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A New Giant

THE year 1919 has not been a very prolific one in great discoveries. But the greatest scientific achievement of the year 1919 and perhaps a decade, doubtless, was Professor Michelson's discovery of a method for measuring the size of stars.

Fixt stars are so far removed from us, that even the nearest one, *Alpha Centauri*, is so distant, that if we imagine a wire stretched to this star, it would take our voice four and one-third years to travel over this wire until the man at the other end of the telephone receiver would hear the first sound; altho we know that electricity travels at the rate of 186,000 miles per second. Professor Michelson succeeded in measuring the size of some of these stars, altho they are billions of miles distant from us. *Alpha Centauri* just mentioned is over four light years distant from us, meaning thereby that it takes light or electricity, both traveling 186,000 miles per second, over four years to bridge this tremendous chasm. While we know that all fixt stars are suns like our own, and for that reason are of tremendous proportions, the imagination is overwhelmed when we try to grasp the size of Betelgeuse, in the constellation of Orion, which Professor Michelson's researches recently made it possible to measure accurately. Betelgeuse, which is about 150 light years distant from the earth, is 40,000,000 times as large as the sun. In other words, if we were to place about 350 suns side by side, we would then have a star of the diameter of this new giant, Betelgeuse.

Figures of this kind, while tremendous, mean nothing to our imagination, because our microscopic minds simply fail to grasp them. The writer therefore wishes to give a few illustrations which will make the enormous size of Betelgeuse more apparent.

A man on the earth, let us say, weighs 150 pounds. Transported to the sun the same man would weigh 4,146 pounds, or over two tons. This is due to the greater gravitational attraction, just as on the moon the same man would weigh less than 25 pounds, the moon being much smaller than the earth. But on Betelgeuse the same man would weigh 2,494,146 pounds, or 1,242 tons, if we estimate that Betelgeuse has the same density as the sun, *which, by the way, it has not.*

Suppose you live on Betelgeuse and you have a friend living on the other side of that globe. You call him up on the telephone, and it takes your voice exactly 42¼ minutes to travel half way around Betelgeuse, altho electricity as we know travels 186,000 miles per second. In this case you would speak your message into the telephone receiver, go out and have lunch for over an hour, and when you returned the words from your friend would just begin to pour from your receiver.

A train traveling 60 miles an hour speeding along the equator without stopping would take 419 hours or a little over 17 days to complete the circle on our own globe. The same train on Betelgeuse running at the same speed would take 1,792 years to cover the trifling circumference. In other words, a train which had started during the downfall of the Roman Empire would just now arrive at its destination!

Betelgeuse is 52,630,000,000,000 times the size of our earth. This means nothing to our mind. If, however we asked you to count these billions of globes that you could tuck away into Betelgeuse, at the rate of 100 per minute, it would take one million years to count them all, not forgetting that each globe is the size of our earth.

H. GERNSBACK.

CONTENTS FOR FEBRUARY, 1921

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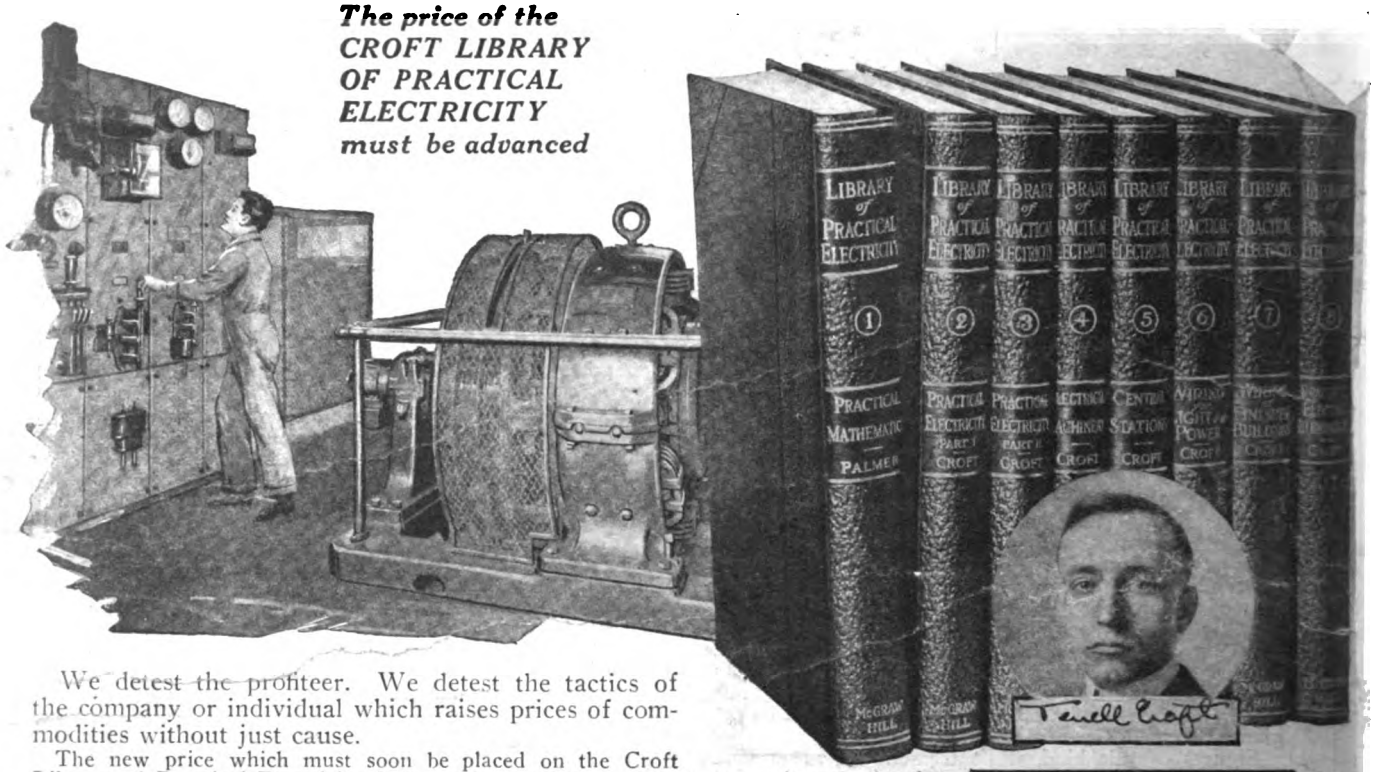

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Whole No. 94

Science and Invention

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

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No. 10

A Floating City

WE illustrate an interesting suggestion from a German contemporary, which the editor thereof terms a "Utopia of Karl Ammon," who probably got his idea from Jules Verne's "Floating City." The point is made that in the development of airplanes and dirigibles, great advances have been made in the art of producing light structures which at the same time are strong. This lightness is in the very essence of airplanes and dirigibles, and now in the present project, it is proposed to apply it to the development of a new mode of sea transport.

