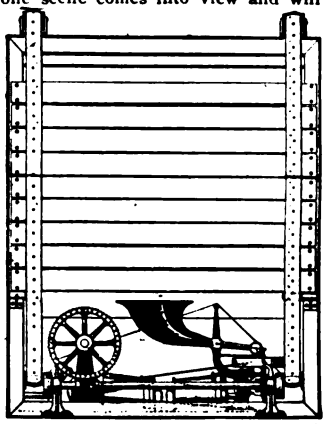
Electric Deaf-Phone.
1,343,717, issued to Earl C. Hanson.)

The inventor of this telephone apparatus for the deaf has realized another of the features to which audions can be put. In addition to using the regular apparatus for deaf people which ordinarily consists of a carbon ball transmitter and telephone receiver, together with the necessary batteries, he has incorporated a small induction coil, the secondary of which goes to the grid of a vacuum valve. The plate potential then passes thru an amplifying transformer, thru a second valve and hence thru head phones, thus amplifying incoming voice waves considerably.



Combination Talking and Moving Picture Machine.
1,345,128, issued to Pierre T. L. Champeix.)

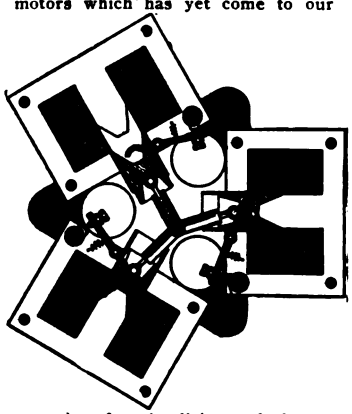
This apparatus is for the purpose of presenting animated pictures formed by sections of an illustrated band and a means of synchronizing the presentation of the pictures with a phonograph thru mechanical means. It consists of a frame-work having a number of horizontal or vertical transparent bands separated from each other by two thicknesses of "picture" bands and illuminated from behind. This picture band is movably mounted and its movement is accomplisht by means of perforations along the edges, much like moving picture film. A phonograph placed in the base of the instrument can be regulated by a differential mechanism and a device for locking the movable picture in place is also added. In this way one scene comes into view and will



remain there for a short space of time until released, when the entire band moves the distance of the horizontal or vertical slats, and a new scene comes into view. The device is similar to the "moving pictures" printed on strips of paper which are sometimes to be won in prize bags and certain brands of popcorn, except that it is built on a much larger scale.

Electric Impulse-Motor.
(1,347,002, issued to Marie Emile Alfred Baule.)

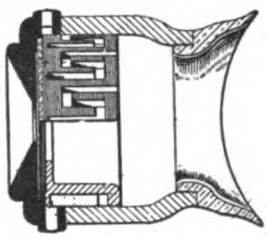
This is one of the cleverest electric motors which has yet come to our



attention for simplicity and the remarkable number of unique features. It consists of three electro-magnets arranged 120 degrees apart, the cores of which communicate with a crank-pin on the driving shaft. The movable cores of these electro-magnets are composed of plates insulated from each other and arranged so that when the core is out the current will flow thru the solenoid itself, but the moment that the core is fairly well attracted by the electro-magnet, a resistance is automatically inserted which diminishes the amount of current in the solenoid, and therefore gives an equal pull instead of the much stronger pull generally found when an armature closely approaches the iron core of a solenoid. A commutator excites the various core magnets in order.

Telephonic Apparatus.
(1,345,049), issued to Maximilian Weil.)

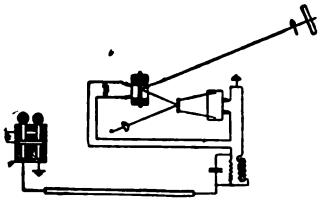
The following invention is for the purpose of eliminating telephone



booths, etc., so that conversation can be carried on in private without the inconveniences of a booth. It consists of a special transmitter adapted to fit the user's mouth while telephoning, and the voice then passes thru a series of labyrinths, which eliminates air pressure and also minimizes reflecting echo and other sound waves, whereupon it impinges on a diafram. From this diafram the sound is focust upon the transmitter of a regular telephone, from which it is held away several inches when in use.

Telegraphy Improvement.
(1,339,550, issued to Thomas Bullit Dixon.)

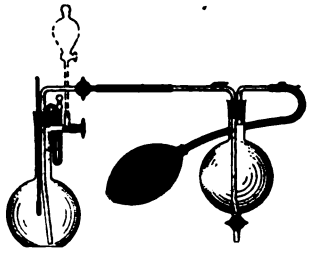
As is generally known, in cables, particularly submarine cables, great difficulty is experienced by operators in overcoming the low time period surges due to earth currents



which sometimes upset telegraphic communication completely. The fact that these changes are of low time period in comparison with the regular signal changes has induced the inventor to place two coils in the apparatus, so that one will counteract the effect of the other and yet they will in no way interfere with regular reception of signals, either those recorded by the galvanometers or siphon pens, or those received thru relays.

Apparatus for Conducting Experiments.
(1,338,967, issued to Reuel W. Bennett and Elmer M. Jones.)

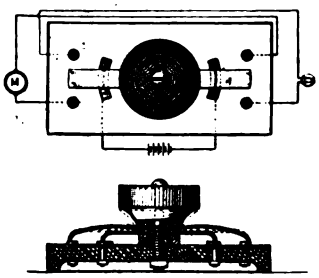
This apparatus is designed for performing a large variety of experiments for use in class rooms, etc., and can be used with little or no modification by the experimenter to perform various experiments, quickly. It consists of a flask with a side tube thereon, having a stop-cock, and is



provided with a compressible bulb, a manometer and thermometer, and also if desired, a drying tube and a separatory funnel, any or all of which can be used at the same time. The inventor then shows the additional apparatus used in determining the hydrogen equivalent of metals; the percentage of oxygen in air; the weight of gases; the amount of carbon dioxid in baking powder; and the absorption of ammonia by water, etc.

Electric Switch.
(1,336,455, issued to Clifford L. White.)

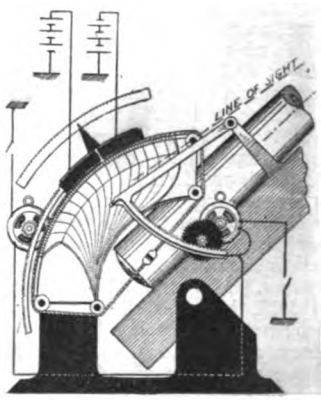
We have in this patent a very clever switch which promises to take the place of the ordinary double-pole, double-throw type and is particularly adapted to control branch circuits. A novel feature of it is that it is simplicity in the extreme, and the fact that it operates by a very easily controlled ⅛ turn of the knob moving, in this way, the blades. The radial arms or switch blades are



made out of one piece of brass or other material bent upon itself, so that its major portions lie in contact with each other. The shorter blade makes contact with a bar and the longer blade with the switch points.

Electric Sight-Controlling Mechanism.
(1,343,003, issued to Robert V. Morse.)

This mechanism is for the sighting of anti-aircraft guns and particularly for continuously readjusting the sight range of elevation, as the angle of position of the enemy aircraft changes as it flies. It consists of a sight mechanism which is automatically controlled by a motor, after the initial altitude has been



transmitted to the gun by the officer in charge. A gage is then set. From the bottom part of this gage are two long brushes which automatically connect a series of curved, angular copper segments to a battery making one side above the pointer of the gage positive, and the other side a negative potential. A brush upon the sight telescope then allows the motors to be kept in constant operation. Contact on one side would cause the motors to turn to the right, and contact on the other, because of difference in polarity, causing the motors to turn to the left, thus either elevating or lowering the gun and sight mechanisms and making the device entirely automatic. In this way, when once the altitude of the enemy aircraft is obtained, the gunners are not confused by the rapidly changing range.

Scientific Humor

And the Kids Wanted To See the "Fireworks".—While riding on a train one day I saw a man wearing handcuffs. Beside him sat his wife.

Soon she said to him, "John, shall I bring the children down to see you electrocuted?"

The man looked astonisht and said, "You ought to be ashamed of yourself suggesting such a thing."

"That's just like you," she remonstrated; "you never did want the children to enjoy themselves."—*Max L. Goldstein.*

What's the Citrate of Magnesia?—VIOLET: I see where nitrates have gone up in price.

RAY: What do I care? We never telegraph anywhere.—*Theo. R. Williams.*

He Ought to Move Into the 4th Dimension—Chug-Chug! Br-r! Br-r-r-r-! Honk! Honk!

The pedestrian paused at the intersection of two busy cross-streets.

He looked about. A motor-car was rushing at him from one direction, a motorcycle from another, a steam truck was coming from behind and a taxicab was speedily approaching. He looked up and saw directly above him an airship in rapid descent.

There was but one chance. He was standing upon a manhole cover. Quickly seizing it, he lifted the lid and jumped into the hole—just in time to be run over by a subway train.—*John C. Batchelor.*

The Worst Yet!—To prove: That a piece of writing paper equals a lazy dog.

PROOF: A piece of paper = an ink-lined plane.

An inclined plane = a slope up.

A slow pup = lazy dog.—*Ralph E. Carson.*

But Did He Count Them?—TEACHER: What is a kilometer?

PUPIL: A hundred feet.

TEACHER: Oh, no, that would be a *centipede*!—*Ralph E. Carson.*

Probably "Matched" Each Other.—"What caused the fire in the match factory?"

"There was some friction, I believe, between the heads of the departments."—*J. W. Case.*

He was En-light-ened.—During a flood a few years ago the river reached the power plant about 3 a. m., cutting off the power.

The operators in the telephone exchange called the wire chief; who started to the office in his flivver, and found his lights out. Before reaching the office he was stopt by a police officer, who askt him why he had no lights. Doing a little quick thinking, he told the officer:

"Of course, my lights are out, the juice is out all over town."

The officer studied a minute and said: "By golly that's so, go ahead."—*H. M. Palmer.*

FIRST PRIZE $3.00

We'll All Want One—

— "I've an invention at last that will mean a fortune!"

+ "What is it this time?"

— "Why, it's an extra key for a typewriter. When you don't know how to spell a word, you hit this key, and it makes a blur that might be an e, an a, or almost anything else!"—*Joseph F. X. Prestia.*

And Both Are Very Fragile.—Love is like a photographic plate—it takes a dark room to develop it.—*A. G. Kalmbach.*

Why Didn't the Car Burr Ate 'Er?—"I had the devil of a time with my Ford last night. I got awfully 'cranky' with it and when I gave it the gas it thought it was laughing gas, I guess, for it just sputtered. The engine kicked because the timer didn't have time to help the spark plug, which was 'broke,' and wouldn't give a scent if the exhaust was exhausted waiting for the radiator to get 'rady.' Anyway, the bearings couldn't bear it because the axles held up 'the chassis'; and the transmission forgot its mission, when the gears got 'shiftless' after finding out that the wheels were tired. And so I decided to retire, too!"—*Carleton Farmer.*

ALL jokes accepted and 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.

Easy Marks Must Be Fingerprints.—"A man's boot marks on the roadway are called footprints, aren't they?

"Yes."

"Well, what would you call the marks of a motor car?"

"Oh, *autographs,* of course."—*C. Spurrow.*

And Chemistry Won't Be Repaid.—"We owe a great deal to chemistry."

"Yes, indeed. For instance, to chemistry we owe a great many of our blondes."—*G. H. Roskein.*

Sure! The Equator Is in Africa.—TEACHER—"What is the equator, Johnny?"

JOHNNY—"The equator is *a menagerie lion* running around the center of the earth."—*N. Back.*

And at 25 Miles He Gets Rattled.—"I don't need any speedometer on my Ford. I can easily tell my speed."

"How do you do it?"

"Well, when I go 10 miles an hour my lamps rattle, when I go 15 miles an hour my fenders rattle and at 20 miles an hour my bones rattle.—*Dale Hackley.*

We Simply Can't Down These "Currant" Jokes!—ANODE—"What is the difference between a Direct Current Dynamo and a currant bush?"

CATHODE—"Search me."

ANODE—"The dynamo produces direct current, and the currant bush produces currants direct."—*Benneville Bertolet.*

And It Makes a Bad Scent.—IKEY (looking up from his book)—"Fader, what is der meaning of 'Vortex'?"

FATHER—"Vy, Ikey, don't you know? Dat's der extra cent vat dey charge on movies und ice cream 'Cohns'."—*Harry L. Moody.*

And Dew Drops.—Struck by the notice "*Iron Sinks*" in a hardware shop window, a wag went inside and said that he was perfectly aware of the fact that "iron sank."

Alive to the occasion, the smart shopkeeper retaliated:

"Yes, and time flies, but wine vaults, sulfur springs, jam rolls, grass slopes, music stands, Niagara Falls, moonlight walks and holiday trips, scandal spreads, standard weighs, India Rubber Tires, the organ stops, trade returns, and—"

But the visitor had bolted. After collecting his thoughts he returned, and showing his head at the doorway, shouted:

"Yes, I know, and marble busts!"—*John Bigenwald.*

The Dy(e)ing Lover.

I love thee, blue-eyed sweetheart. Be mine!
Dibromocresosulphonaphthalein!
Thine eyes, blue as the sky, tint divine,
Tetrabromphenosulphonaphthalein!
I'll dye a Parisian blue if you decline,
Oh, dibromthymoesulphonaphthalein!
—*Harry L. Moody.*

One on the Prof.—PROFESSOR, explaining the movements of heavenly bodies—"Perhaps it will be clearer if I let my hat represent the moon. First is there a question?"

PUPIL: "Is the moon inhabited?"—*Kenneth Purdy.*

He Ought to Evaporator.—"This," said he, "is the engine boiler."

"But why boil the engines?" said the sweet young thing.

"To make the engine tender," he answered gently

—*A. Tzatzhen.*

He Was Tickled to Death.—FIRST BOY: "My father occupied the seat of applied Physics at Harvard."

SECOND BOY: "Dat's nothin', my fader occupied the chair of applied electricity at Sing Sing."—*B. Rosenblatt, Jr.*

He'll Get It Coming and Going.—A certain town in Nova Scotia receives its electricity by high voltage transmission from a coal mine. Each pole within the town limits bears the following notice:

Danger—66,000 *Volts.*
Contact with any one of these wires will prove fatal.
Any person tampering with these wires will be prosecuted.—*W. E. Davidson.*

THE ORACLE

The "Oracle" is for the sole benefit of all electrical 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.

RECTIFYING COMMUTATOR.

(1061) W. H. Rogers, Turtle Creek, Pa., asks:

Q. 1. Several questions as to the salability of a motor-driven rectifying communicator.

A. 1. We would advise you as follows concerning the rotary converter which you propose:

There does not seem to be anything radically new in the scheme you outline for rectifying A. C. to D. C. and comprising a multiple segment commutator driven by a synchronous A. C. motor operated from the incoming A. C. mains, as several of these machines have been placed on the market in the past few years.

They are used for operating motion picture projectors, etc., where a high amperage of from 50 to 100 amperes is required. These machines have been advertised in various electrical journals.

This type of rectifier possesses, as you mention, the merit that only a small motor is required to drive the commutator, no matter how much current is taken from the latter device.

EDISON PRIMARY CELL.

(1062) E. I. Abrams, Chicago, Ill., asks *The Oracle:*

Q. 1. As to the merits of the Edison primary battery for lighting lamps.

A. 1. The Edison Primary Battery is excellent for lighting six volt automobile lamps, but about 5 to 6 cells connected in series will have to be used. This cell can readily be refilled by renewing the electrodes and the electrolyte.

It can be used steadily and does not deteriorate to any appreciable extent when not in use. The voltage of these cells is very low (about .9 volt usually), altho the output runs up to 200 or 300 ampere-hours for each cell.

PECULIAR TRANSFORMER AND SPARK COIL EFFECT.

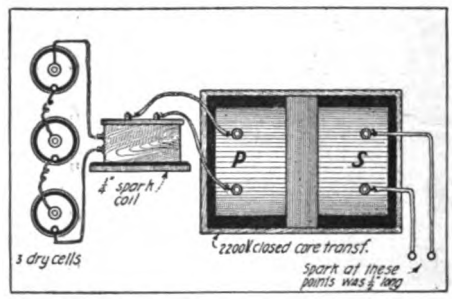
(1063) Thomas S. Parker, Palestine, Texas, writes this department:

Q. 1. I have just obtained a 2200-volt, 60-cycle, closed-core alternating current transformer from the local electric light company. It steps up the potential from 110 volts to 2,200 volts. It is a transformer which has both primary and secondary enclosed in the core.

With it connected up as shown in the diagram I was able to obtain a ½-inch spark. As you see, the spark coil only gives ¼-inch spark, and I want to know if there is any advantage obtained in this way for use on a wireless transmitter, or will the transformer cut down the voltage of the spark coil to where it will be only 2,200 volts?

Could this transformer be used for wireless if it was connected with a 110-volt line, 60 cycles, alternating current?

I connected a bell in series with six dry cells and connected the wires to the transformer, and obtained a good loud spark at the secondary terminals; a fact which I thought impossible with an alternating current transformer.



Peculiar Arrangement of Spark Coil and Step-Up Transformer, Which Yielded a Larger Spark Than the Usual One Produced by the Spark Coil Alone. A Freak Condition It Is Thought by the Editor.

The bell was acting as an interrupter and I obtained a good loud spark with the direct current, which same is considered impossible with an alternating current transformer; nevertheless it worked, and would even charge a Leyden jar to the extent that it could be heard all over the house and out in the yard. The jar was a little larger than one pint. How do you account for these facts?

A. 1. In regard to the operation of a spark coil in conjunction with a step-up transformer of a closed-core type, our opinion is as follows: What you have done is apparently this: You have taken several thousand volts secondary output from your spark coil and passed this thru the primary of a transformer. The transformer thus should raise this current of several thousand volts to twenty times its value, if the transformer was wound to stand this voltage.

Frankly speaking, our idea of this whole matter is that the secondary current from the spark coil at several thousand volts potential has simply "walked" thru the transformer, or at least jumped thru it by some peculiar freak, managed to induce a somewhat higher potential in a part of the secondary winding, perhaps, and produced in consequence the one-half-inch spark which you describe.

Of course, the whole matter sums up as follows: Whether or not such an arrangement was practicable, electrically speaking, you could not gain any power in this way, as every time the current passes thru another piece of apparatus there is a loss of efficiency of transformation. That is to say, while the voltage might be higher, as manifested by the spark after the current has past thru the transformer, the strength of the current or amperage would be less, and the wattage less than that resulting or available from the secondary output of the spark coil originally.

The transformer you have rated at 2,200 volts at the secondary is too low for any ordinary type of wireless transmitter as about 8,000 to 10,000 volts at least is invariably used to charge a glass plate or other form of condenser for wireless transmission. The experiment you made by using a vibrating bell in series with six dry cells to the primary of the transformer and obtaining thereby a good-sized spark at the secondary, is nothing so unusual.

There are a number of different radio sets as well as ozone transformer outfits in which a vibrating interrupter is used in the primary circuit for locations where direct current is available. But for radio work the spark gap must be synchronously attuned with the primary interrupter and moreover, the interrupter should be made in the form of a commutator with two or more segments, as described recently in *Radio News* and also several months ago in the Radio Department of SCIENCE AND INVENTION.

AUDION AS AN AID TO HEARING.

(1064) Miss Belle Henry, St. Paul, Minn., writes:

Q. 1. I have been much interested in "The Versatile Audion" in your February issue.

Not being a scientist the information on the audion was new to me and seems very wonderful.

But the use which immediately occurred to me, to which it might possibly be put, is not mentioned. That is, in connection with the electrical instruments for the deaf. These instruments now are only partially successful but would be wonderful if they could be perfected to take the place of normal ears.

A. 1. There is one application of the audion as an aid to hearing for the deaf which comes to mind at the present time, which uses its amplifying properties when used in conjunction with a microphone or sound-detecting instrument, together with the telephonic receiver or reproducer. When a two-stage audion amplifier comprising two vacuum bulbs is suitably connected, the sound picked up by the microphone will be of course wonderfully intensified when reproduced in the receiver attached to the ear.

A very interesting article entitled "The Physiophone" appears in the April issue, and this covers a new scheme for putting music into undulating electric currents which are taken thru metal handles into the body, and it is pointed out in the article in question that even deaf mutes, who have never and can never hear orally thru the ear, may indeed be able to "feel" or "hear" indirectly, as we might say, the rhythm and beauty of music, and also for that matter the spoken word or speech.

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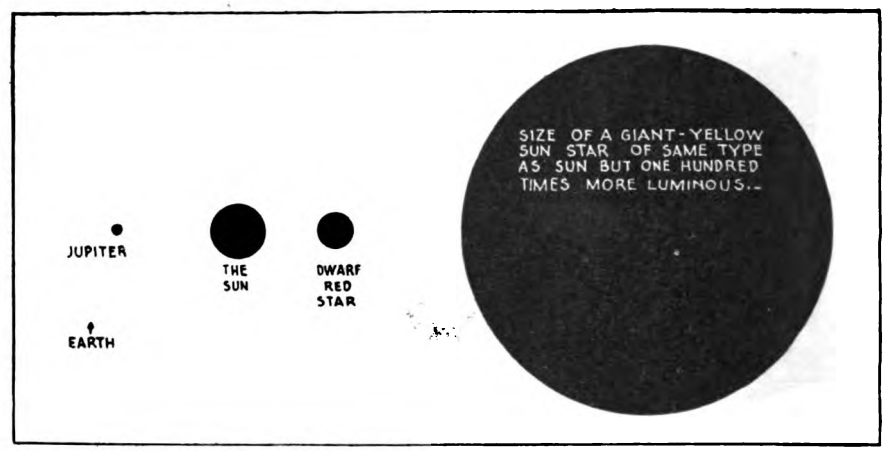
Popular Astronomy

By Isabel M. Lewis

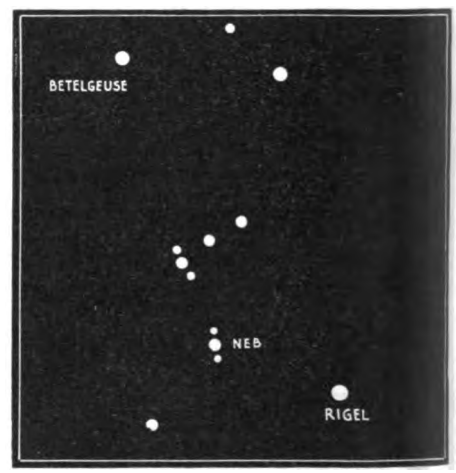
(*Continued from page* 615)



A Giant Red Star If Drawn to Scale Would Be Represented by a Circle with a Diameter About Four and a Half Times That of the Giant Yellow Star.

The red giants of class M probably have densities that average only a *few millionths* of the density of the sun while their diameters may occasionally be as great as forty million miles. On the other hand, the density of the red dwarf stars cannot be much greater than that of our own sun for it is very doubtful whether a body much more condensed than our sun would be in a gaseous condition. Moreover, if a dwarf star were as dense as the sun and contained only a tenth of its mass or quantity of matter it would be a very faint object and therefore invisible to us even if comparatively near. A dwarf star of the size of Jupiter or Saturn and of the density of the sun would have such a small mass that it would probably be practically non-luminous. Many such dark suns may exist in the universe. Jupiter has a density almost exactly equal to that of the sun and the density of Saturn is less than one-half that of the sun and both are non-luminous bodies resembling extinct suns rather than planets.

It was believed, before the discovery of radio-activity, that the radiation of the stars was supplied solely by the gravitational contraction of gaseous bodies. Assume that a giant red Cepheid variable of enormous volume and very low density begins to contract under the gravitational attraction of its parts. According to the law of gases as it contracts it grows hotter and its radiations become more intense. It becomes yellowish in color as its temperature rises and density increases and at the same time its size decreases. As it becomes still hotter and more condensed its color changes gradually from yellow to white and then to bluish white and its density increases still further. When its density approaches one-tenth of the density of the sun, however, the star no longer behaves as a perfect gas and its loss of heat by radiation begins to surpass its gain of heat by gravitational contraction and it gradually cools off, and grows dwarfish in size and high in density, going thru the color changes in the reverse order from bluish white to white, then to yellow, orange and red. On this hypothesis the existence of the two groups of dwarfs and giants in each spectral class can be accounted for and the order of stellar evolution as outlined by Russell is from diffuse giant red stars thru orange, yellow, yellow-white, and white giant stars successively to the hottest type of stars, the blue helium stars, which stage can be reached only by the most massive of all stars. Stars of moderate mass would not attain to this height of development, but would begin to decrease in size and density and return thru the dwarfish groups of the same types to dwarf red stars without at-



Outline of the Constellation Orion—With the Exception of Betelgeuse, Which Is a Giant Red Star, All the Stars Shown In This Group Are Giant Stars of the Helium Type, Often Called the Orion Type Stars Because They Occur In Such Profusion In This Particular Constellation; Rigel Is One of the Supergiants of the Universe, Being at Least One Thousand Times More Luminous than the Average Star of the Helium Type or One Hundred Thousand Times More Luminous Than Our Own Sun.

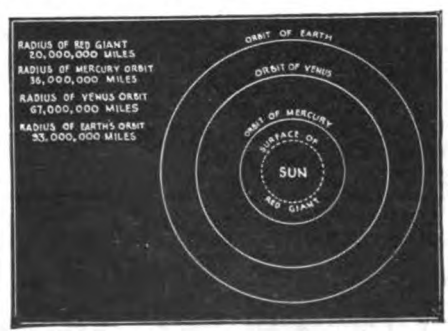
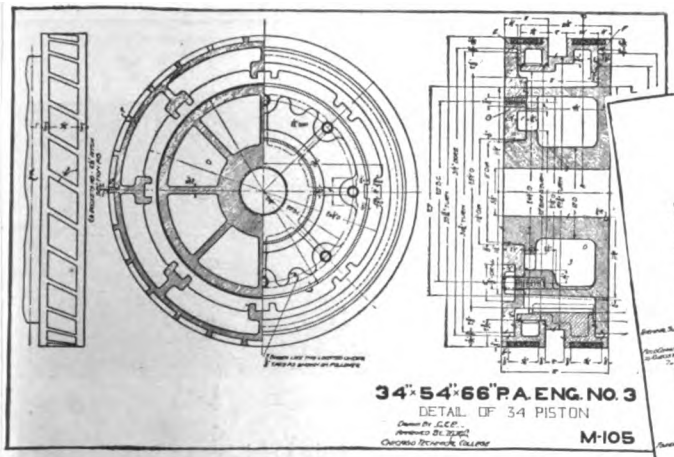
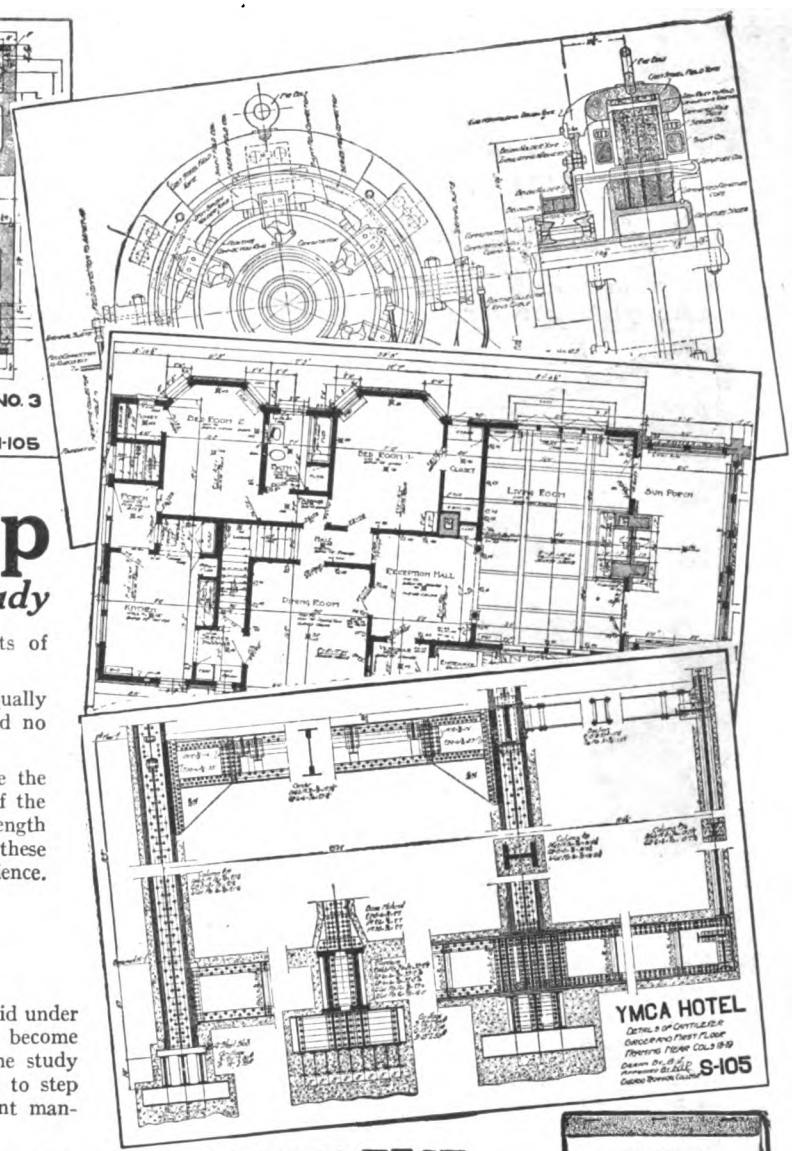


Diagram Showing Relative Sizes of the Sun, a Super-giant Red Star, and the Orbits of the Planets Mercury, Venus and Mars.

(*Continued on page* 662)





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"Movies" of Flying Bullets

By PIERRE H. BOUCHERON

(*Continued from page* 611)

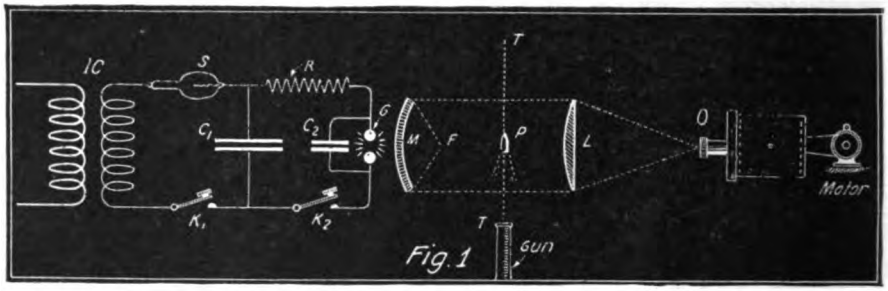


Diagram Showing Arrangement of Camera, Spark Gap, Etc., for Photographing Bullets in Flight.

the spark gap G, across which has been shunted a condenser C2, of very small capacity.

When the large condenser is fully charged and the circuit is closed, the electrical current will continue thru the circuit and charge the small condenser. When the potential of this smaller condenser has obtained a sufficient value to jump across the space of the spark gap, a spark takes place. Thus this cycle of events reproduces itself constantly and as the charge of the large condenser diminishes, the sparks occur less frequently. Furthermore, by directing a comprest air-jet upon the spark to prevent the formation of an arc, and while maintaining the voltage and capacity at a constant factor, as well as the length of the spark gap, it is possible to regulate the frequency of the sparks with exact precision.

The electrodes of the spark gap are placed facing the approximate center F of the parabolic mirror M, which has a diameter of 40 centimeters. This mirror projects the emitted light of the spark in a stream of parallel rays upon a convex glass L of equal diameter placed 3 meters distant, and which causes the rays to be ultimately focust upon the objective O of the photographing apparatus.

In order not to damage the instruments during fire and so that nothing is lost of the action, the firepiece is installed in such a manner that the trajectory T-T of the projectile P will pass at an equal distance

(*Continued on page* 654)

Solving the Housing Problem

By H. GERNSBACK

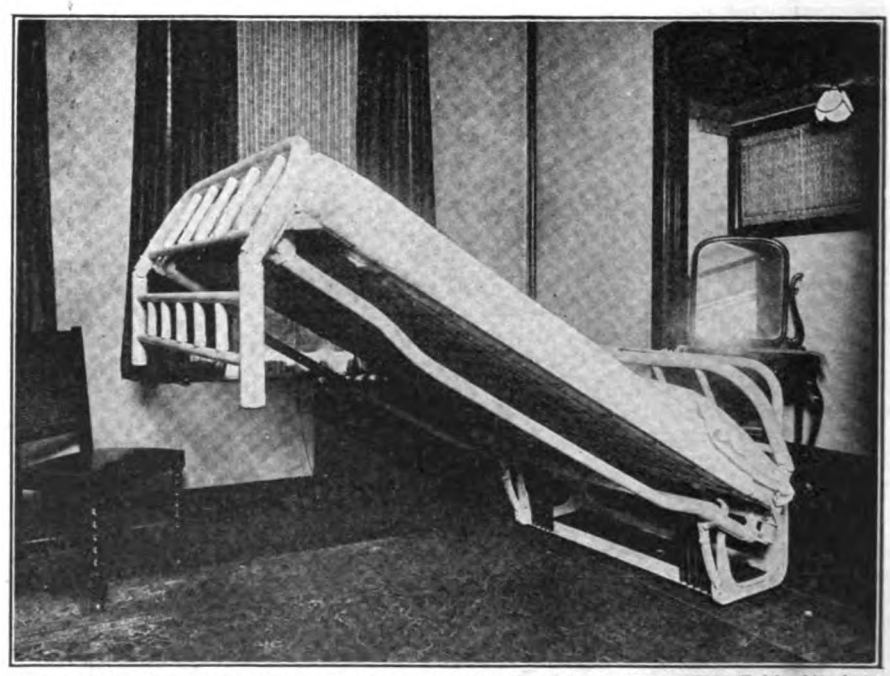
(*Continued from page* 619)

commuter. Just watch any outgoing commuters' train where every other man is loaded down heavily with bundles and packages.