Four ships, each larger than the "Imperator" are decked in and provide simply room for the working crews for the machinery and for the motive power, and for some or all of the requisite fuel. Thru the body of each ship, starting at the deck, there is an inverted funnel-shaped structure, at whose apex near the keel, is a steel hemisphere forming one member of a massive ball and socket joint. A great platform or deck over fifteen hundred feet square, is carried by the four ships, the entire weight of the great structure resting on the four ball and socket bearings within the four ships.

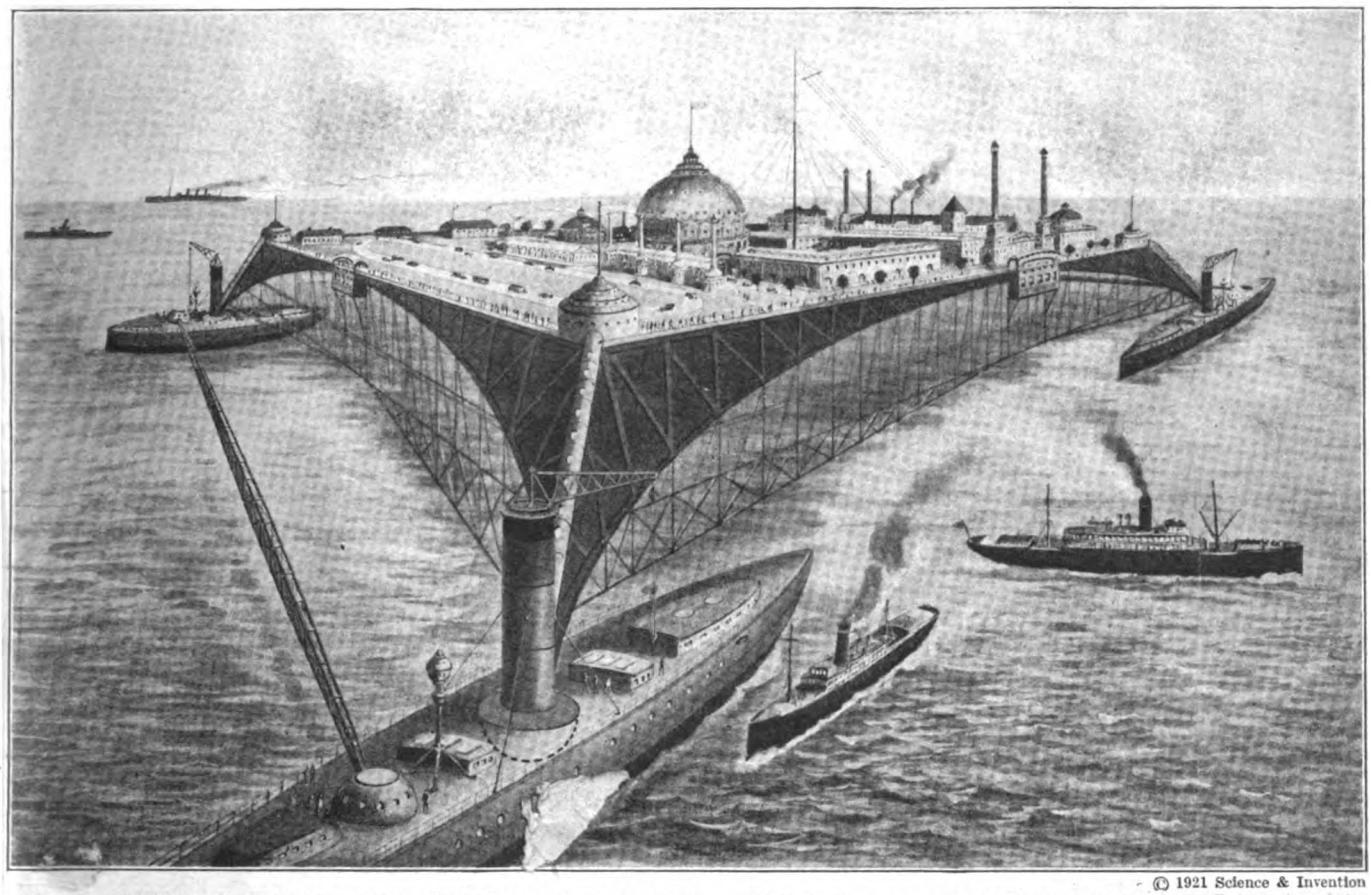
An auxiliary thrust strut is used to keep each pair of ships parallel. The result of all this is that the great platform will have very little motion in the heaviest sea way; the bearings on which it rest are in the part of the ship where the motion is the least and its length of side will also operate to minimize the motion.

On the deck, the imagination of the inventor exercises itself in the construction of hotels and other structures which may be accommodated on so large an area. It will be noticed that it is practically one-third of a mile square. Houses, shops, bathing establishments, theatres, a wireless station and the local telephone service are all supposed to be supplied, and there is to be a printing press to publish a daily paper and special announcements.

In short the proposer wishes to construct an actual *floating city*. Naturally it is claimed that there will be no sea sickness, altho one is free to doubt this. It is said that the traveler will no longer have the feeling of confinement to a small area, but that he or she can spend hours walking about the great deck, which it is claimed will take half an hour to walk around. The mere view of the raging sea from this practically motionless platform high above it will be a wonderful sight it is said.

Of course provision is made for any quantity of freight, automobiles and the like. Out of the funnel-shaped opening in each ship rises a great steel pillar and to this the trusses of the superstructure are secured. All the motion of the platform therefore that arises from the ship is the comparatively slight up and down

(*Continued on page* 1141)



A Floating "Atlantic City" May Be the Realized Dream of Tomorrow. The "City" Is Built on a Huge Platform Nearly One-Third of a Mile Square and Supported by Four Giant Steamships. The Supporting Towers Are Flexibly Mounted in the Holds of the Vessels.