MR. EDISON'S PREDICTION.

What then is the solution of the problem? Some months ago when the writer interviewed Mr. Edison, the latter predicted that within twenty years Manhattan Island (New York City proper) would not contain a single residence. It would then only contain business houses, factories, etc. Everybody would come to work by suburban rapid transit trains and return home in the evening. Mr. Edison's prediction is, of course, correct. For, if you look about us, you find that the City of New York is becoming more and more a business center, driving out apartments every year. Last year, for instance, has witnest the erection of hundreds of business institutions, theaters, etc., while this year there is only contemplated the erection of *a single apartment house*, where several thousand of them

(*Continued on page* 683)



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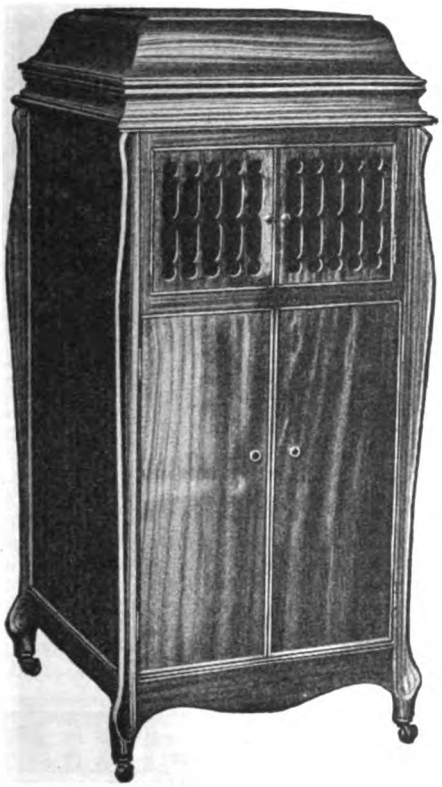

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"I received everything O.K. and I have already built and enjoyed it for two weeks and I am very much pleased with it."—Bieschke, Chicago, Ill.
"I have the model No. 1 set up and in fine running condition and would not sell it unless I could get another one like it. It is equal to any I ever saw. I have finished it in natural wood and all that have seen it say that there is not a finer machine in any store in town."—Corbin, Vancouver, Wash.
"Have just finished the cabinet and believe me she sure does look swell. I can guarantee you several more orders very soon."—Armhein, Milwaukee, Wis.
"I am well pleased with the MAKAFONE I ordered from you some time ago and am now placing another order for a No. 4 machine."—Hysong, Covington, Ky.
"I received my MAKAFONE and have built it and find it a dandy. I will send an order for a No. 3 machine in the very near future."—Bank, Sanatobia, Miss.

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"Movies" of Flying Bullets

(*Continued from page* 652)

between the mirror M and the lens L. As for the chrono-photographic apparatus itself, this is built up of a hermetically sealed wooden case and which brings the objective within its interior.

In the inside of this box is placed a very light cylinder made of *duraluminum* which is rotated at the rate of 12,000 revolutions per minute by means of an electric motor. The next, and one of the most important parts of the arrangement, is the moving picture film which is wound upon the drum or cylinder. Since it is mounted upon a horizontal axis every spot of its circumference is placed within the focus of the lens. The film attains a speed of 100 meters per second which speed permits the taking of 10,000 images, each 1 centimeter in length, or 20,000 images of five millimeters. By means of an electrical arrangement, the shutter of the camera may be opened at the beginning of the experiment and closed at the conclusion.

Now that we have an idea of the various parts which enter into the chrono-photographic apparatus, that is, the electrical as well as the optical ones, let us see just exactly how film pictures are taken at the rate of from 5,000 to 20,000 images per second, and which feat must be accomplisht within the very short space of time taken by a projectile to pass the photographic field.

Whether the experiment is for the purpose of studying the characteristics of a 37 millimeter cannon, or that of a hunting rifle, gun or revolver, the arrangement does not differ in principle. The discharge circuit of the Ruhmkorff coil is quite short in order that the sparks may be extremely brief in duration. These sparks are very photogenic, that is to say, they serve to illuminate the movable projectiles, and since the duration of the sparks are of the magnitude of one millionth of a second, the photographs are practically instantaneous. The spark gap or discharger is formed between aluminum electrodes which are thoroly polisht with fine emery cloth before each operation. The gap distance is about one millimeter.

THREE GRAPHIC EXAMPLES.

Thanks to this ingenious method Mr. Bull was able to secure very remarkable photographs of the projectiles. Possibly a few remarks concerning their characteristics are not untimely. Upon the films reproducing the movement of a projectile issuing from a 37 millimeter cannon, and which are of the order of 5,000 images per second, are distinctly seen the various phases of the phenomena and which may be studied by referring to the illustrations of the film. First is noted the preliminary puff of gas which is due to the rapid expulsion of air caused by the explosion and which takes place at about 70 centimeters' distance from the muzzle. The size of this preliminary gas increases gradually and travels at a speed of 60 meters per second. Following this are seen the gases caused by combustion surrounding the projectile and this is followed immediately by the large mass of gases. Finally the film shows a series of small sparks which are probably due to flaming powder grains surrounding the projectile.

The films taken at the discharge of a regular rifle show, among other interesting particulars, the grouping of the lead shot after leaving the barrel.

In the films of revolver explosions obtained by Mr. Bull, the frequency of the images reaches from 15,000 to 20,000 images

(*Continued on page* 656)

"Movies" of Flying Bullets

(*Continued from page* 654)

per second. First is seen the barrel extremity of the revolver, then come the fusing gases surrounding the ball and altho the initial speed is very great, it is observed to rapidly diminish. Just as soon as the projectile has completely left the revolver, the gases escape from the muzzle in small circles of but an instant in duration, after which they assume a conical shape. Then as these gases gradually lose speed the bullet overtakes them and the latter becomes visible once more at a distance of about 15 centimeters from the muzzle of the revolver. A short distance further, the projectile is made to penetrate a narrow pine strip, the splinters of which are readily discernable in precise order to the right and to the left of the bullet. In connection with this a curious observation is that several of these splinters of wood attain speeds much greater than that of the projectile.

In summing up the explanation of these interesting experiments, thanks to the employment of continuous spark discharges broken up by blowing, electricity once more is made to play an important rôle in the production of moving pictures at a rate of speed exceeding 20,000 photographs per second. Here is an excellent and golden opportunity for our American film producers to utilize this method for the filming of some unique and refreshing "movies."

Hammering Electrons Out of Matter

By HAROLD F. RICHARDS, Ph.D.

(*Continued from page* 633)

some experiments were performed in which the metal and insulator were brought into intimate contact by the simple expedient of allowing a hard-rubber ball to bounce upon a brass disc. *By this means the metal disc has been electrically charged to a potential of nearly 200 volts.* A *single* collision of the ball with the disc has produced as much electricity as would have been obtained by a considerable amount of rubbing, altho the ball and the disc were in contact for only a *minute fraction of a second.* In the course of the experiments, balls of hard rubber (ebonite), glass and ivory have been allowed to strike upon discs of brass or zinc, and in *every instance* the metal received a positive charge of electricity. All the results showed that there is a natural tendency for the free electrons in the metal to diffuse into the insulator, which possesses fewer free electrons. Thus it is evident that rubbing is not necessary to produce the electricity. Many delicate experiments were performed to find how the electrical charge depended upon the velocity of impact, the weight of the colliding bodies and the electrical capacity of the metallic system upon which the charge was produced, and all the results showed conclusively that the electrical energy does not depend directly upon the mechanical energy lost in collision. It is, therefore, apparent that electrification by friction and by impact are contact effects of the *same nature as the contact effect between metals,* and that there is no direct transformation of the mechanical energy of rubbing into electrical energy. When electricity is produced by friction, the electrical charge does not come from the mechanical work done, but from the vibratory energy of the electrons. These results seem to settle conclusively the much-discussed

(*Continued on page* 661)

Hammering Electrons Out of Matter

(*Continued from page* 656)

problem of why friction produces electricity. All that the rubbing does is to bring the molecules of the two surfaces sufficiently close together to permit them to exchange electrons in accordance with their *natural* tendency.

A NEW ELECTRICAL GENERATOR.

In accordance with the results of these experiments, an electrical generator can be constructed which will operate upon an entirely new principle. The diagram shows how to make it. The machine is nothing more nor less than a little trip-hammer, with electrical connections to take off the charge generated. The wheel is turned by hand and carries teeth, so that it alternately raises and releases the hard-rubber (ebonite) disc attached to the end of the lever. Thus the disc strikes repeatedly upon the metal anvil, which may be of iron, brass or any convenient metal, and the electricity generated upon the anvil can be drawn off thru the wires shown. In order to obtain a continuous production of electricity it is necessary to discharge the surface of the ebonite disc occasionally by passing a flame rapidly over it, for negative electricity is produced on the ebonite at the same time that positive charge is formed on the metal anvil, and after a sufficient amount of electricity has accumulated upon the ebonite the further production of electricity will stop. With an apparatus similar to this, the writer has charged a metal anvil *of small capacity* to a potential of 386 *volts.* The ebonite disc had to strike the brass anvil thirty-three times in order to produce this voltage, and it was found necessary to discharge the disc three times during the course of that experiment. This generator will not produce electricity fast enough to be of practical use, but it is intensely interesting because it operates *by virtue of an entirely new principle!* If an ordinary Leyden jar is connected to the metal anvil, *a few minutes of turning the crank of the machine will generate enough electricity to kill a rabbit or give a strong shock to a human being.*

WHEN BABE RUTH KNOCKS A HOMER.

It is interesting to think of the electricity which we are constantly generating. When the typist pounds the keys, when the pianist dashes thru the Twelfth Hungarian Rhapsodie, when Jack Dempsey lands his right, electricity is produced. Even in walking, the repeated collisions of the leather soles with the pavement cause a continual generation of electricity. A pile-driver produces electricity every time it strikes. Babe Ruth, the home-run king, is a notable generator of electricity, for every time his mighty bat collides with the leather-covered sphere this strange thing called electricity is produced. The experiments that have been performed indicate that if we should collect in a Leyden jar the electricity generated every time he makes a hit, forty hits would suffice to electrocute a mouse. From this it appears that Ruth's efficiency as an electrical generator is not very high, when we consider how many mice he could kill if he used his bat directly on their heads. The efficiency of producing electricity by hammering the electrons out of matter is so small that this new method of generation will never be used practically, but the discovery of the effect and the laws governing it have shed much light upon many puzzling electrical phenomena.

Popular Astronomy

(Continued from page 650)

taining to the splendor of a giant helium star. This theory accounts very reasonably for the division of each cooler stellar type into groups consisting of dwarfs and giants. Among the helium and hydrogen stars however, there would be, evidently, no division into dwarfs and giants since all stars attaining to this height of development would necessarily be exceptionally massive giant stars. This scheme of evolution of the stars does not recognize nebulae as the progenitors of the stars. Tho helium stars are often found associated with nebulae, no giant red star has ever been found associated with a nebulae. It has always been the orthodox belief that the nebulae condensed into "young" or "early type" helium stars, which in turn condensed further in cooling into white, yellow, orange and reddish stars, consecutively.

This theory of evolution has no place for the diffuse giant stars of the same series and the discovery of their existence has proved somewhat disconcerting to the supporters of the older, more firmly established theory of the origin of stars from the great diffuse gaseous nebulae. It has been suggested that the nebulae may rather result from the disintegration of unusually massive helium stars that have become so abnormally hot in contracting from a diffuse state that radiation pressure has prevailed over gravitational attraction with a resulting dissipation of the "star stuff" into space.

The origin of the diffuse giant red stars is indeed a puzzle. It is plainly evident that they do not arise directly from condensation of the luminous nebulae since the two are never found associated in space. It has been suggested tentatively that diffuse red giant stars may owe their origin to *interatomic action* in the vast non-luminous tracts of matter known to exist universally in space. Tho the density of these red giants is less on the whole than the earth's rarer atmosphere, there is every reason to believe that they are strongly condensed toward the center, instead of being uniformly dense thruout.

Since it has been definitely proven that contraction alone is insufficient to keep up the supply of radiant energy of the stars too great stress cannot be laid upon any one theory of stellar evolution. Many puzzling astrophysical problems would be solved if the source of the radiant energy of the stars were known.

There are known to be stars differing little in size, mass and density that differ tremendously in light-giving power. Thus the companion of Sirius, tho half as massive as the brighter star and of the same type of spectrum, gives only one five-thousandth as much light as Sirius.

There was discovered but a year or so ago a most remarkable calcium-type star near us in space that possesses only one five-thousandth part of the intrinsic luminosity of the sun, altho per unit of surface area normal stars of this type radiate much more intensely than the sun. Either this star is not much larger than our planet Earth in size or else it radiates far more feebly per unit of surface than a normal star of its class. A true solution of the puzzle depends upon a knowledge of the source of the radiant energy of the stars. Certainly no known source of radiant energy, including radio-activity, could keep in a state of sun-like incandescence thru the ages a minute sun no larger than our own little planet.

On the other hand, there are known to exist among all types of stars, super-giants such as Rigel and Canopus that radiate fully five thousand times as much light and heat as a normal star of the same type.

How to Become a Professional Radio Man

By PIERRE H. BOUCHERON

(*Continued from page* 643)

first day out of New York the food was passable and there was plenty of it. After this, however, we had prunes and canned "Willie' for breakfast, canned "Willie" and prunes for lunch and "Willie" canned and prunes for supper. I do not mention tea or coffee because, altho the mess cook called it by these names, they were *not;* in fact there was no palatable difference between the two.

For that reason, I say to you, *take along the books,* also the notebook and the camera. Take out a correspondence course even if it be only one in correct English. Several prominent radio men have reached their present positions today, solely by the amount of technical book-learning they were able to secure while seagoing operators. The majority of radio men are young; that is, all ages ranging from 18 to 30, at which time the mind is more pliable and receptive than in later years, making comparatively easy the mastery of various technical subjects allied with the radio art.

The camera and the notebook are most valuable. The camera for its all-seeing eye and the notebook (call it a diary if you wish) for its graphic record of your experiences while in "foreign lands." Preserve these records as you would your life insurance or your bankbook. They will prove invaluable to you in later years.

Trephining the Skull

(*Continued from page* 610)

up the area of the opening with cocoanut shells. Compare with the modern idea of covering up a hole with a silver plate screwed in place.

The instruments have been improved upon and the operation instead of taking months requires only 12 to 15 minutes. Altho sometimes the old form of trephin is still used, electricity has rapidly taken its place in the form of a new circular bone saw. The old style trephin was auger-like in nature and drilled a starting point for the saw. The cylindrical saw then cut a perfectly round pellet out of the skull, which was removed with the saw. This then gave access to the covering of the brain which had to be incised in many cases.

The purpose of the operation is many fold. The skull, as we now know, is made up of three distinctly different sections of bone. An outer table which is firm and hard, a middle or diploëic table which acts as the nourishing layer, and the third or inner table of hard boney matter. The middle one is quite porous.

Thus a blow on the head will sometimes not show any perceptible injury on the outside and yet a fracture of the inner table might have occurred, driving fragments of the bone into the brain tissue. Here, due to the wonderful blood circulatory system of the brain quite a bit of blood is forced out, which will later clot, the same as blood does in any other portion of the body.

A blood clot may now undergo a series of degenerative changes or may disappear entirely thru being absorbed by the tissues. In the latter case there is nothing to fear, but in the former it causes degeneration of the tissues, and rapidly spreads over quite a large area. The pressure inside the cranial vault or skull becomes very great, and the action of the brain is markedly impaired.

The degeneration changes may gradually spread so that finally they become distinctly localized and begin to show defects in bodily movements or sensations. If the leg area is reached, the leg will become paralyzed on the opposite side of the injury, i. e., if the right hemisphere of the brain has been injured, the left leg will be paralyzed and with the leg of course the arm on that side.

The injury or abscess then would penetrate the brain tissue still further and may result in blindness in one-half of the visual field of both eyes. Difficulties of speech would present themselves and word blindness occur, dependent on the direction in which the abscess grows. In addition, intense throbbing in the head and perhaps deafness on the same side as the injury would be indicated. Of course, none of these signs would show invariably that the brain has been injured or that there is any intercranial pressure.

The attending surgeon always attempts to ascertain by interrogation whether or not there had been any previous injury, and if the answer is in the affirmative, regardless of whether the injury was on the surface or not he advises immediate operation when the other signs just mentioned are present.

If the operation is not refused by the patient, it means but a matter of a few moments to carry it to a successful completion. The surgeon after setting the depth gage for the saw and adjusting the width of the saw-cut, places his patient under anesthesia, and then as near as possible he attempts to locate the position of the injury. A flap of scalp is then removed, the head having been shaved at the spot determined upon, the current turned on and the saw cuts its way thru the skull, without necessitating any pressure upon the handle of saw.

This causes two parallel incisions to be made, even into the proximity of a splintered skull, and there is no danger of forcing fragments of bone into the brain as was generally the case with the old style trephines. Reversing the saw and cutting two more parallel lines at right angles to the first cut, the surgeon is able to remove a square portion of bone or a triangular portion if the same should prove advisable, in which case the saws are close together.

A cut thru the dura mater or covering of the brain exposes the brain, and instantly if there has been any cranial pressure quite a large quantity of pus will escape. Sometimes the opening thus formed, if it is of large size, is covered by a silver plate screwed into place right into the bone, the dura mater of course having been sewed up prior to this step.

Automaton Mimics Real Man

(*Continued from page* 607)

Mr. LaReine, after having obtained a mechanical man, discovered the fraud in the method of actuating its mechanisms which, as the readers undoubtedly know, was controlled by a real live midget, and after years of research has produced a rival to the old type. This new marvel, in addition to writing his name on blackboards and riding a bicycle, can actually talk; the voice emanating from him being very distinct and clear.

The arms of the man in writing are actuated by a series of cams, which enable the operator to direct any desired movement to these arms. A selective device allows any of the various functions to be actuated separately, much the same as these selective controllers employed in wireless controlled vessels. A gyroscope in the bottom enables the mechanical man to ride a bicycle across the stage in startling fashion.

An American Jules Verne

(*Continued from page 623*)

ships—to lift them up vertically—are becoming a realization at the present time. Witness the various helicopter machines that actually have flown in the past few months and which were pictured in this magazine recently.

Nor did Mr. Senarens write vaguely about his wonder machines. Quite the contrary, he described them minutely. While of course no such technical data, as for instance that used by Jules Verne, appears in Senarens' descriptions, still the boy who read the stories had a pretty good understanding of the workings of the mechanism, and his imagination always helped him along so that the machine was pictured by him down to the last nut and to the last binding post. Most interesting is it that Mr. Senarens used electricity as the motive power of most of his devices. At that time, altho there were as yet no electric lights, electricity had just come into use. Electricity in those days could do anything, and the people believed that the marvelous new force was capable of doing the impossible, as indeed it has approximated to since. Not the most interesting part about Senarens' writings were his scientific creations, but the stories themselves were little classics in construction. Mr. Senarens had written since he was a boy fourteen years old, and was a very accomplisht writer with a fervid imagination, not only in things scientific. He was a master of romance, fiction, adventures, plots and everything.

Mr. Senarens is still at it, and altho he is not writing any more scientific stories just now, he is in the ring and doing work as an editor for a New York publishing house at the present time. Mr. Senarens is fifty-eight years old and is a very active and energetic man who does not show his age. Perhaps at some not too future date Mr. Senarens will give us some more imaginative stories, picturing the world as it will look fifty years hence.

And the other day when we made him dig out a few hundred of his time-worn yellowed paper-covered novels, each adorned with an old-fashioned wood cut on its front cover, Mr. Senarens smiled wistfully. He had long since forgotten those "wild impossible dreams" of his younger writing days. Altho he does not like to admit it now, he was actually ashamed to write such "nonsensical wild pipe dreams" those days. In fact, there were many people who thought that his stuff was too fantastic and would actually hurt the young boys. And here nearly everyone of his "pipe dreams" has come true!

"Yes," Mr. Senarens sighed deeply, when we called his attention to it, "truth is indeed stronger than fiction. I believe anything is possible now."

How Were the Pyramids Built?

(*Continued from page 599*)

the other hand, tools of that period brought to light by excavation are of the most primitive kind.

"How, then, were the pyramids constructed? How were enormous blocks of stone, each weighing many tons, hauled into position up to nearly five hundred feet above ground level? This is the problem which has puzzled engineers. While several theories have been advanced, none has been propounded which has met with anything like general acceptance. The most popular (if it can be so called) is the earth (or rather sand) ramp theory, which propounds that as one row of blocks of stone was laid, from the foundation upward, an inclined plane of sand was constructed around all four sides

until it was level with the top of the row. Up this inclined plane the blocks of stone for the next row were hauled, and when positioned the sand-ramp was lengthened and heightened to the top of them, blocks for another row hauled up, and so on and so on. In other words, the theory involves a belief that the Egyptians constructed one huge earth mountain to enable them to construct a smaller stone mountain, it being apparent that to get an angle for haulage over soft sand, the approach rise of the ramp would have to commence from nearly a mile away.

"To the writer this idea appears crude in the extreme. Also it gives very little credit to the master-builders of a very extraordinary age.

"The writer's theory is that the smooth cement covering (this smooth outer covering which can be seen on the pyramids even today, altho badly disintegrated in most cases, is and has been popularly supposed to have been put in place after the stone work was all finished) was put on from the bottom upward as the work proceeded. That is to say, when the first row of stones above the foundations, *i. e.,* above ground, had been positioned, their outer sides were given the cement plastering. Assuming this to be so, the edifice had a smooth *glissade* of an ever-rising height as each layer of masonry was added. The object of such a method of construction will at once become apparent if we imagine a roller to have been placed at the angle of the flat top and a number of ropes laid over it down the sides. (See illustration herewith for probable arrangement of the rollers and ropes.) When the word 'ropes' is mentioned we must calculate upon long lengths, spliced into cables. The fabrication of, say, five such fibrous cables, about three-quarters of a mile in length, replaced as worn out, would have been a small undertaking compared with the fabrication of a colossal and totally unnecessary *ramp,* or huge mountain of sand, the erection and removal of which would have been a titanic operation alone. On one end of those cables would have been hitched a block, already faced and angled, with its smooth side against the cement incline. On the other end, a number of men would have been ranged in lines for hauling.

"The number would have been a great one, but history relates that nearly *one hundred thousand men* were employed in the construction of the pyramids! With regard to the hauling of the blocks into position, therefore, the only limits would have been the length of the cable and of the ridge. In such conditions, 10,000 men divided into five rows of 2,000 each, hauling on a twenty-ton mass over rollers, against a smooth *glissade,* would have had an easy job. Once up, the blocks would be hauled to the near side of the haulers (pushed along on rollers, presumably), and the process of erection would go on away from them, until the *glissade* was reached, when the latter would be built up to the new level, and work would begin again, positioning another row of blocks.

"The theory advanced is supported by several considerations. The modern block-and-tackle system is unquestionably only an evolution of the very plan of handling heavy weights just described. Both the older and the modern methods required a number of parallel ropes or cables to take off and divide the tension of a very heavy weight, without which division the strain on a single strand would be too much. In each method also there is the division of the pulling force between several strands. The principles involved are the same, only the modern power- or hand-driven block and tackle is more scientific and less cumbersome than the ancient cables working over rollers. But —and here is the point—how much less cumbersome is this method than the idea of mountainous sand-ramps, first thrown up and then thrown away?"

A Universe in Miniature

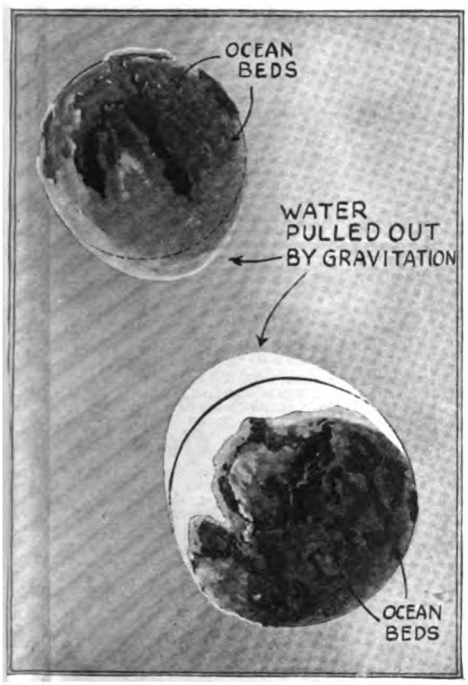
(*Continued from page* 603)

their own, and they are so transparent that one may see the farthest stars through their substance. Finally, there is the turning of the rings, and they turn according to the law of gravitation. This is a fact which all theory accepts and of which the hypothesis of Dr. Birkeland does not seem to take account. The wisest plan, therefore, until the new order comes, is to hold to the old theory of Cassini and to follow with interest the ingenious experiments of Dr. Birkeland."

What Caused the Great Flood?

(*Continued from page* 606)

so much by the rain which fell as by the breaking up of *"all the fountains of the great deep."* In plain English, this can have but one meaning, viz., the waters of the ocean.



This Shows Graphically What Happens When the Earth and Another Heavenly Body Approach Within a Short Distance. The Water on Both Bodies Will be Drawn Out as Shown.

That these waters were actually ocean waters can best be proven by the fact that fossil sea shells have been found upon the summits of our highest mountains in all parts of the world with the exception of some African mountains.

Mr. Gernsback's explanation of the flood is very simple, and might readily have occurred as follows:

If some celestial body in its wanderings thru the heavens past sufficiently close to the earth, that is within ten or twelve thousand miles, there is no question of a doubt that such an encounter would have caused havoc on earth. We are not concerned here what this body was. It might have been our own moon, or it might have been any of the other planets, or even an extraordinary large cometary body of a bulk as large as the earth, or even as small or smaller than the moon, passing sufficiently close to the earth,—say two thousand miles. The mutual gravitational influences would then raise tremendous tidal

waves, not only upon the earth, but upon the other heavenly body as well, providing there was water on it.

Now if Noah had been, as he presumably was, a wise man, he no doubt would have been able to foresee what was coming, just as any astronomer can foretell the return of a comet years in advance. The flood is commonly supposed to have occurred in the year 2348 B. C. If we credit a man with ingenuity enough to build the Ark, in other words a vessel 500 feet long and 50 feet deep, as mentioned in the bible, a vessel comparing very favorably with a modern ocean passenger steamer, that man must have had a rather remarkable intelligence. He probably was astronomically inclined, and he could probably foretell the time when the encounter of the two bodies, viz., the earth and the strange wanderer, would occur. This of course, would give him time enough to build his Ark, and therefore escape the ensuing cataclysm.

Our cover illustration gives a good idea of what would happen if the earth and the other celestial body would be at their nearest approach, say 10,000 miles. It should be remembered that such an encounter as this is not of long duration. The earth moves very rapidly in its orbit, namely at the rate of 1,600,000 miles per day. The other body would move at an approximately similar speed. The havoc caused by the mutual gravitational attraction would be colossal as well as swift.

As the two bodies approach, the ocean waters of the earth, being the most plastic substance of the almost rigid earth, would be drawn sky high, all depending upon the distance which separated the two heavenly bodies. That the ocean waters would be lifted up in gigantic tidal waves of anywhere from ten to twenty-five miles high is only a very reasonable surmise. The lifting up of these waters would of course be swift, and would not necessarily cause immediate havoc then, but the minute the two bodies separate, the waters naturally would recede with a rush, and would inundate the continents considerably over the highest mountain tops.

Consider that the waters of the earth cover five-eighths of the entire surface. If therefore, this theory is correct, the receding waters would rush over almost every continent of the entire globe. Nor will this titanic disturbance be momentary. The gigantic waves created will not come to rest immediately, and the momentum will probably be sufficient to cause the waters to race around the earth for many days to come. It might even take months for some continents to become depleted of the waters; undoubtedly new oceans would be created and old ones turned permanently into land. Witness, Dr. Wright's remarks as to the historical Chinese ocean known as Han Hai.

How long such a disturbance might last until the oceans finally came to rest again, is impossible to know now, but it cannot be doubted that the time element would be rather long. It is well-known that a cloud burst sometimes deluges a section of the country for some days before the waters finally have entirely dispersed, thru filtration into the ground, or by being carried away by rivers. Such a local inundation probably never exceeds an average of ten to fifteen feet deep. If then it takes days for the waters to recede from such a purely microscopic local affair, how long would it take the waters to finally disappear if an ocean wave anywhere from ten to twenty-five miles in depth swept over the lands?

No serious objection has been raised by astronomers to Mr. Gernsback's theory, and this explanation is probably as good or perhaps better than many other theories that tried to explain the reasons for the flood unsuccessfully in the past.

COMMENT ON THE ABOVE.

By Isabel M. Lewis, M.A.
of U. S. Naval Observatory.

If, in the course of ages, a dark bod comparable in size to our own plan chanced in its wanderings thru space pass so dangerously close to our solar sy tem as to come under the overpowerin attraction of the sun and were draw thereby into his domain, and happened, it advanced toward the sun in hyperboli orbit, to pass within a few thousand mile of our own planet world, the effects would not be so transient as are the effects of cometary encounters.

Were our planet in a semi-gaseous state it would eject a stream of matter in the direction of the intruder as a result of the state of tidal stress and strain set up b the close approach of the two bodie Since, however, our planet is an elastic body and as rigid as steel, it would yield but temporarily to the deforming force (unless this was so great as to completely disrupture our world), and immense tidal waves would sweep over the earth's surface for many days, increasing in force as the two bodies approached and gradually decreasing as they drew apart. Great tidal waves sweeping over the surface of the earth would not be the only effects of such an encounter.

There would be great and persisting climatic changes as well. The visiting body being comparable in size and mass to the earth and exerting a great gravitational pull upon it, would produce a change in the form and size of the earth's orbit that would continue after the body itself had past on, just as a comet that has past close to a planet has the form of its orbit permanently changed by the encounter. The distance of the earth from the sun and its period of revolution, or year, depend upon the form and size of its orbit, so as a result of the encounter our year and our distance from the sun would be different and accordingly the amount of light and heat received from the sun would change and therefore our climate as well. Moreover, a change in the form of the earth's orbit would bring changes in the nature of the seasons which would be still further affected by a change in the direction of the earth's axis which would undoubtedly be brought about by the action of the disturbing body.

Great tidal waves of a transient nature, produced by the gravitational attraction of two massive bodies passing close to each other with high velocities, and lasting climatic changes produced by the change in the earth's orbit and in the inclination of its axis would result from the visit of this stranger from space.

In historical times no great changes have taken place in the earth's climate, but as we delve backward into the earth's history thru great geological eras that stretch into the dim and distant past we find quite a different state of affairs. At periods in the earth's history great climatic changes were brought about, glacial or ice ages when polar caps extended far into the temperate zones were followed by periods when luxuriant tropical vegetation flourished as far north as Greenland.

What was the cause of these tremendous variations in climatic conditions over the earth's surface during different epochs? No completely satisfactory answer has yet been given.

Periodic changes in the form of the earth's orbit, changes in the inclination of the earth's axis, or cyclical changes in the intensity of the solar radiation are some of the factors that might produce those alternating climatic periods; or again, variations in the heat of the earth itself or changes in the composition of its atmosphere might account for them more satisfactorily.

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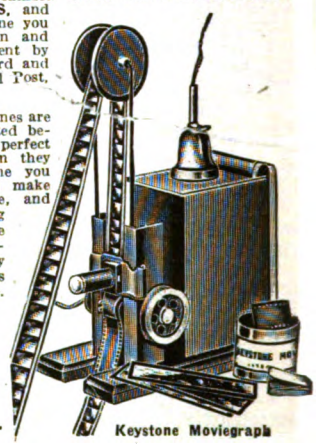

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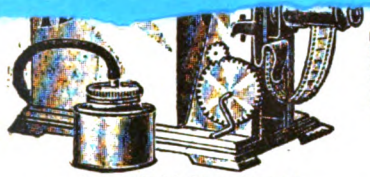

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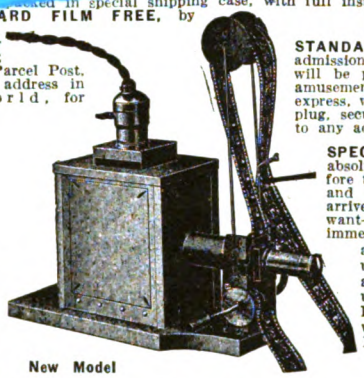

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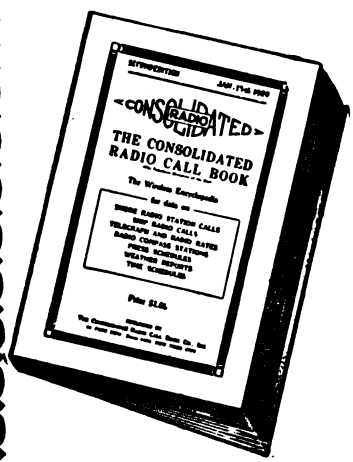

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How We Balance Ourselves

By WILLIAM M. BUTTERFIELD

(*Continued from page 608*)

fiddle-fashion with the sac. The sacs and the bulbs appear to perform the same work, and the hollow interiors of all are filled with *long, tapering hairs* radiating toward the center from all sides (Figs. 7 and 10). The sacs and two of the bulbs are pierced by branches of the vestibular nerve (Figs. 2 and 7), and the nerve filaments, on entering the cavities, split up into twig-like formations that spread out in all directions, twisting their unprotected fibrils in among, and also around the hairs (Figs. 8 and 10). In this manner a nerve connection is made with the brain, thus informing that organ of the slightest movement of the hairs.