Swiftest Things on Earth

IT is interesting indeed to compare some of the slowest moving things on earth with those which travel the fastest—the fastest thing we know, of course, being radiant light, and one of the slowest things, the human thumb nail which grows 2/1,000,000,000ths of a yard per second.

high horse-power just for the sake of demonstrating high speed in a race, but it is only one-half the horse-power developt by the Maple Leaf-V, which not only was 50 per cent longer in hull measurement, but carried four 450 horse-power Sunbeam engines.

The best speed attained by Maple Leaf-V,

necting New York and Chicago and other large cities to-day. These flyers develop speed in the neighborhood of 70 to 80 miles an hour, and average considerably lower than this.

Sixty miles an hour, or mile-a-minute speed has been proven and is now considered the safe high speed limit for passen-

The Fastest Thing in the World is Possibly the Cannon Ball, With a Velocity of 2,000 Miles Per Hour. One of the Slowest Moving Things Is a Tree Growing, or Also the Human Thumb-Nail.

Next, we may here consider tree growth, the bamboo tree growing at the extremely slow rate of 27/10,000,000ths of a yard per second. Now comes the proverbially slow snail which moves at the average rate of 15/10,000ths of a yard per second.

A man has walked in a record test, one mile in 6½ minutes, equivalent to the rate of 9¼ miles per hour. A man can run, as records show, at the rate of one mile in 4¼ minutes or at 13½ miles per hour. A man has skated at the surprising speed of one mile in 2 1/5 minutes, or about one half as fast as an express train.

The Fastest Boats

Next, we come to fast boats. One of the fastest vessels we know of, is the naval destroyer. Recent high speed tests have demonstrated that one of these ultra-powerful submarine spotters and destroyers can tear thru the open sea at the rate of 42½ knots, which is equivalent to 48 statute miles per hour. The gasoline-engine propelled motorboats of the hydroplane type have gradually outdistanced all other vessels which propel themselves thru or over the surface of the water.

The past year, *Miss America* eclipsed all international rivals and establisht a new world's record with an average speed of 76.655 miles per hour. This was the average of six tests,—three with and three against the stream current. This remarkable motorboat was built just large enough to carry the engineer and pilot, and was powered with two 450 horse-power Liberty motors. This may seem like tremendously

was during her trials when she attained 62.4 miles per hour. *Miss America* has a one step hydroplane hull, and reached a maximum speed in some of her runs, of 77.698 miles per hour, or almost 80 miles an hour.

One of the fastest things in the world capable of carrying a man, is the ice boat. Well built ice boats have attained a velocity of two miles a minute or 120 miles an hour on the Shrewsbury river course. These glide over the ice on runners, propelled by the wind blowing against a large sail. It is an exciting and adventurous sport. Our large ocean liners attain a speed of 26 to 30 miles an hour, but the average of the smaller passenger-carrying vessels is from 10 to 20 miles an hour.

High Speed Railway Trains

Railway trains, strange to say, have not shown us anything new in speed,—even those of the present day! It is peculiar indeed to note that (as pointed out by one of the consulting engineers of the largest locomotive concern in America), it is not considered or shown to be economical or practical at all, to drive a modern steam railway engine and train at a speed in excess of 100 miles per hour. Probably the fastest speed at which a steam engine and train ever flew over the rails, was in 1901 over a five mile run in Florida, when an engine and train attained a speed of 120 miles an hour, or 2 miles per minute. This speed record has never been exceeded, and has not even been approached by the far-famed "20th Century" railroad flyers con-

ger trains, whether on short or long runs for the past ten years, and those that have traveled by rail to any extent, know that this is about the highest speed rate on the average, tho the writer has traveled between Philadelphia and New York and clocked the speed with a stop-watch, when a mile was made in 34 seconds, or at the rate of 108 miles an hour for a distance of a few miles.

The fastest speed attained by electrically driven trains, either with locomotives or with motors on the coaches themselves, is 130 miles per hour, recorded in the tests made some years ago on the German electrified railway between Berlin and Zossen. The trains were tried with various shapes of wind shields fitted on the forward car in an endeavor to reduce the terrific wind resistance encountered at such high speeds, and finally, the trains showed a speed of 130 miles per hour over a measured distance, the highest ever attained by a railway train so far as we know.

Automobiles have carried man over the face of the earth at next to the highest speed ever attained. Tommy Milton, during the past summer, in his famous Duesenberg racing car clipt several seconds from the former world's motor records, including those of De Palma and flew over the measured course at the terrific rate of one mile in a little more than 23 seconds. This brings the speed of man's travel on earth up to 156 miles per hour, and to travel any faster than this, at least at the present time, we have to consider the airplane.

(*Continued on page* 1145)

A Niagara of Bubbles

IT is indeed rather astounding when one visits a large number of theatrical productions and sees the various widely diversified scenic effects, each one representing a new mark of genius. Undoubtedly one of the finest effects obtained in the production "Tickle Me," is obtained thru the use of soap and water. Not alone does it excel in scenic splendor, but is scientifically a feature well worth noting.

This play is the vehicle in which Frank Tinney is starring at the Selwyn Theatre, New York. The effect when the curtain rises is a stage flooded with soap bubbles, millions of them, which come pouring down a long flight of steps, as well as on both sides of the stage. There seems to be no end to them and billions of them are produced in a very few minutes. Of course, the bubbles are very small, probably not averaging over an inch in diameter, but their production in wagon-load quantities results in a scene of splendor hard to forget.

Colored lights play on them constantly, wonderfully enhancing the display. The girls in the play are then seen to romp around in this fairy-like ocean of seething bubbles. Shortly, out of the conglomeration of bubbles, one of the girls appears and descends the long stairway to the stage, pushing aside the white foamy wall until she reaches the stage proper.

The delightful comedy incorporated in this show and the pleasing costumes will not be discust in this brief description. The scientific question now arises as to how these bubbles are formed.

"Back stage," before the curtain rises, one can see the scene being hurriedly put in place. The scenic background consists of five distinct sections, each of which has a double tank approximately one foot high, one foot wide, and eight feet long attached to it. The tank itself is divided longitudinally into two compartments; the lowermost one being about 1½" deep and separated from the upper one by a sheet-iron partition perforated with countless small holes.

On top of this partition are placed shavings of Ivory soap and communicating directly with it is a small trough allowing water to be poured into the tank from behind the scenes. Hundreds of pounds of soap are used every day in the presentation of this novel feature.

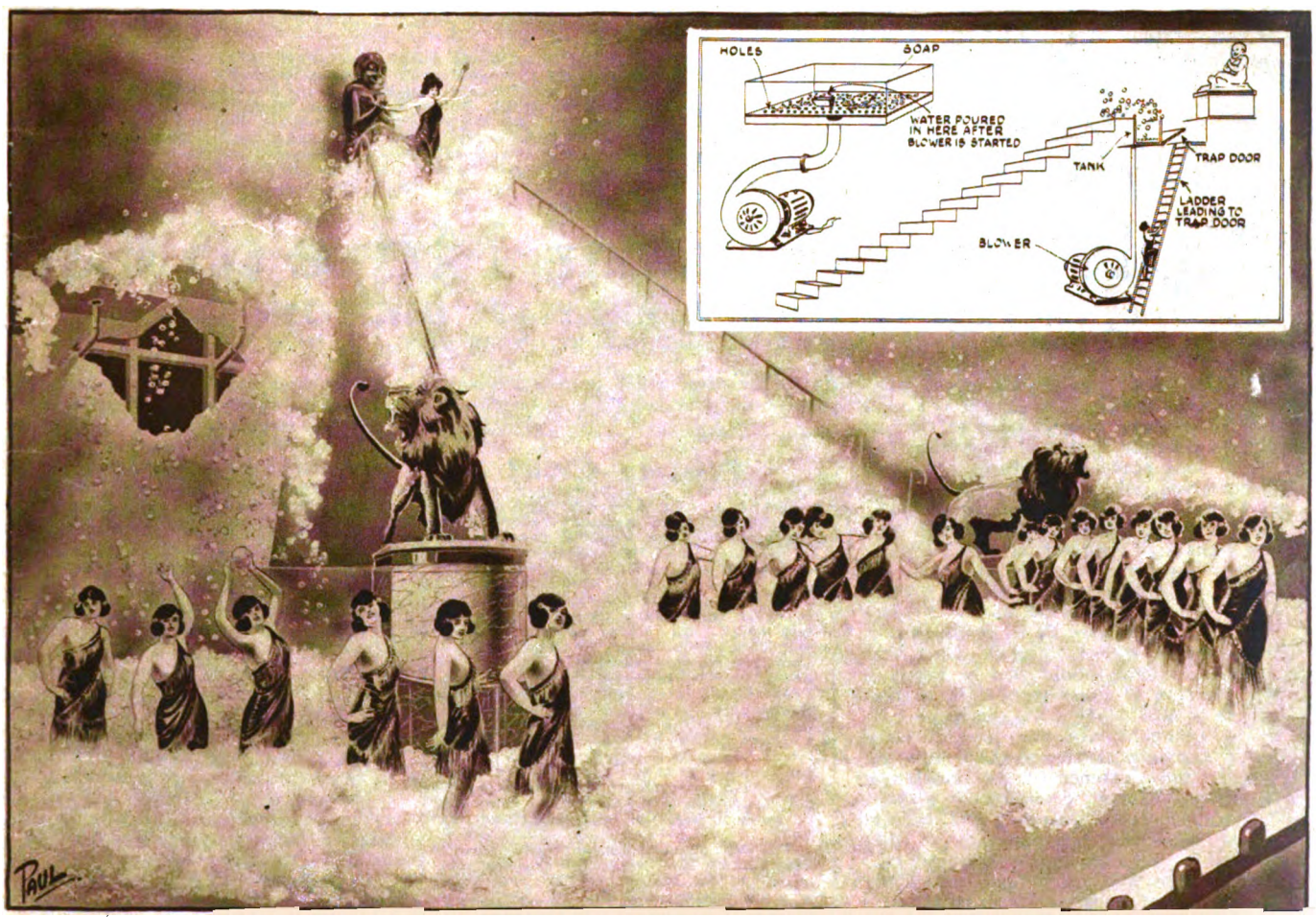
To the lower compartment is connected a pipe leading to a motor-driven wind turbine or pump as the illustration shows. Every two tanks are connected to a blower and arranged on the same background prop. The center tank has its own air blower, however, and is placed at the head of a stairway leading to the stage. In back of this center tank is a small platform fitted with a trap-door. A ladder leads to this platform so that at the opportune moment a girl can ascend the ladder, push aside the trap-door and at the same time wend her way thru a dense maze of soap bubbles, down the central stairway.

Of course, the audience does not see how this is done. They only see a girl appearing from the midst of the bubbling mass. So simple is the operation of the apparatus that it takes but a few minutes to fit it up and flood the stage with the rolling billows of bubbles. A gallon of water is used in each tank and poured into the trough after the motors operating the blowers have been started; immediate action results, and the white foam pours from the top of the tanks, which, of course, are left open.

Down the stairway these bubbles roll and spread all over the stage, while all five tanks contribute toward the production of great quantities of beautiful bubbles which roll down over the wall. A short time later, the curtain rises upon the scene.

At the close of the act, another strange occurrence takes place. Armed with brooms and brushes, the stage attendants flatten or pat out the bubbles and sweep them into a receptable provided for the purpose which is located under the stage and whose mouth opens on a level with the stage floor.

The bubbles must wet the stage you will say. Of course, they do, but even this has been protected with a canvas covering, the canvas being removed at the end of the act to allow for subsequent scenes to be erected and is replaced before the stage attendants leave the theatre so as to dry out over night. The fact that the holes in the partition dividing the tank are so small, and as the blower is operated before the water is poured into the tanks, prevents the water from flowing down into the blowers, the air pressure being too great to allow any water which might possibly pass thru the tiny holes passing down into the blowers.