The envelope of the organs is composed of three separate skins (Fig. 5). Embedded in the inside skin, among the hair-cells and lying opposite the nerve entrances in the sacs, sometimes in one place and then another in the bulbs, there are always found groups of crystals that form in balls (otoliths), held together by meshes of delicate fibrous tissue (Fig. 9). The areas where the crystals lie are thus weighted and develop movements of the skin, which fall inward, obeying the action of gravity (Fig. 10), or again outward, moved by the pressure of the enclosed fluid; in this peculiar way forming an automatic gravity operating vibration.

This, in brief, is a description of the organs as now well known and understood. To illustrate what takes place when the organs perform their work, let us take a small bottle of water as representing the fluid confined in the inner cavity of each organ. It takes but a very little experimentation to show us that there is not a movement of any kind that can be made with the bottle that does not cause the water to change or move in some contrary way. If the inside of the bottle was lined with long flexible hairs, this contrary motion would be transmitted to them; hence if the bottle was revolved or dropt or tilted, the various motions would show by a series of definite motions of the hairs. For the purpose of controlling an intricate animal machine, the organs, with their hairlined parts, are most queerly shaped and situated, but the fluid in them moves the hairs in just the same way. These variations, caused very properly by the shape and disposition of the various parts, constitute the varieties of impressions conveyed by the nerves to the brain.

The weighted areas would seem to have a separate function, that of recording unusual movements, such as we have described, and as a means of notifying the individual that the body is in an unusual position. As a final illustration of the efficiency of these organs, we will give the result of some experiments made on the fowl and pigeon. When all of the semicircular canals are cut in a live bird, it for the time loses all conceptions of equilibrium, flying upside down, walking sidewise, lying on its back and kicking its feet, thus showing that it has no control of its movements. These experiments can be repeated with other birds, always with similar results. When the canals are cut on one side of the head the bird flies or walks in a circle, and so the experiments are carried on with various canals. When the wounds have healed and the canals filled with fluid, the birds are once again apparently normal.

A community carpet sweeper is to be one of the first investments of a certain little Italian town where the American Red Cross introduced vacuum cleaners in the hospital it maintained for the heroes of the Piave. As soon as a fixed quota of carpet owners pool their interests the investment will be made.

The "Loaded Line"

By CHARLES S. WOLFE.

(*Continued from page* 617)

against no ordinary leak, the idea took root in my mind that we were having a taste of what the circus men call—er—dirty opposition."

Noting Fenner's arched brows and the evident bewilderment of the Chief and myself, he hastened to explain.

"There is no other traction company operating in our territory, of course, but you will recall that since I took charge our company has branched out into the business of selling *power*. Here we meet the City Gas and Power concern, and quite a lively competition has ensued. I am forced to say that we have been getting the better of the bargain, and while I dislike to entertain the thought, it occurred to me that possibly the other side was striking at us in this fashion."

"Don't agree with you, Mr. Forbes," blurted Davidson. "Theory don't gee, my way of thinking. I'm no electrician, but I can realize—and so would any member of the City Gas crowd—that this little leak would scarcely be felt by you—financially."

Fenner smiled. "You brush Mr. Forbes' theory aside rather thoughtlessly, Chief," he remarked. "Suppose that some one connected with City Gas were well enough versed in Professor James' stuff to realize the probable effect of this mysterious and unexplainable peak on the working force of the traction company, particularly on the car crews? It wouldn't be such a trivial thing then, would it?"

Forbes beamed. "Exactly, Mr. Fenner," he cried. "You have grasped my idea in its entirety. Unpleasant as the thought is, the only really plausible explanation that has occurred to me is that some one who desires to cripple us is attempting to terrorize our men."

Davidson yielded gracefully. "Put it that way, it sounds better," he admitted. "If Fenner can find the spot where the leak is being pulled over, I'll answer for the rest."

"Whoa!" laughed Fenner. "You'll have stripes on the president of that corporation within the next thirty seconds if you don't pull up. That's a possibility, not a probability."

Once Davidson became possest of an idea it took terrific and overwhelming proof to the contrary to dislodge it. "Sounds good to me," he rumbled; "I'll have a couple of gum shoes sitting on that crowd's coat-tails on my own hook."

"One thing more, Mr. Forbes," Fenner remarked, "I would like to see the charts that have those power curves on them."

From his coat pocket Forbes promptly produced a bulky envelope. "Here they are," he said, and we crowded around the table to stare at them.

They were the conventional charts, ruled off into squares, with a heavy black line meandering over the face of each. That line told the story of power consumption for every minute of the twenty-four hours that constituted the traction company's working day. Any unusual call for power was instantly discernible by the sharply rising line, the duration of the load being indicated by the length of the line on its highest level. For instance, during the rush hours the advent of the trippers and the calls made by numberless startings of frequently stopt cars stood out clearly.

And, on the other hand, the gradual lessening of the load as cars finished their runs and were turned into the barn was equally noticeable, the low dropping line telling the story vividly.

It was only necessary to glance at the time marked off on the bottom edge of the sheet to tell at what minute any particular incident had occurred.

And on each sheet, at one forty-five in the morning, when the dropping line told of only a few straggling freight cars on the rails, a sharply rising peak in the power curve betrayed an enormous call for current.

Of all times, when such a call should have been lacking, that was the hour of low ebb. Therefore, this mysterious peak was a phenomenon calculated to draw the scrutiny of those who had on their hands the handling of the big generators.

As Forbes had said, that peak indicated a mighty unusual condition, and the regularity with which it occurred made the matter doubly suspicious.

Davidson gazed down on the tell-tale sheets with what very closely resembled awe.

"Clever, that power curve stunt," he rumbled his admiration; "I get that peak trick now."

"I may have these?" Fenner queried, "I'll return them at the termination of this business, of course."

Forbes nodded. "And is there anything further to be brought up? If not, I'll wish you good evening. I am relying on you in this matter."

Fenner and I arose as Forbes and the chief made their adieus. When the door had closed after them, he turned whimsically to me. "Great old world," he laughed; "now what do you think of that?"

"Looks mighty serious for somebody riding high in City Gas," I replied, soberly; "somebody is stooping to dabble in pitch, and is due to be nastily defiled."

"You and Davidson make quite a team," laughed Fenner, in mock admiration; "because Forbes suggests a possibility, you are both busily engaged picking a jury and speculating on the extent of the sentence."

"Dead open and shut," I retorted, for to me it was obvious that the only persons who could benefit by this in reality trifling steal were the heads of the suspected corporation. "Bet you a quarter we're knocking on their door before tomorrow night."

Fenner wheeled, power charts in hand. "Bet you the niftiest amplifier we can get the De Forest people to turn out, that the only reason you'll have to knock on City Gas' door will be to apologize," he said.

"You think that someone else, and not they, are doing this thing?" I cried, amazed.

"Don't think it, I know it," he retorted, "I mentioned that James' dope merely to show Davidson something of Forbes mental processes, not because I favored the theory."

"And why not?" I demanded.

"For the same reason that I would not suspicion them of doctoring their gas meters to give a dishonest reading. Too many people involved, and too much chance for leak. The president of that corporation—or any other executive officer—is too darned busy to do more than conceive a plan of that kind. He hasn't the time—and ten to one, not the ability—to execute it. And he would not dare entrust such a mission to easily bought subordinates."

"Surely you don't regard this thing as an accidental *ground* that forms by coincidence at just that hour each morning?" I flung at him.

"It would be possible, yes," he came back, coolly. "But I am willing to take the linemen's word for it that they have scrutinized every point where grounds would be likely to occur. Which leaves us just one other hypothesis."

"Which is?" I demanded.

"Theft by an individual, or individuals, of power for some purpose."

"Yes," I jeered, "A purpose that must be served at one forty-five each morning, and which is apparently satisfied in under two minutes. Some nut, I presume, who goes forth in the wee small hours to test a freak motor."

Fenner's face clouded. "That's just what gets me," he said, thoughtfully, "The duration of the peak. I can't possibly think of anything that would require such an awful bundle of juice for such a short time. There's something I want to think of—something that seems to escape me. There is one thing that I can mention that would require such a load, and only one thing that I could suggest off hand."

"Which is?"

"I'm not going to mention what it is just now," came the disappointing rejoinder, "It happens to be weaker than the City Gas theory. And as I don't think much of it myself, I'm not going to get you confused by adding it to your already acrobatic mind."

Knowing him as well as I did, I did not urge. The hour was late, and we parted for the night.

We sallied forth next morning with no very definite end in view. About the only definite objective was a trip over the lines to see what we might be able to stumble over.

Passing thru a quiet block on our way to the nearest car line, we beheld a huckster actively engaged in disposing of his stock in trade, which seemed to consist entirely of fish. He was selling from a discrepit looking push cart, and as we past he quoted a price to the housewife he was bargaining with.

Fenner grasped me by the arm. "Gee, that was cheap," he said.

Amused, I bantered. "Didn't know you were up on the value of fish," I laughed, "Versatile, aren't you?"

"I know that was cheap," he retorted, "And I'm going to send that fellow around to the house. Come on."

We went back to the push cart and its odorous load. Finisht with the woman at the door, the fish merchant came over to us.

He was not a very prepossessing individual. He was a young man, but dissipation had written with a heavy hand, and the bloated countenance told loudly of an altogether too intimate acquaintance with the "cup that cheers."

Having heard his prices, Fenner gave him his address with instructions to mention the meeting. Then as an after thought, he added, "Have you a telephone? I might need fish for a special occasion in the near future, and if I could get you in a hurry you might land a sizeable order."

"I ain't got a telephone, mister," the chap replied, "But I live at number nine Juniper Street. Send me a post-card, and I'll be right on the job."

Fenner carefully noted down the address, and as we rode along on the car I remarked. "Now what? Going to treat a bunch of radio fiends to a fish lunch? You wrote that address down as if you treasured it."

"In these days of high prices I cherish anything that is cheap—even fish," came the unperturbed reply.

"And where are we off to now?" I demanded, anxious to get to the business in hand.

The reply was startling.

"To the zoo," replied the amazing Fenner.

"The zoo," I echoed, blankly. "What in Hades do you expect to find in the zoo?"

"Animals," he said, demurely, "We will feast our eyes and minds on nature's wonders. The traction company has provided the transportation."

"What becomes of the peak in the power curve?" I snorted. "Are we going to twiddle our fingers?"

"We are—until this evening. Then we will sally forth and endeavor to put an end to this peak."

"We will sally where?" I demanded, "Just take a guess?"

"Yep, but I think we can do some very close guessing, at that. That's all you get 'till tonight."

And so it was that I left the car barn that evening with a party consisting of Davidson, Forbes, a plain clothes man, and

ourselves as much in the dark as the rest of them.

Fenner directed our activities. We transferred to a car bound out into the open country.

Noting the mystified look on Davidson's face, Fenner laughed. "Don't look like the road to the City Gas office, does it?" he bantered.

Davidson growled. "If I didn't know you as well as I do, I'd say it was the road to nowhere, with just nothing waiting for us at the end. However," he shrugged, "It's your party."

At Fenner's command, we dropt off from the slowed down car at a dark, lonely spot in the open country. In silence we stumbled single file over a narrow path thru the scrub at his heels.

Then, a hundred yards or so from the track, a clearing—and the river.

There was a quickly extinguished flare from Fenner's electric flash-light, then comparative darkness again.

"Eleven forty-five," said Fenner, in low tones, "We have a couple of hours wait. No talking and no smoking, please."

"See here—" began Davidson.

"Until this expedition fails, I'm in charge, Chief," said Fenner, quietly, and with a grumble Davidson subsided.

And for two hours we crouched there in exquisite discomfort, gazing mournfully out over the river, rather beautiful in the moonlight, viewed from our dark tree-covered bower.

My feet had been asleep about a century when I felt Fenner's fingers closing over my arm. At the same time I sensed Davidson's bulk tensing in the darkness beside me. Both of them heard the rustle of parted branches along the pathway beyond. It had escaped Forbes and me.

Heavy breathing, and a blacker bulk moving in the blackness before us. With bated breath I watched its shadowy movements. Fearful of even the sound of my own breathing, I was half stifled from an effort to live on a minimum of air.

Then the bulk retreated toward the river, and presently, silhouetted in the moonlight at the clearing's edge, we got a glimpse of the man's form. Something about it was familiar. Memory struggled to assert itself.

I felt Fenner lean over me to touch Davidson. Then he stept forward.

"Fish are cheap," he remarked, loudly.

The man whirled, and in that instant I placed him. The fish dealer of the morning. There was a startled oath, a quick gleam in the moon light, a blinding flash, and a red hot sear on my cheek. A thunderous report, and another stunning one at my very temple.

Dazed for a moment, I could not follow clearly what happened in the next few seconds. I was vaguely aware that that second concussion had been the roar of Davidson's automatic.

When I saw clearly again, Fenner and Davidson were bending over a huddled form on the river bank. Forbes joined them, and I followed slowly.

He was dead, poor devil. Davidson had drilled him clean in a vital spot. The Chief was shaking his head. "I didn't mean to do that," he said, sorrowfully, "I'm a dead shot, and I shoot before I really get a chance to think. It's automatic."

"Well," said Fenner, soberly, "I had no idea he'd shoot, or I would never have staged this little drama. Anyway, Mr. Forbes, there will be no more peaks in your power curves."

Forbes' voice trembled. "What was it?" he queried, "What was he doing?"

"Fishing," replid Fenner; "fishing with your five hundred and fifty volt trolley wire for bait. He's placed something—an old water boiler, most likely—out there in the stream, and all he had to do was turn on the current and go out and make his haul."

"But my linemen examined the line down this way and found nothing unusual," cried the bewildered Forbes. "How did he get the current?"

"Easy enough," rejoined Fenner, shortly. "A sixteen foot bamboo pole with a bare copper wire hook on the end arranged in one of the trees skirting the right of way. He had only to hook it on the trolley wire, and come on down here to his switch."

"And when you saw the fish this morning," I asked, "you could tell they had been caught this way?"

"No," admitted Fenner, "I could not. But the price suggested some easy method of getting them, and it occurred to me that this method would fit in with that one thing I refused to name to you last night."

"Which was that?" I asked, mopping the blood from my cheek with a handkerchief. "I don't get it yet."

"Electrocution," retorted Fenner. "And I knew that was ridiculous. But when I saw the fish and heard the price it set me thinking. I knew this was the only place where the car line touched the river bank, and I came down here tonight on a chance."

Editor's Note: Mr. Wolfe's story is based on well known facts. By directing a powerful current into a body of water containing fish, the latter will be electrocuted by the hundred whenever they come into the path of the current as it traverses the water. The killed fish then float to the surface and are easily gathered. Such a method of "catching" fish is manifestly unfair, as not only full grown but the very small fish are killed alike. If such a method is used frequently, the stream or lake will soon be depleted entirely of all fish.

For that reason most of our states have prohibited fishing by electrocution and many states punish offenders with severe fines and even imprisonment.

CORRECTION NOTICE.

Thru an error in the August issue, credit for the photos accompanying the "Synthetic Ruby" article by Mr. O. Ivan Lee, was given to Heller & Son, whereas the credit for the use of these photos should have been given to L. Heller & Son, Inc., an entirely different concern.

* * *

In the "Synthetic Ammonia" article by Lucien Fournier, appearing in the September issue, the abbreviation "Az" is the French equivalent to our nitrogen, and this should have been explained in the original article; also the word "separation" in next to the last sentence of the first paragraph of this article, should have read *combination.*

ARTIFICIAL WOOL.

According to a Belgian report, there is considerable interest in Germany in a patent recently taken out on a process for the manufacture of artificial wool. Shreds, short fibers and wastes are comprest and then immersed in a viscous solution of cellulose or a cellulose compound, with a small percentage of glue. This product is then cut into thin sheets and strips, which can be twisted and spun very much as paper yarn has been manufactured.