"Novelty" I·
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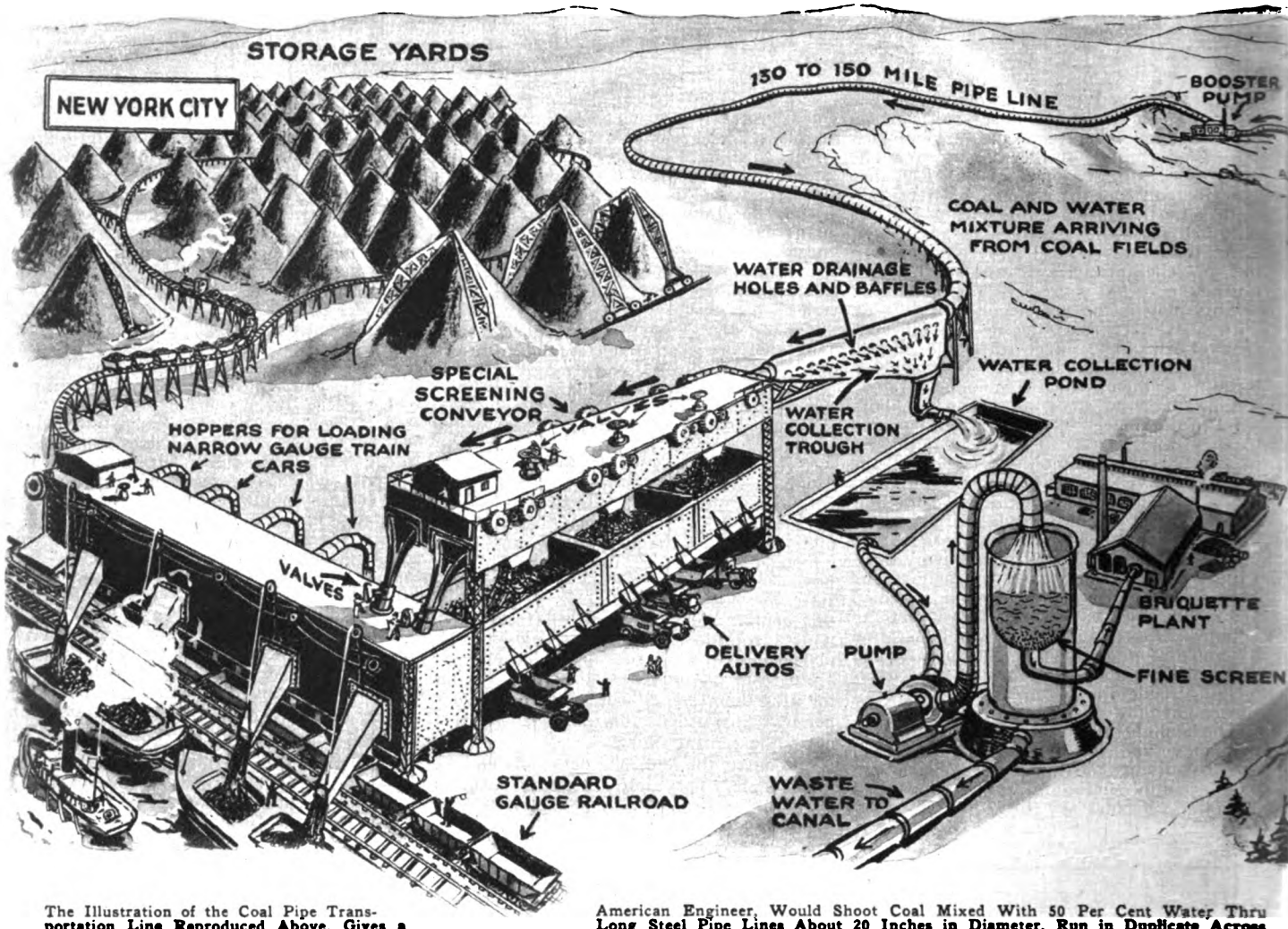


The Illustration of the Coal Pipe Transportation Line Reproduced Above, Gives a Clear Idea As to How Mr. R. P. Bolton, An American Engineer, Would Shoot Coal Mixed With 50 Per Cent Water Thru Long Steel Pipe Lines About 20 Inches in Diameter, Run in Duplicate Across the Country Direct from the Coal Mines to the Centers of Distribution. From the Pennsylvania Coal Regions to New York is About 130 Miles Air-Line Distance, as Mr. Bolton Pointed Out in An Interview, But the Distance Might Be Somewhat Longer When the Pipe Line Is Built, As It Is His Idea to Have the Pipe Run Along the Railroad Right-of-Way Which Would Solve Two Important Problems: First, It Would Undoubtedly Mitigate the Heavy Expense of Purchasing An Entirely New Right-of-Way for the Line; and, Second, It Would Automatically Share In the General Maintenance and Protection Afforded by the Regular Railway Personnel, Thus Preventing Tapping of the Line. The View Above Shows How the Water Is Separated from the Coal Thru Openings in the Pipe. This Water, Which Contains, of Course, a Large Amount of Coal Dust and Particles, Discharges Into Large Collection Ponds.

Piping Coal from Mine to City

By REGINALD PELHAM BOLTON
CONSULTING ENGINEER, NEW YORK CITY

THE fuel supply of a great community may be regarded as a vital necessity, second only to that of a supply of water. The latter has long been recognized as a problem to be solved only by the united action of the people, and the vast investment by the metropolis upon its present water system, although unremunerative from a mere monetary standpoint has been endorsed by public opinion on the ground of its necessity. In view of the disturbing conditions of coal shortage which now recurs every winter it would seem that concerted action should also be taken in this problem of fuel supply. The present system of coal delivery has reached a condition of inadequacy that has in recent years become a menace to the health, yes even to the existence of the population. It is the outcome of *undirected growth*. The transportation, handling and delivery to the consumer, are complicated; they require the accurate inter-relation of railroad, harbor and truck operations; they are dependent largely upon vicissitudes of weather in our variable climate, and they employ a variety of agencies, each adding a quota to the cost of the vital material, the expense of which has now risen to a point where its use becomes a luxury to the larger part, which is also the poorer part, of our population, let it be said.

Piping Coal

The bold idea here advanced by an American engineer, Reginald Pelham Bolton, for piping coal from the mines direct to the large industrial and social centers, may seem quite absurd or far-fetched to many of us. However, similar long pipe lines have been in use for a number of years for transporting oil and it undoubtedly will come as a surprise to most people to learn that the Standard Oil Company has had for some time a pipe line 1,500 miles in length carrying oil from Texas oil fields to Philadelphia, Pa., and Bayonne, N. J., great oil distributing centers. This line is composed of a steel pipe 8 inches in diameter, and the oil is forced into the pipe at a pressure of 900 pounds per square inch at the start of its journey. At frequent intervals, there are relay pumping stations along the line which pump the oil so as to keep up the pressure thru the line.

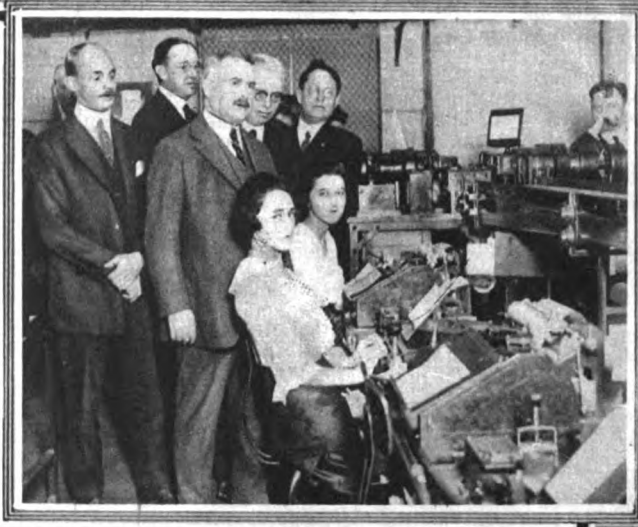
The coal pipe-line transportation scheme advanced by Mr. Bolton and recently submitted to the Mayor of New York City, who has referred it to the city engineering staff, is shown clearly in the accompanying illustration.

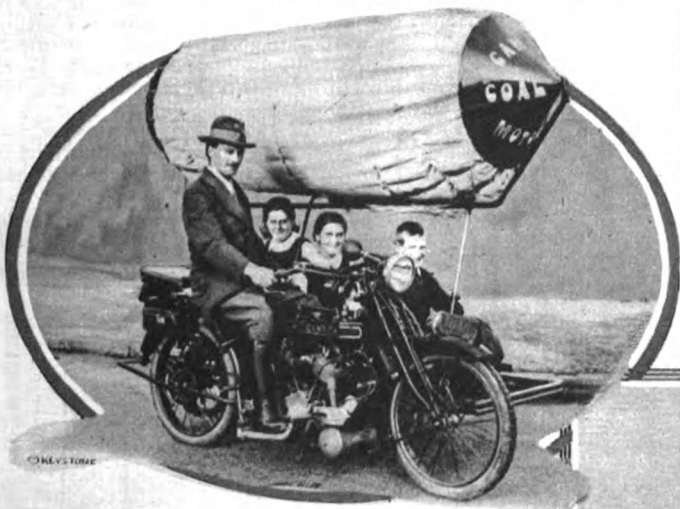
This important element in our domestic existence has in fact become as precarious as it is expensive. The exigencies of the city are not provided for in advance. The supply of coal is produced in response to trade demands, no provision is exercised to forestall excessive cold weather and such a situation is always liable to occur as was the case in 1918, when a severe spell of frost bound up the harbor just when the need for fuel was at the maximum. Our system of fuel delivery, more complex than that of water supply but almost of equal importance, is being conducted in a haphazard and uncertain manner at enormous expense and with grave anxiety to the community. The situation cannot improve but must grow increasingly complex as time advances and population increases, unless some new system be adopted that will simplify the methods of transportation, effect a reduction in expense and freedom from weather vicissitudes, and above all will provide an adequate provision in advance for the fuel needs of the city.

It seems time to consider whether some more adequate methods of dealing with this situation, and its probable future increase cannot be found. The fuel best suited for the purpose of domestic heating and the majority of the smaller industries is anthracite (hard coal).

IN PICTURES

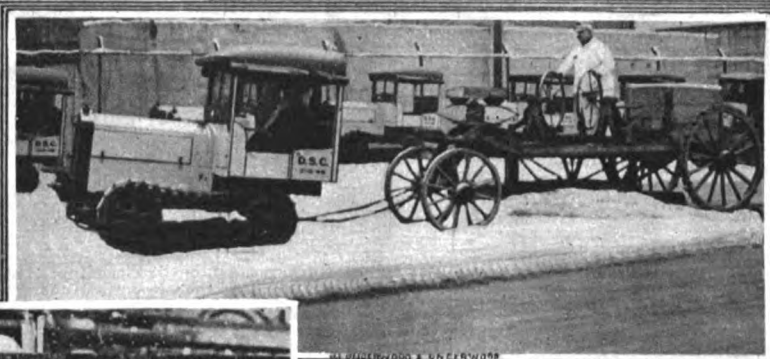
Direct Wire Communication Between New York and Seattle Was Inaugurated by the Western Union Telegraph Company Recently. Officials of the Company, Representatives of New York City and of the Chamber of Commerce Witnest the Sending and Receiving of the First Messages Over the Wire, Which Is 3,381 Miles Long. The Messages Are Sent and Received on Automatic Typewriters. A Tape Runs from the Typewriter to an Electric Sending Machine. This Photo Was Made in the Western Union Telegraph Company's Operating Room in New York.





A New Motor-Cycle Novelty With Side Car Driven on "Coal Gas." The First Motor-Cycle and Side-Car Driven by Coal Gas. The Cost of Running Is Two Cents for Ten Miles. It Has Been Driven 100 Miles and Works Very Satisfactorily. The Photo Shows How the Side-Car Can Be Used As a Pleasure, As Well As a Commercial Car. The Passenger Body Is Placed Under the Bag That Carries the Gas.

The "Flivver" Put to the Test in the Bleak North. The "Ford" Bids Fair to Become As Popular in the Snow-Covered North As It Has in More Temperate Climes, Following the Successful Operation of a "Motor Sled," Propelled by the Ford Motor, at Nome, Alaska. The Sled Is Capable of Traveling At Speeds Up to Thirty Miles Per Hour. The Motive Power Is Transmitted to the Rear Axle, Which Is Arranged to Drive Two Wide Slat-Covered Wheels. The Front Sled Is Pivoted and Enables the Driver to Easily Steer the Novel Vehicle.