Waterproofing is obtained by treating the wool in the process of manufacture with compounds of chromium and later with formaldehyde and tannin, after which the product will resist the action of boiling water. Glycerine provides sufficient flexibility, and the Germans claim the yarn thus prepared possesses all the properties of real wool. The process is now being modified so that a certain percentage of paper pulp may be mixed with the woolen waste, after which the product is treated with sulfuric acid and zinc chlorid. Various other compounds may be used to give the necessary flexibility and waterproofness.

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.

IMPORTANT NOTE TO CORRESPONDENTS

We receive from thirty to fifty letters requesting advice on patents every month. Due to lack of space, even tho condensing this department into the smallest type, we can only publish from eight to ten letters, with their answers, monthly. Obviously we are falling back further and further, and it looks as tho we will never be able to publish all the requests.

For this reason we would urge correspondents to avail themselves of our special service, as outlined above. In that case an immediate answer will be assured.

EDITOR.

WALNUT BRANDER.

(410) J. E. Carlson, Edgewater, N. J., says:

Please let me know whether or not a patent can be obtained on a simple walnut branding machine. It is very cheap to manufacture and works perfectly. It can be run by a small motor and is made of two parts, one feeding hopper and one receiving hopper, two rollers, two branding rollers and two automatic inkers.

A. Walnuts in order to be branded do not present very smooth surfaces, and it is necessary that a branding machine be of such a nature to brand *between* the crevices of the nut. Also, it is desirable to brand at least 80,000 per hour.

The machine must not injure in any way the kernel of the nut nor is it allowed to crack the shell.

If your machine lives up to these conditions, we would advise that you have a search instituted by a reliable patent attorney.

SECRET TELEPHONE.

(411) C. F. Cummings, Akron, Ohio, writes:

Has there been invented a telephone box or arrangement which permits two parties to talk over the same wire to which other phones are connected without other parties listening in? Is it possible by this supposed new invention for two of those parties to talk to one another without any of the others being permitted to listen in? A company with headquarters supposedly in Columbus, Ohio, has sold stock in a concern of this kind to some of my friends. I have felt that it was a swindle and would like to get your idea on it.

I do not know the brokerage firm selling stock in this concern, but if such a thing has never been invented I shall certainly get busy and look into it.

A. The writer knows of three or four devices on the market which will prevent anybody from listening in on a private telephone wire. In fact, we would even venture to say that thirty or forty such devices have been patented, but they do not seem to meet with any great favor by the telephone companies, who have refused to allow the installation of such devices, and hence we do not believe that you will profit materially from buying stocks in a concern selling material of this nature.

We do not know of the patent in question, but would advise that you get in touch with some brokerage or other concern of similar nature or write to your local newspaper, who will be able to tell you the actual value of stocks of this nature.

PERPETUAL MOTION.

(412) Arnold Whitock of New Castle, Neb., has the following to say:

What are the requirements of a perpetual motion machine? Has any machine been constructed which would run itself alone? Would a machine run by gravity alone and developing *surplus* energy to an appreciable extent have any commercial possibilities? Please don't dismiss this question by saying that it is impossible, because I have tried it. Are there any awards awaiting the inventor of such a machine? Thanking you, and hoping to see an early answer in SCIENCE AND INVENTION.

A. There is no such thing as perpetual motion on earth. You can no more obtain perpetual motion than lift yourself by your own boot straps. As long as you are dependent upon the gravitational influences of the earth, you cannot hope to produce energy free. The nearest approach to perpetual motion are the heavenly bodies, as for instance, the earth, moon, etc., which keep on spinning without diminution year after year, century after century. Strictly speaking, however, this is not perpetual motion either, because the rotation will stop some time, altho this will be maybe a million years from now.

Some machines have been actually constructed that approach perpetual motion, but they really do not come under this classification, because they use some natural force, and this of course is not perpetual motion, because a perpetual motion machine is supposed to require no outside energy whatsoever, but generate all its own power. For instance, there is a clock in existence at present that works by expansion and contraction of metal rods due to the inequalities of the temperature. Then there is another clock that works on a similar plan due to expansion and contraction of an air body, which again makes use of the difference of temperature during the day and night. But such machines cannot be termed perpetual motion machines for the reason that they are dependent upon an outside force.

FUSE PLIERS.

(413) Frank Kunert, Detroit, Mich., writes us as follows: For quite a while I've had an idea for a pair of pliers for extracting 30 and 60 amp. cartridge fuses from panel boards and fuse boxes. Sometimes there is not much extra room in fuse boxes and a man new on the job will shy at taking the fuses out with his fingers, so will try to pry it out by using a screw-driver or a piece of wood, which generally results in a ground, as only one end of the fuse comes out of the fuse-clip and that swings against the side of the fuse box. Would like to know if any such pliers have ever been patented and if there would be a market for them in case a patent was obtained.

A. We have seen some wooden pliers in use that actually did the thing you mention, and these pliers, as far as we are aware, have not been patented. We do not know what sort of pliers you have in mind, and unless they are rather unusual we doubt whether you could obtain a patent on the device.

WATCH WINDER.

(414) Archie C. Bowers, Gardenville, N. Y., submits the following question. Do you think that a small motor for winding a watch, with gearing, enclosed within the watch, is a patentable idea? A friend of mine, a jeweler, is making the works for the watch. They are of the size used in a wrist watch. From the winding gear on the spring, gearing is connected to make the motor more powerful. I am making a model of the tiny motor. It is a copy of the small motor described in the "E. E." during 1918 or 1919. A searchlight battery is used for power. Applying power for a minute winds watch.

A. There are at present commercial watch winders on the market, but as far as we have been able to ascertain they are not in great demand. It is such a simple thing to wind a watch that unless you have a jeweler's shop where hundreds of watches are to be wound every day the device will not be in great demand except by jewelers and watch factories. While no doubt you can get a constructional patent on your idea, we doubt whether it would pay you to do so.

FURNITURE ROLLER.

(415) Harry Schiff, Brooklyn, N. Y., sends us the following idea for patent advice: I would appreciate it if you would give me, through your magazine, an opinion on a device I have in mind to take the place of the wheels now used on the legs of furniture such as beds, buffets, tables, phonographs, etc., to make it easy to move such objects. The difference between my wheel and those now in use is that my wheel uses a ball as a means of propelling, which ball is capable of turning in any direction with perfect ease instead of the wheel which other wheels have, thus making it possible for them to turn with ease in only two directions—backward and forward. I am convinced that as wheels are but a trivial item in the cost of an article of furniture, this wheel will quickly take the place of those now in use. The point on which I want to be advised is its mechanical value. I am enclosing sheet containing a description of the device.

A. The device of which you speak is not new. It has been used for many years, but due to the large friction set up it has never come into popular favor, and is not used today. If you can make some special ball arrangement which works easy, and which has not too much friction, we believe you will have a good thing. So far it has not been produced.

TIME SWITCH.

(416) W. A. Kauder, Jamestown, N. D., requests the following information: Please let me know thru your "Patent Advice" columns if it would be practical to obtain a patent on a "time switch." My idea is such that a light will remain lighted for about 20 seconds after the switch is turned off. Would there be much demand for such an article? Its use is obvious, as, for instance: Get ready for bed, push the button and get into the quilts. After you're all "comfy" out goes the light. The "on" button works instantly and the "off" button can be made to do so also at will by placing three buttons in the switch instead of two.

A. There is a good market for a time switch such as you describe. There have been some switches of this sort on the market, but we have never seen one that worked satisfactorily, and which was low enough in price to commend attention from the average public. If you have something new in this line that works well and can be sold at a low price, you should have success.

WAR DEVICE.

(417) Mr. B. P. Hine, Athens, Ala., writes: While "overseas" I had the opportunity of trying out a "listening-in system" that proved very successful. Also had it so prepared that any unknown party handling it, it would explode, throwing into the air poisonous gases. This was of my original make-up, and I could take the sound of footsteps very clearly through this instrument, and all other faint sounds or whispers not heard otherwise in our personal work. As this was just an experiment and not completed or applied for use I would like to know if there is any chance for this as a commercial value or valuable to our army. Give me an idea as to how, when and where I could apply for aid on such an article, as my financial and mechanical conditions limit me in the completing of an actual model, as it takes some few expensive electrical equipment.

A. There are many listening-in devices—the so-called detectophone instruments on the market today. The idea of the instrument giving out poisonous gases when used by an unauthorized person is a pure war device, and would of course hardly be used ordinarily by anyone. For that reason we are almost certain that you would have a hard time to convince anyone to back you financially to produce such an article.

LADDER.

(418) O. R. B., Worcester, Mass., sends in a drawing of a platform to be mounted on a straight ladder, so that paint or other material could be placed on a side platform, or even workmen can stand on the same, instead of using the ordinary straight ladder,—the platform being adjusted to any angle of the ladder and collapsible.

A. Platforms of this nature are nothing new, and we do not believe a patent could be obtained on same. Many hardware companies in Greater New York are selling such ladders at the present date.

Solving the Housing Problem

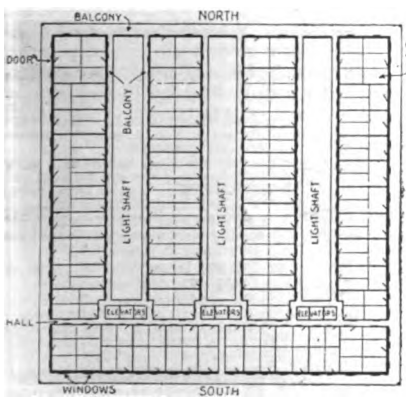
By H. GERNSBACK

(*Continued from page 652*)

are needed badly. The writer who was much impress with Mr. Edison's prediction is the sponsor of the following plan:

Why not move the city bodily into the country, taking all of the city conveniences with you, yet having all the country conveniences, but neither the inconveniences of the city, nor the inconveniences of the country?

Imagine a big co-operative building set up in the midst of the country, close to the woods if you wish, near a lake or a stream, and not too far away from a rapid transit railway station within commuting distances from the city, let us say twenty to thirty miles from any one of our large cities. Picture a 40 or 50-story building, housing, let us say 2,000 families. From our illustration, it will be noted that there are two distinct sections to this building. *The bottom stories are given over exclusively to business,* while the *upper stories are for residential purposes only.* The entire building is *self-contained.* By the words "self-contained" is meant that the building is like a city unto itself.



Floor Plan of Composite Town and Country House Suggested by Mr. Gernsback as an Aid in Solving the Housing Problem.

2,000 FAMILIES IN ONE HOUSE.

The 2,000 families living in this building will give enough business to the business section to keep it going on a profitable basis. Whether you wish to buy a steak or a pound of nails, whether you desire a hair cut or to cash a check at the bank, whether you wish your vacuum cleaner repaired, whether your clock needs fixing, whether you wish an ice-cream soda, whether you need your chair upholstered, or whether you require a dentist, or a chiropodist, or wish the latest magazine, or whether your wife wants a new dress, or if you need a prescription filled—all of these and more are to be had right in the house. The business section will give good service and sell you merchandise or services vastly cheaper for the following reasons.

In the first place, the cost of delivery is practically nil. You will not see a boy with his delivery wagon and horse nor a push-cart, for that matter, in this co-operative building. Consequently the cost of delivery is at a minimum. All goods sold to tenants of the co-operative house are distributed by means of dumb-waiters, the same as is done now in up-to-date apartment houses. Suppose you wish to order a porterhouse steak. You lift up the hook of your telephone and the *house-central* will connect you with the butcher you patronize. You give him your name and apartment number. He takes the order, and within fifteen minutes you have your steak *via* an electric operated dumb-

waiter. Your wife will not have much marketing to do, and she will not have to run around in a hot sun or blasting cold, wasting one or two hours of her time to buy the various things for the table. Note also from the butcher's or grocer's standpoint that all he has to do is to step into the hallway where the dumb-waiter shafts are located; all he has to do then is to place the goods on the dumb-waiter and press a button which rings a bell in your apartment. The dumb-waiter automatically stops at your apartment, and no other one. You take off the goods, push another button and the dumb-waiter goes down, ready for the next customer.

NO RENT FOR TRADES PEOPLE.

How do we establish the various trades people in such a co-operative building? In a very simple manner. First, we could readily fill the stores and business places of such a house without much trouble, once they were assured that they were to have a community of 6,000 souls to serve EXCLUSIVELY. But we do better. The management of the house will allow these trades people to have their places of business *rent free* as a great inducement. This is done for two purposes. First to reduce the cost of the merchandise or service rendered, and second to make them anxious to stay in such a community. In order to make things interesting, our co-operative building will have two competing lines of trade. In other words, there will not be more than two butchers, two drug stores, two hardware stores, two electricians, etc. The reason is simple. If there was only one, he might not give such good service as if he had a little competition. It will also tend to keep prices at their correct level. Of course, the management or the board of directors or the "mayor" of the house—if you wish to call him such—will see to it that the two butchers or the two hardware stores do not enter into a combine in order to exploit the tenants. *This is also the reason why no rent is charged the trades people.* They have no permanent lease. If the management of the co-operative house finds that unfair tactics are used, the trades people can be dispossest at once on short notice. All these things will tend to keep prices down and service up; far better than is the case today in the average community, where things are handled very loosely, *and only for the benefit of the trades people themselves.*

As for the goods and supplies themselves, these of course come by train direct from the city, and here again we have a saving. Take your present butcher in the city. He buys from the wholesaler, who himself maintains a distributing station. It means a double handling. Your butcher on the other hand in our co-operative building buys his goods directly from the big distributing centers, and they come by train and are therefore only hauled once. Another saving. All this saving goes to the tenants who therefore will be enabled to buy their supplies, goods, etc., at a more reduced figure than is possible now.

YOU ENTER HOME FROM OUTSIDE.

Coming to the apartments, these are laid out in such a manner, that all of the rooms have sufficient light and air. (See illustration of ground plan.) By studying the ground plan of one of the floors, a great innovation will be noted. All elevator halls lead to the outside balcony running around the house on every floor. *Access to any apartment is had only by way of balcony* from the outside. No door opens inside of the house.

An important feature of the co-operative apartments is that they are all built on, what is now called the "California plan" unless the tenant wishes it otherwise. The California plan means that *there are no actual bed rooms in the apartment.* We have nothing but living rooms, dining rooms, parlor, etc., but no real bed room.

The illustration which we reproduce elsewhere shows this better than a lengthy description. The idea is simply that the bed swings back into a small alcove, which also is used for dressing purposes. Beds at the present time take up a lot of room unnecessarily and all of this is done away with. Such apartments are actually in use in all of our large cities where room is at a premium.

Turning to the kitchen we will have many conveniences. The present housewife, particularly when she has no help to fall back upon, becomes a drudge and slave to her work. No more washing dishes for her; our apartment will have a steam-operated dish washer, which not only washes the dishes, but dries them from the heat of the steam, and the dishes, forks, knives, et cetera, come out sterilized and perfectly dry and clean. Our kitchen besides the usual hot and cold water has running ice water as most up-to-date hotels have now. Nor is there ice in the ice-box. Instead there is a "snake" which supplies freezing cold at any time day and night. If you wish ice, all you need do is to place a dish of water inside of the ice-box, and within three hours ice is formed. Make ice-cream the same way. Such installations are now in use in many New York City, Chicago and Cleveland apartments.

RAILROAD IN BASEMENT.

All apartments are of course steam-heated in the winter time, and here again the management will make a big saving for the reason that it is easier to buy coal in twenty carload lots than buying it by the truck-load. Furthermore, the distributing charge again is low, for there is no expensive city trucking. Indeed, a railroad siding runs right into the basement of the house *via* a short "subway," so as not to mar the surroundings of the place. *The coal is delivered from the railroad cars direct into the coal bins of the house.* The cars being dumped automatically, the handling charges are therefore reduced to the very minimum. Ashes and refuse are returned on the same cars. If the house is located near a stream, things will be even better, for then all electricity can be derived by hydro-electric power and the building need not be dependent upon a central power plant nor have to genarate its own electricity by burning expensive coal.

GLASS BALCONY WALKS.

An innovation of the co-operative house is that each floor is surrounded with a glass bottomed balcony. If you wish exercise and do not wish to go down to *terra firma,* you can run a short marathon around the apartments of your floor. Of course, children can play here as well, if the weather permits, and there will not be any dust either. The balcony in the evening is lighted up electrically so you can walk around, or if you care, place a steamer chair outside your parlor, and take the air. The glass bottom is necessary so as not to cut off light from the apartments below.

Due to the fact that most of the apartments are so high up, there will be little bother with either dust or insects. It is well known that neither of these rise very high in the air. The absence of dust, particularly is a boon to the housewife. Thus the present country house must be dusted every day, and even then it cannot be kept clean. All of this is done away with to a great extent.

Of course, all other conveniences of the city are had in this house. We have our own theater, a first-class moving picture house accommodating 2,000 people at one time. We have our gymnasium, our open air dining rooms in the summer time and closed in the winter time; our skating rinks, our indoor tennis courts, dance hall, swimming pools, and finally on the top our conservatory *de luxe* with its own weather bureau. Natural plants and a fairy garden all by itself, as well as a roof garden and a

small restaurant all rolled into one. Here is where we can entertain our friends, or if we have been sick we can convalesce in the sun parlor with or without our attending trained nurse, supplied from the house hospital.

As for the tenants themselves, for many reasons it would be desirable that *the apartments should be sold outright* as is now done in our great cities. In other words, you do not rent your apartment any longer—you buy it outright, and then of course you can do anything in it you wish—making any alterations that you care to, etc. It is just like buying your own house. You understand that you will have to pay for your electric light, elevator service and other services, and taxes, just as you would have to pay were you to own your own house. This plan has been tried and is now flourishing, particularly in New York City, where many tenants are buying their own apartments. This means that they are independent and no longer have to worry about increases in their annual rents.

FARMERS SELL DIRECT TO YOU.

Now as to the outside, it will be seen from our large illustration that we are right in the midst of the country; farmers are all about us tilling the soil and selling the produce at low cost to our own trades people and *there is no middleman or distributor that costs money.* We get fresh corn, fresh potatoes, fresh fruit, etc., without the usual expensive storage and without hauling them over great distances. Consequently the price is astonishingly low.

Outside, we also have a co-operative garage where all the automobiles of the tenants are housed. Further, we have the children's playground as will be noted, and the tennis court as well as golf links are not missing. We also have a flying field so if you own your airplane, you can land right near home. If you have neither automobile nor airplane, you can take the auto buses that run to the railroad station which meet all incoming and outgoing trains, and which bring you to the city and to your office in less than three-quarters of an hour.

Let us suppose some syndicate with a capital of seven or eight million dollars would erect such a building or for that matter half a dozen of them in the suburbs of either New York or Chicago. Have you any doubt that these houses would not be filled to capacity within two days?

X-RAY NOW ROBS MARRIAGE OF UNCERTAINTY?

Marriage no longer needs to hold terrors and uncertainty for the future. X-rays have scientifically solved the problem of positively ascertaining the character, disposition, tastes and special traits of any individual—so says Doctor Maingot, noted French X-ray specialist, in the *New York Journal.*

The old-fashioned character reading from the human hand is unreliable, whereas X-ray examination of a person's breathing gives an absolutely accurate picture of that person's character as well. The results of such examinations have proved true in every instance. Well! Well!

A jealous woman breathes differently from a good sport.

Would-be brides and bridegrooms should submit to medical X-ray examinations before taking out marriage licenses, in order thus to make sure that they are suited to their respective mates. Photographs of the movements of the diafram never lie.

But what if the M. D. is your rival? What he'll tell "her" about you!!!?

WEATHER BY RADIO.

The University of Wisconsin is working on a plan to give Wisconsin farmers weather forecasts by wireless telephone.

Farmers within one hundred miles of Madison, who install an inexpensive wireless telephone receiving outfit will be able to receive the new service at a certain time every morning.

Radio Power Transmission

By SAMUEL COHEN

(*Continued from page 637*)

the frequency which the equipment has already been designed for. This second problem of frequency conversion is just as important as the problem of transmission from the transmitting source. Of course, it is possible to design motors, controlling apparatus, et cetera, for the frequency of the incoming high frequency currents, thereby doing away with the second problem. This will only hold true for new installations; for old power installations the second problem must be considered from an economical point.

Thirdly, a system of this nature must be directive or else proper legislation must be provided to prevent every "Tom, Dick and Harry" from tapping the transmitted energy which is passing thru our free ether. This could be remedied by the use of properly concealed apparatus which no one can build except the company controlling the system. This, however, is quite impossible and the writer does not believe that apparatus and equipment secrecy can be maintained for any length of time. It is quite possible, however, with proper government legislation to protect the company from being robbed of its ether transmitted energy by unlawful means. This of course will come at the proper time, when the system will be put into effect.

The new art has hardly been touched upon, and it will take quite a number of years before we shall see a workable system for the transmission of energy thru the ether medium without the use of any conducting wires.

ELECTROMAGNETIC TRANSMISSION OF POWER ABOUT 2 PER CENT EFFICIENT.

From data obtained it seems that the greatest efficiency attained was that of 2.27 per cent, energy being transmitted at a distance of *twenty feet*. From the above it is evident that the equipment necessary to furnish electrical energy and transmitted by radio thru medium distances as in present practice would be gigantic, and it is quite doubtful at the present time whether suitable apparatus can be made with our present knowledge of the subject.

In order to fully appreciate the above facts, the author will disclose some of the work he has conducted in this direction. Altho the work was of a miniature nature, the data, experience and knowledge obtained from this work was sufficient to result in some very important findings.

Some time ago the writer was asked to design and build a powerful loop radio transmitter for signal and energy transmission purposes. With no or little data on this subject, it was therefore necessary at first to evolve certain mathematical equations and study the problem from a theoretical point and compute the fundamental requirements for the proposed system.

It was rather surprising when the theoretical computations were completed and the construction of the apparatus followed thru the guidance of the theoretical work that the final result of the tests of the equipment verified conclusively the theoretical assumptions in the problem. Every step of the theory was, therefore, carefully checked by actual tests, and it was rather interesting to note the resemblance of the data obtained from theoretical and actual tests.

DETAILS OF THE APPARATUS BUILT BY THE AUTHOR.

The complete apparatus is shown in the accompanying photographs. Fig. 1 shows the complete installation consisting of power

source with its controlling elements, the transmitting loop and an auxiliary piece of apparatus which will be described later for denoting the intenstiy of loop field.

The power source consisted of a 5 kilowatt (5,000-watt), 500-cycle (1,000 reversals per second) inductor type alternator, separately excited and driven by a 110-volt direct current motor. Both of these are inclosed in the same frame case as shown in Fig. 3 which is a rear view of the panel. The motor and generator field rheostats are both mounted on the main control panel. The generator armature is protected from high potential surges by means of a condenser protective device. The motor starter is of the remote control automatic type and is mounted on the panel indicated in Fig. 2, being a front view of the control panel. The meter on the panel is a frequency indicator, this being used to ascertain the resonant frequency of the *loop circuit* and that of the generator. The two large fused switches are used to connect the input D.C. supply to the motor and output generator current respectively. The generator field which is externally excited is controlled by the small double pole switch.

The resonant condenser which is linked with the *transmitting loop* is one of the mica dielectric type and both are mounted on the back of the panel shown in Fig. 3. The large grid resistance shown below the condensers is a protective line resistance in the generator circuit. The jack at the base of the power panel shown in Fig. 2 is used to connect the loop proper to the power source, this being by means of No. 4 stage cable, as shown in Fig. 1, which is fitted at each end with a plug. A corresponding jack is placed on the loop frame as perceived.

The transmitting loop which is shown in Fig. 4 is eight feet square and fourteen inches high and wound with No. 6 flexible cable in multiple layer form. The frame was made from one-inch oak and the total loop weight approximated 150 pounds. The total measured inductance of the loop including the connecting cable was .02455 henry. The two large mica condensers, both of which were connected in parallel, had a total capacity of 4.13 mfds. These values of inductance and capacity had a resonant period at 500 cycles. The current circulating thru the coil at resonance was 65 amperes.

RECEIVING APPARATUS LIGHTS LAMP AND RUNS MOTOR

In order to ascertain the intensity of the field surrounding the loop transmitter, an apparatus is shown in Fig. 5 which consisted of a large inductance wound around the frame; within the frame were mounted a bank of five lamp sockets each fitted with twenty-five-watt tungsten lamps. A mica condenser shunted across the inductance, a small series motor and a double-pole switch which connected the lamps and motor across the inductance and condenser were connected in parallel in order to produce current resonance. The measured values of the inductance and capacity were .159 henry and .637 mfd., respectively. The resonant frequency of this combination was 500 cycles.

Having noticed the value of the current transversing the loop coil and the value of its inductance, one may readily ascertain the intensity of the magnetic field. One may picture the intensity of the field, when the writer states that he was able *to light up the five incandescent lamps to normal brilliancy and run the motor at top speed when the receiving frame containing the lamps and motor was moved twenty feet from the transmitting loop!* This of course was accomplisht when the transmitter was tuned to the exact resonant frequency of the re-

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Radio Power Transmission

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ceiver, which was 500 cycles, and when both transmitting and receiving coils were both in a parallel plane.

In accomplishing the above results the input was 6,000 watts and the output measured at the receiving end was 165 watts, or an approximate efficiency of three per cent attained at a distance of twenty feet from the transmitting source. From this figure the reader will fully appreciate the inefficiency of such an apparatus used for energy transmission without the aid of wires. However, this apparatus should not be taken as the criterion for the solution of this important subject by any means; and the final solution of this problem will depend upon the use of powerful electromagnetic waves emanating from the transmitter instead of using the principle of induction upon which the above apparatus was specifically designed and built. But the work accomplisht with this apparatus serves to show in a clear, definite manner that but little is to be expected apparently from further developments along these lines; i. e., by means of electromagnetic transmission of power.

How We Smell

By JOSEPH H. KRAUS

(*Continued from page* 628)

unable to analyze the two. This is particularly demonstrated in the use of what is termed an olfactometer, just a simple tube having a container at one end which is inserted into the nostril when air is inhaled, so that it passes over the odorous substance into the nostril.

Again, certain odors are a good deal more penetrating, perhaps due to their diffusibility. 1/100 mg. of mercaptan diffused in 230 cm. of air is still distinctly perceptible. Each liter of air would then contain only .0000004 mg. of the substance and the amount in contact with the smell cells would be even smaller.

A curious feature is that air containing even such a small proportion of an odorous substance absorbs radiant heat to a very much greater degree than pure air. Perhaps this may be the reason that we distinguish the sense of smell, or perhaps as Aronsohn points out, it is due to the fact that the odorous substance is soluble in the fluid content of the nose. In either event it is the stimulation of the hair cells in the top of the nose which forward such a communication to the brain.

SCIENCE BAFFLED BY SCENTS

Some time ago there was held in England a "Wonders of Science Exhibition" which served to reveal many marvels to the public unfamiliar with the work done with the microscope, the microphone and the micrograph.

The microphone magnifies sound as the microscope does things seen. The micrograph is the instrument used by the scientist in taking pictures of things shown by the microscope. More people are familiar, to some extent, with the microscope than with the microphone. They know it is possible to make objects entirely outside of the range of natural human vision visible by the use of the telescope for great distances, and by the microscope for minute things close by; but few have any knowledge of the device by which it is possible to hear a fly walk or a caterpillar crawl.

Many other wonders of science were shown at Surbiton, but neither there nor anywhere else has science demonstrated its

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Reporting Yacht Races via Radio

By DONALD McNICOL

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Put yourself in the position of one of these men and suddenly hear the rapid dots and dashes being transmitted. The signals read: "*Shamrock* leading, *Resolute* five miles to the rear and off the course." A minute later, "Captain Adams (the skipper of the *Resolute*, the American Cup Defender) has something up his sleeve as the *Resolute* suddenly comes up with a fresh breeze, shortening the distance between itself and the *Shamrock*, gaining one-half. Nine more miles to the finish."

Then the Blimp starts "talking" via radio —"We have swooped down upon both vessels, the *Resolute* having gained another one-half mile over her rival. It seems to be the *Resolute's* race." A minute later, "The breeze falls, *Shamrock* has the advantage. *Shamrock* spreads fiddler jib. The American crew is much faster than the British crew at handling of the sails. *Shamrock* proceeding ahead rapidly, being seven minutes twenty-seven seconds ahead of *Resolute*. The *Resolute* will have to travel a little faster in order to make up the time allowance of a little over seven minutes. *Resolute* jibs at 5:28, *Shamrock* one minute later." And then quite a lull during which time the excitement of everyone at the receiving instruments is such that their eyes are fairly popping out of their heads. Pencils are clutched nervously as the slightest sound disturbs them.

After each message had been recorded it was immediately given to a boy and rushed downstairs post-haste to the pressroom where it was immediately hammered off in presses to get out in the earliest "extra." At last, the intermission is broken again by several more taps and the minutes seem like hours.

One more message and it would all be over. "Here it comes; no, not yet." Another wait and then two words, "*Shamrock* wins!" Thus were the radio messages of to-day transferred to and from the fleet which surrounded the International Cup Yacht Races and are already in the papers long before even those who have actually viewed the races have debarked from the vessels. In fact, those who were there can, by the time they come home, actually obtain copies of the papers containing the complete news of the contest which they have seen perhaps scarcely an hour before.

A key and relay connected the office of the *Evening Post* with the Radio Corporation's transmitting set at West Street, and messages were directly transmitted to the U. S. S. *Goldsborough* from the station shown in the photograph. The relay can clearly be seen in the center of the table.

BORDEAUX RADIO CIRCLES GLOBE.

The first message from the new Lafayette radio station at Bordeaux, France, the product of American inventive and scientific genius, was received at Washington, D. C., August 22d.

A message to Secretary Daniels was the first ever sent from the Lafayette station. It was received here by naval wireless. The message read:

"This is the first message to be heard around the world and marks a milestone on the road to scientific achievement."

The statement that the message was the first to be heard around the world draws somewhat on the imagination. It actually traveled 24,000 miles, the length of the earth's circumference. It went 12,000 miles east and 12,000 west, literally bumping into itself at a point above the earth's surface directly opposite Bordeaux.

How We Smell

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ability to help the sense of smell. It can do marvels of sight, hearing and touch, but not for the humble and useful nose. In that field the accomplishments of science have been nil.

Let a man stand two miles, say, to windward of the point where a herd of caribou will cross an open plain over which a fresh breeze is sweeping and it must be apparent that only an infinitely minute particle of whatever matter may be given off from his body or clothing can possibly reach the nostrils of any one deer in the herd. Yet, if the man is completely screened from sight by a rise in the surface of the ground the caribou will nevertheless catch the taint in the air. They would be warned of the presence of a wolf in the same way.

Yet science is utterly unable to detect anything which the olfactory nerve of the deer senses and identifies. It cannot see with a microscope anything in the air which came from the man. It cannot find any such substance with a chemical test of any kind. Instead of aiding the sense of smell, it is entirely incapable of matching it. Here is another realm for science to invade and subdue; but would the conquest be altogether desirable? It is a question whether the average man needs to smell more things or sense more acutely the things he smells already. It is thought that the gains would not offset the losses under the prevailing conditions of life.

THE DETECTION OF PLATINUM THEFTS.

The news service of the American Chemical Society has issued a bulletin describing the arrest of two men while attempting to dispose of 280 troy ounces of platinum *sponge*, the porous state of the metal. They had left small lots with two different firms who, having circulars concerning various thefts, notified the authorities. The Bureau of Standards last March had lost 73 ounces in the form of laboratory ware valued at nearly $11,000, while in December, 1919, the Roessler & Hasslacher Company of Perth Amboy had missed $5,000 worth of the metal in the form of sponge. Several universities had also complained of platinum thefts.

The exact composition of definite consignments of platinum is fairly well known to chemists, the slight variations being due to traces of other substances, such as iridium. Chemical analysis indicated that the seized supply had come neither from the New Jersey plant nor from the laboratory of the Bureau of Standards. In its quality it closely resembled the stocks at the War Department plant in Nitro, West Virginia, where the inventory showed there should be 5,800 ounces of sponge, and also the stock of 13,800 ounces at a government military plant at Jacksonville, Tennessee. As some of the platinum at Nitro was known to contain a large percentage of palladium, that supposed to be stolen seemed to have come from Jacksonville. There the metal was of exceptional purity, as it contained 99.58 per cent of platinum, with slight traces of iridium, rhodium and iron. Its texture was uniform except that here and there were lumps of a yellowish brown substance, which on ignition yielded platinum sponge and gave off fumes of chlorine. It was learned that an order had been given at Jacksonville to turn back large quantities of platinum chloride into sponge. Then came a thoro search. In eighty-six cans in the safe was found a substance supposed to be platinum, which on examination proved to be a mixture of mercury with ordinary moist dirt.

GERMAN RADIO-TELEGRAPH DEVELOPMENTS.