Type of Snow Plow to Keep New York Traffic Open. The Police of New York City Are Already Receiving Instruction in the Operation of Snow Tractors, Built After the Lines of the Army Tank, Which Are Expected to Keep Traffic Moving This Winter. Plows Are Either Attached to the Front of the Tractors, Which Are Only of Twelve Horse-Power, or Are Pulled Behind Them. It Is Expected That the Tractors, Large Numbers of Which Have Been Obtained and Will Be Stationed at Various Fire Houses, Will Clear All City Streets in One Day.

A Rotary Windshield for Autos. This Rotary Windshield Was Displayed at England's Biggest Auto Show. When One Side of the Glass Becomes Dirty or Covered With Rain, It Can Be Whirled About and the Dirty Side Wiped Off and the Clean Side Used, Until It Is Time to Turn It Around Again. For Those Not So Fortunate As to Possess One of These Whirling Discs for Their Auto, They May Try Rubbing a Little Glycerine on the Windshield Glass. This Is Said to Prevent Snow and Rain Reducing the Clearness of Vision.

A Radiogenes

By CHARLES S. WOLFE

THE last train up in the evening—it put in its appearance, by the way, at 6:10—brought Mr. William Jones—no degrees—back to his native village.

William had behind him, to his credit or discredit, as you will, four years of roaming, done mostly on sundry tramp freighters. On these hoary-funneled free lances of the deep he had been known as "Sparks" because of the fact that he admitted that he was a wireless telegraph operator. Because of his ready admittance, perhaps, he had seldom been called on to prove it.

The village band was not at the station to greet him. Neither had the populace turned out in force. No one fell on his neck. The only thing that showed any desire to thus greet the prodigal were a dozen empty milk-cans, hurled by a hasty baggage master.

No one had killed the fatted calf. Nor did his father run to greet him while he was still afar off. As a matter of fact, the old man was in his accustomed chair in the kitchen when William and his suitcase blew in, and Dad greeted him with a non-committal "Hello, Bill."

And so, after supper, William wandered out of the front gate and over to the village store to see the boys, as had been his wont before he had journeyed forth to beard the world in its den.

As he closed the gate behind him, his eye fell on the house adjoining, and instantly memory recalled vividly the occupants.

"Fred Ashton," said William to himself, whimsically; "I wonder if he is as mean and shifty as ever, or is he meaner?" For previous and intimate acquaintance with Fred led him to expect the worst from that worthy, and we may note in passing that William was entirely justified.

His keen glance took in the details of the Ashton homestead, and being an observant young man, he noted something that would entirely escape the casual observer.

The rain spouts were gone! The long downward-leading pipes had been removed, leaving only short lengths leading from the roof gutters, and under these, on the ground below, stood barrels to catch the drip.

"Now that's funny," mused William, and then forgot it, as an old pal hove in sight. The affectionate greetings over, the twain hied themselves to the general store.

They found the clan assembled. William had previously learned from his companion that it assembled early of late, for a weighty and engrossing topic needed nightly threshing out. The male population of the village—and of the country at large, for that matter—was deeply interested in the outcome of a pending heavyweight fight for a championship.

One Punch Molinsky and Bruiser O'Brien were scheduled to pummel each other some three nights hence, and each of the Italians had a considerable following. In this particular village the factions, considered numerically, were about equal. Furious and loud waxed discussion, and William soon found that the sinful practice of wagering was not an entirely unknown pastime in these wilds.

Fred Ashton was there delivering freely his opinions of the outcome of the impending mêlée, but all efforts to get him to back his ideas with coin of the realm were futile. To all offers and taunts he merely grinned impudently, and said, "I'll place my bets on the night of the fight, and not before."

When the session broke up that evening, William, perforce, walked home with Ashton. He found him the same arrogant, overbearing Fred of [illegible]d whatever views Bill may have ent[illegible]ined regarding the ability of the two heralded contestants never got aired, for there was simply no place that they could be wedged in between Ashton's ever-expanding monologue.

William bade him a thankful goodnight at the gate, and made his way quietly to his room. His window opened out toward the Ashton residence, and as he sat there in the darkness, puffing a meditative cigarette, an upstairs window in the house across suddenly blazed into light. Watching idly Bill saw Fred enter and seat himself at a table near the window.

Suddenly, with a rather profane ejaculation, William Jones sat bolt upright in his chair, and for the next few minutes he gave Fred his undivided attention.

"And So It Came to Pass That on the Night the Fight Was Pulled Off, Fred Ashton Dropped Into His Chair Before His Instruments and Donned the Headset With Shaking Hands. All Unknown to Fred, in His Carefully Darkened Room a Hundred Feet or So Away, There Sat Also William Jones, Who Chuckled As He Watched Fred's Every Move."