In order to supplement the ordinary telegraph system and to serve as a substitute in cases of extensive breakdowns of the telegraphic communication, the German State Ministry of Posts and Telegraphs is establishing a comprehensive State Wireless System. The State Wireless System is being constantly extended. Bavaria and Württemberg will also be linked up in the system by the establishment of transmitting and receiving stations in Munich and Stuttgart. The Ministry has also established in Königsberg, East Prussia, two transmitting and two receiving wireless stations in order to render independent of the "Polish Corridor" the telegraphic communication of East Prussia with the remaining parts of the State. At the present time the main traffic passes between Königsberg and Stettin and between Königsberg and Berlin. Other developments are projected, and it would appear that the Government is determined to make its telegraphic service as independent and self-contained as possible.

Simplest Long Wave Receiver

By ELLIOTT A. WHITE

(*Continued from page* 641)

A large antenna cuts down the size of inductance required, to a marked extent. As the author's set is portable, he has carried it around and tried it on several open antennas and has been surprised to see what a small portion of the coil must be in circuit, with a 500 or 600 foot antenna. The figures here given are for an average small sized amateur antenna, of around .0003 mfd. capacity.

The principal novelty in this set lies in the use of a *single, tapt honeycomb coil.* This coil, recently put on the market and widely advertised, is remarkable for its compactness, low resistance losses and low distributed capacity. It has been an ideal coil except for one defect: it is made only of fixt values, necessitating several sets for various ranges of wave length, thus adding prohibitive expense and objectionable complexity of parts and mountings. The idea of tapping these, however, is new, and makes the coils universally useful.

For the long wave set here described, the largest coil, that of 175 millihenrys inductance, is used, in order to make sure that the set will tune to the longest waved stations on any antenna, no matter how small, without loading condensers, tho the next size smaller (and on very large antennas, many sizes smaller) is large enough in most cases, the next size having 125 millihenrys inductance. Of course with loading condensers, as noted above, a much smaller size may be used.

The 175 millihenry coil is wound with No. 28 solid wire or with 5-36 "Litz" (stranded cable). The former, which is recommended, is 2 inches inside diameter, 4 inches outside diameter and 1 inch thick, thus giving a winding section 1 inch square. The wire is wound in layers, crost and spaced, so that taps can easily be taken at the edge of the layers wherever desired (Fig. 3). To make a tap, a smooth sharp point is forced under the wire where it bends out at the edge of the layer (a round divider point is suitable), and enough pressure applied to break the varnish and enable the wire to be bowed out away from the coil about 1/16 inch, for a space of about 3/16 inch. More than this or rough handling will break the wire and ruin the coil. In the case of the solid wire coil, a strip of thin mica is slipt under this loop to insulate the joint and to prevent scraping the insulation of adjacent turns. The loop is then scraped carefully and the

insulation slipt back, leaving a bare space of about ⅛ inch. No more is necessary. The tap is made of some small wire, such as No. 24, by scraping it clean of insulation for about ¼ inch at the end and bending the end into a small hook. This hook is bent tight around the bared loop on the coil, and neatly soldered, using very little solder. The mica shields the other turns from the heat of the iron. If it is desired to make a dead end at any tap, for a dead end switch (tho this seems superfluous), the wire loop on the coil may be clipt and a tap wire soldered to each of the ends left by the cutting. Altho making these taps is easy, it must be done carefully, for if the wire is broken the whole coil is thereby made useless. Ordinary care is sufficient.

In the case of the 'Litz" coil, the tap is made by prying out the wire at the edge of the layer, as before, and then cutting the loop sharply with scissors or end-cutting pliers. Some flux is then daubed on the ends thus left, and the *ends* of the strands are tinned by putting on a large drop of solder which will make contact with the end of each individual strand of the enamel wire. The tap wire or wires may then be soldered to this drop of solder. It is not possible to *scrape* the individual strands, as the ends are too short, but the cutting bares all the ends and leaves them clean for tinning. However, the solid wire coil is recommended, as the "Litz" offers little advantage at the longer wave lengths, and the longer the wave length the less its advantage, besides there is the increased difficulty of making the taps.

For the set described, to make sure of going down to below 2,500 meters on a fair-sized antenna, the first tap should be made one-sixteenth inch out from the center, measuring from the inside edge of the coil (In these coils it is not possible to count the individual layers, so that the measuring must be done instead.); the next at ⅛ inch, the next at ¼, the next at ½ and the last at ¾ inch from the center. The inside and outside terminals of the coil (A and B, Fig. 3) are already accessible at the soldered plug terminal, which may be removed or not, but is better left to hold the coil together and keep it from being injured. The author received Arlington, 2,500 meters, on the tap ¼ inch and even 5/16 inch from the center, with a loop antenna of considerable size (a 50-turn helix 4.5 feet by 7 feet), but the lower taps are handy to have available if they are wanted, tho three or four taps are usually enough (see paragraph at end of article). Thus a multi-point switch, of from four to seven points, is all that is needed for the inductance—giving a wide range of wave lengths without changing the inductance at all, and leaving practically only the one adjustment, that of the tuning condenser C1.

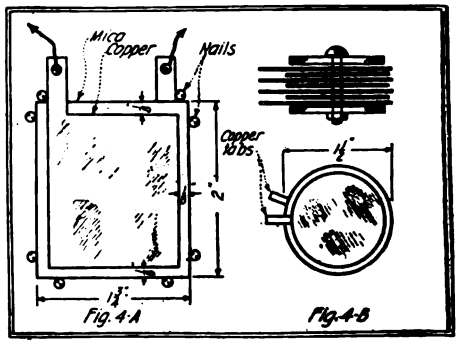
There are several ways of handling the tap leads after they are made. One way is to run them thru sleeving (old round shoelaces with the string core pulled out make good sleeving) across the face of the coil, then across the outside edge of the coil under the fiber binding strap which clamps them down solidly. Another way is to drill small holes along the edge of the fiber strap opposite the tap points, thread the bared ends of flexible leads thru these holes, solder them into a compact terminal and solder the small tap wires to these, with a strip of mica or tape underneath to prevent injury to the edge of the coil. This makes a good solid job. Small metal punchings, or even small brass paper clips, may be fastened to the edge of the strap instead, for terminals. Another way is to remove the fiber strap entirely; but this leaves the coil exposed to injury. The taps should of course be staggered across the face of the coil to keep them from rubbing and short circuiting on adjacent

tap-loops. The mica strips slipt under the loops, under the soldered taps, should be made long enough to extend clear across the face of the coil, so that the tap wires may lie on them, as the coil is not very heavily insulated and is easily damaged, in spite of the thin varnish. Shellac may be put over the mica and tap wires when the job is finished.

It should be noted that this scheme of making taps on the honeycomb coils applies equally advantageously if a more complicated set is used, with primary and secondary, or primary, secondary and tickler, thus saving several sets of coils and saving the change of coils for various wave lengths. In that case the flexible tap-leads may be bunched and taken to switch points on a multi-point switch on the base or panel, whichever mounting is used. It also applies to making a short wave set of these honeycomb coils, where a tap may be taken from every layer, since No. 24 and No. 25 wire are used in the solid wire coils of 20 millihenrys inductance and under.

BUILDING THE TICKLER COIL.

The design of the *tickler coil* depends on individual taste, whether it shall be of the push and pull, slide, swing, hinged or rotating type. It may be a flat pancake that slides or swings across the face of the



Details of Condensers Used in Long Wave Audion Receiving Set.

coil or hinges against it; or a small ball or tube may rotate inside the center; or a small tube may push into the center. Either of the latter is probably preferable to the first, on account of compactness. It is only necessary to remember that the hole in the center of the coil is 2 inches across and 1 inch deep, and that the tickler should have from 150 to 175 feet of wire on it.

The one in this set as illustrated is made of 170 feet of No. 32, enameled wire, tho No. 30 or No. 28 would probably be better on account of their lower resistance, wound on a little stiff paper cylinder 1½ inch long and 1⅝ inch outside diameter. (See Fig. 3.) A wooden, hard rubber or fiber rod or cylinder is good. The wire is wound on this in lump form, but spread out enough so as not to be of too large outside diameter. This may be rotated horizontally in the opening on one side of the inductance coil, or, very conveniently, it may push into the center on a brass rod or wooden skewer or dowel, or in a paper cylinder. In the set described the tickler was shellacked into a stiff paper tube which slides in a larger stiff paper cylinder shellacked into the center of the coil (2 inches inside diameter), which it exactly fits. The two cylinders fit each other tight enough so that the tickler will stay where it is put, whether the coil is standing up or lying down, *but not so tight as to make it move hard.* The tickler leads may be brought out thru a hole in the handle which is fastened to it. The tickler coupling is very important in bringing out loud signals: therefore it should not have a fixt degree of coupling, as is sometimes done. The coupling, however, may be left fixt and the

corresponding adjustment made by having the bridging condenser C3 a large variable, or a fixt and a smaller variable, or a fixt condenser variable in steps; but this increases the expense and complexity of the set and is unnecessary. In connecting up the set the leads from the tickler may have to be reversed, as the proper lead must be connected to the plate in order to secure the proper polarity of feedback and make the set oscillate. This can be quickly determined by trial. It can be determined in advance, but this will not be gone into here.

THE FIXT CONDENSERS.

The fixt condensers C2 and C3 are made of any construction or dimensions to give the desired capacity. Figure 4A shows a convenient size and construction. The plates are of tin, aluminum, copper sheet or foil; the dielectric of paraffined paper, empire cloth (oiled linen), or mica. The best mica (and none but the best should be used) can be purchased quite cheaply, either in large sheets or already cut to the size given, and then split with a knife into sheets of about the stiffness of a thin visiting card (accurate measurement of thickness can be made with a micrometer). Altho only trial will determine the number of plates to use, as the capacity varies inversely as the thickness of the dielectric, it may be stated that condensers of 2 and 2, and 5 and 6 plates were required for C2 and C3 respectively, to give capacities of about .00015 and .004 mfd. This means that for C2, alternate plates being connected to opposite sides, with mica between, and all the tabs brought out on the same side being connected together, 2 plates together on the left and 2 plates together on the right (the number of opposite surfaces is always one less than the number of plates) were correct; and for C3, 5 on the left and 6 on the right. This means that the average thickness of the mica must have been less in the latter, since the area of the latter to that of the former is as 10 to 4, but the capacities are in much higher ratio. If the mica sheets are half as thick they will give twice the capacity, and vice versa. Trial, however, will quickly determine the right number of plates. Paraffined paper is thinner than mica is usually split, but is likely to cut thru. Aluminum plates are good, but copper foil is better, as it can be soldered. In case the mica has been purchased in large sheets, the sheets should be cut with sharp shears first and split afterwards. The metal plates can be cut with shears, and the whole condenser stacked up conveniently by driving finishing nails in a board so that the mica sheets will fit between them, as in stacking up a transformer core. This will make a neater job. Two strips of friction tape should be laid on the board first, or even four, two in each direction, and the condenser built on them. After the condenser is finisht the bottom tapes can be folded over and wound tight, to remove the whole from the board. It can then be wound tightly with more tape, or clampt between pieces of hard wood or brass and dipt in sealing wax, paraffine or other insulating compound, tho both clamping and dipping are not important for ordinary purposes. Leads may be soldered to the tabs if they are of tin or copper; or riveted or twisted tightly thru holes drilled in the ends of the tabs if they are of aluminum. Figure 4B shows another type of fixt condenser which some prefer, wherein the dielectric and the plates are round washers with a hole in the center thru which passes a clamping bolt screwed up tight against two end washers of thick brass. This makes a neat little condenser, and the tabs can be soldered to switch points to make a fixt condenser, variable in steps; but this type is more difficult to construct.

(To be concluded in November issue)

READ THE CLASSIFIED ADVERTISEMENTS ON PAGES 700-703, YOU'LL FIND MANY GOOD THINGS THERE.

Building "Your Own" Phonograph

PART 2

(*Continued from page 630*)

The efficacy of the valve or modulator shown at C is approximately like "B," which is used on one of the best makes of talking machines. This modulator comprises a metal base-piece, as shown and to which is riveted or secured a piece of thick felt abou ¼ inch in thickness and extending abou ⅜ to ½ inch from the metal all around. The shaft on which this valve is mounted, passes thru two tightly fitted brass bushings or bearings, secured in the two side walls of the throat of the amplifying chamber. The action of this modulator is evident,—the tonal strength being a minimum when the valve is in the vertical position, blocking off the chamber completely, and at a maximum when it is turned to the horizontal position.

SOUND-BOX DETAILS.

For those endeavoring to build a talking machine as cheaply as possible, a good sound-box costs quite a considerable amount, and if you have a lathe or machine shop facilities you can build a first class sound-box yourself, or have the necessary parts machined up by a machinist at a nominal cost.

One of the simplest sound-box designs we can make, can be constructed from a watch-case telephone receiver as shown at Fig. 6. A metal hub forms one of the best ways of joining the receiver, whether it be metal or hard rubber composition, to the tone-arm tube. The diafram, either of mica, fiber—yes and tin has been used on some cheap machines—is clampt securely by the usual screw cap. Making a new cap of metal and threading it to fit the threads on a *metal* shell, will permit you to tighten it up, so as to hold very firmly the diafram; this is one of the all-important things in phonograph sound-boxes if you want it to be free from rattling and other unwanted noises when certain notes or chords are played, which noises often are the symptoms of a loose diafram, even on the best machines.

The support carrying the upright post for the pivot screws, which may be ordinary binding posts, is readily bent by heating the brass, or iron stock, it is to be formed of. The stylus arm can be cut from sheet brass or other material and cemented or riveted to the exact center of the diafram. The needle holder or chuck may be fashioned from a small binding post, but this is best made, of course, of the shape shown in the drawing.

Before going further, it may be said that the average diameter, that is, the *free vibrating diameter* of the diafram, in the average phonograph sound-box measures two inches, some a little less, while others are appreciably greater. The greater the diameter, the lower the pitch of the machine, while the smaller the diameter, the higher the pitch. A mica diafram usually measures about 6 mils or six-thousandths inch in thickness and is held between rubber gaskets as shown at Fig. 7. The sound-box design shown at Fig. 7, is one used a great deal among competition tone-arms, and as will be seen, it is very simple to make from brass or other metal,—the diafram being clampt between rubber gaskets, which may be formed of the two pieces of rubber tubing cut so as to exactly meet, end to end. The stylus pivot shaft can be the tempered steel shaft from a discarded alarm clock balance-wheel. With a little ingenuity, the tempered steel pivot cup-screws can also be used, by mounting them in larger screws which pass thru the stylus bearing posts as shown in the diagram.

The upper end of the stylus arm is in some cases, both riveted and cemented to

the diafram. Suitable cement such as that used for repairing china, etc., can be obtained from any drug store. Red sealing wax is excellent, too.

An excellent stylus and sound-box is illustrated at Fig. 8, and in the writer's opinion it is one of the most desirable. Here the diafram clamping ring is simply a circular brass ring threaded on its perifery to fit the threads which have been turned on the inside of the reproducer shell, and the finer the threads the better, as the pressure can be applied more firmly and evenly. To tighten up the ring or to release it, use is made in this case, of a special wrench to be made for the purpose. It is fitted with from two to four steel pins, depending upon how many holes are used in the ring. In the average phonograph sound-box, the distance between the diafram and the surface of the inner wall is about ¼ inch. Any sound-box made like that at Fig. 8, with a diafram having a free vibrating diameter of about 2¼ inches, gives excellent results and corresponds in size to the one now in use on the writer's phonograph.

Rubber gaskets, not shown around the diafram at Fig. 8, are invariably to be used to absorb extraneous vibrations.

Among the substances which have been used are fiber, silk tightly stretched, goldbeateers' skin, Bristol-paper, tin, and particularly German silver which gives very good results indeed.

A friend of the writer's recently obtained a patent on a novel improvement in sound-boxes which enables any machine to be adjusted as to pitch for different ranges of sound, thus adapting any given diameter diafram to low, medium or high pitch records. Briefly explained, it comprises an adjustable ring fitted over the diafram and reducing its free vibrating diameter; the smaller the diameter, the higher the pitch, such as for playing soprano or tenor selections; while the larger the diameter permitted, the lower the pitch, such as for playing baritone or base selections. Finally, if you want the sweetest music, try fiber needles, or cactus points.

The Electric Shoes

By J. MAC-RICHARD

(*Continued from page* 624)

package under my arm when a carriage past me in the Rue Varnier and I heard voices which seemed familiar. I recognized the officer and the Englishman. They were sitting close together and laughing boisterously.

That aroused my suspicions. At my hotel I put on the pair of shoes intended for the King of Italy and hurried down to the dinner table. I toucht several people with my toe. But none of them showed any signs of electric shock. They merely seemed annoyed at my awkwardness. I had to admit myself that my famous shoes were no more *electric* than any other shoes. I had been the victim of a comedy played by two clever conspirators.

My first impulse was to make a complaint to the police. But since the story would certainly have raised a laugh at my expense, I thought it wiser to say nothing.—*New York Tribune.*

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