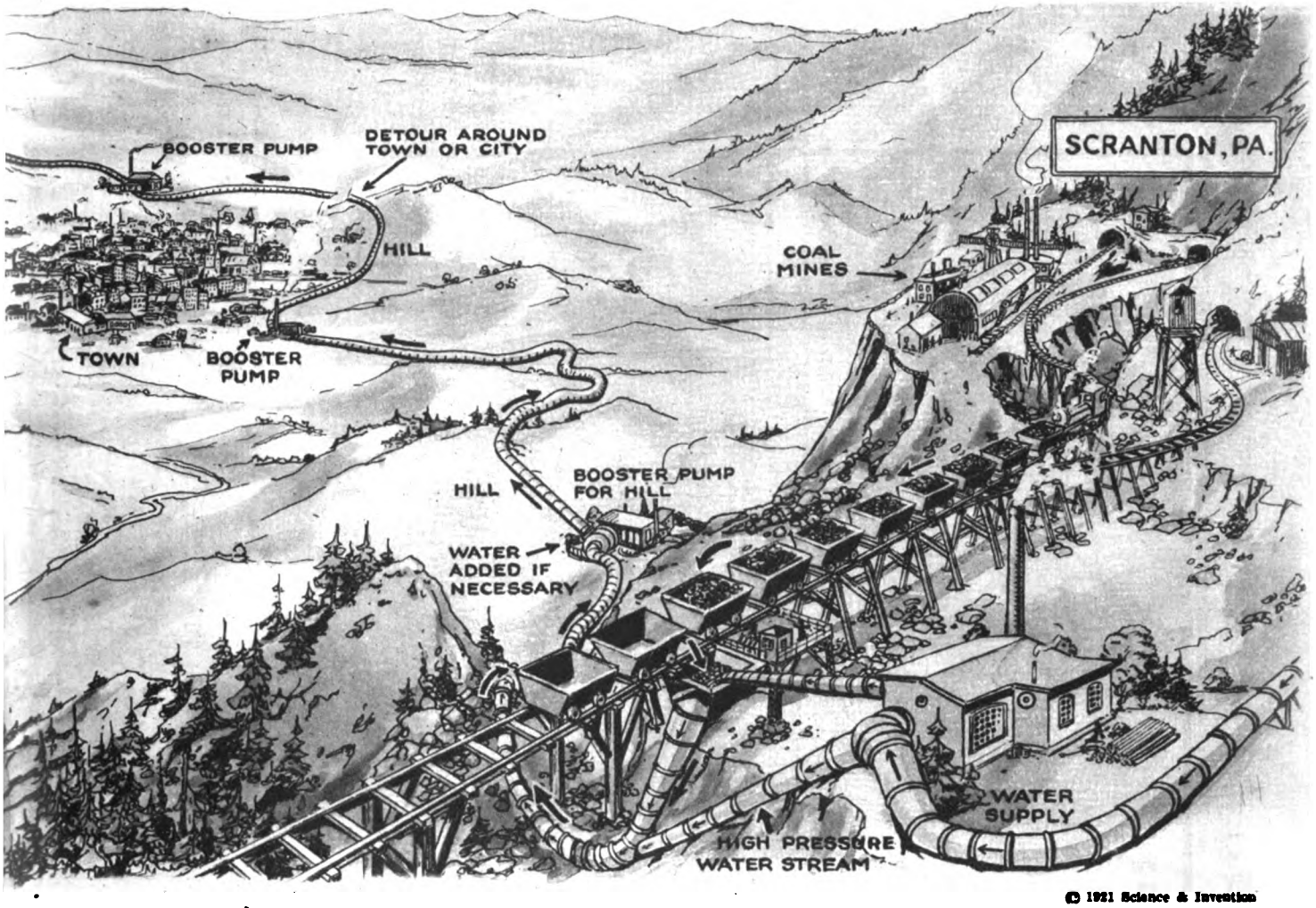
Finally he relaxed, and holding his handkerchief over his mouth, gave way to laughter as nearly silent as he could make it. The tears rolled down his cheeks. "Naughty! naughty!" he gasped, addressing the unsuspecting figure in the lighted room beyond. "Naughty! naughty! Oh, you bad boy!"

For he had established beyond the shadow of a doubt that Fred Ashton was sitting at a table which held one mi[illegible]hty fine wireless receiving set.

Now several things were clear to He remembered the rain-spoutless roo[illegible] saw the reason thereof. Master Fre[illegible] using it for an aerial. And he saw the method in the madness that rest[illegible] him from making bets until the ever[illegible] the fight.

For when the non-resident railroa[illegible]rapher closed the station and depa[illegible]n the 6:10 every evening, the little [illegible]e was practically cut off from the re[illegible]te

(*Continued on page* 1133)



The Pond Water Containing the Coal Particles, Is Then Pumped Into Separating Machines, Where the Water Is Separated from the Coal Particles and the Fine Particles Are Led Off Thru Pipes Into a Briquette Plant, Where the Coal Dust Is Mixed With a Binder and Compresst Into Briquettes of Various Sizes. By Means of Suitable Conveyors or the Usual Railway Distributing Systems, the Incoming Coal at the Receiving End of the Line Can Be Stored in Large Piles As Shown, and Is Also Fed Into the Usual Pockets for Truck Delivery and Is Also Distributed Into Boats at the River Front. The Coal Is Fed Into a Large Hopper at the Mine, Where Water at 800 to 900 Pounds Pressure Is Forced Into the Pipe Line by a Suitable Pump in the Manner Shown—the Coal and Water Mixture Proceeding on Its Way Aided by Gravity, As the Pipe Line Has a Steady Fall From Its Starting Point to the Receiving End. Suitable Centrifugal or Other Pumps Are Placed Along the Line to Boost the Coal and Water Stream. The Coal Would Move at the Rate of 7 Feet Per Second, or Take 27¼ Hours to Make the 130-mile Journey.

Coal Mines but 110 Miles from Delivery Point

Scranton which is near the center of the Pennsylvania coal beds is only about 110 miles in a straight line from Hoboken. The present system of transportation of this fuel, the consumption of which now amounts to about 7 millions of tons per season, is by rail to tidewater, where the coal is transferred to scows, and carried by water to the several parts of the city. It is unloaded to relatively small storage bins on dealers' premises, thence is redelivered to horse-drawn wagons and motor trucks, and by them is hauled to, and often re-handled, at the ultimate point of consumption. The problem thus considered seems to present itself in four features: (1) Supply (2) Transportation (3) Storage (4) Distribution.

Transportation—Shall We Pipe Coal to Consumers?

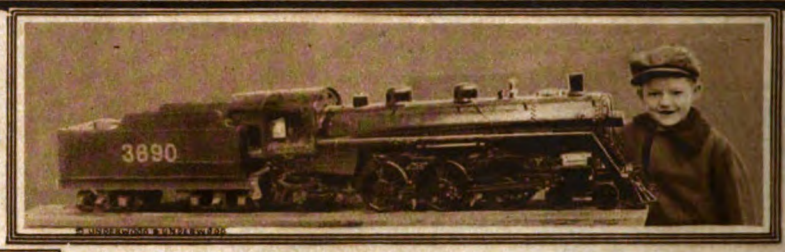
It does not follow that the present system of rail transportation of fuel to the City of New York is the only available or the most efficient method. The movement of such a vast quantity of coal over a relatively short distance is an undertaking which may warrant other means of operation. The burning of coal for the purpose of hauling loaded coal cars, and further use in the return of empty cars to the coal region as well as the employment of cars needed for other purposes must be considered in comparing the advantages or cost of other methods of transportation. Attention is directed by the evident limitations and the uneconomic character of our present methods, to the possibility of the transportation of fuel with water in pipe-lines, which was suggested before a technical audience by Mr. Geo. C. Orrok in 1918. This method was originally proposed and was successfully tested more than a quarter of a century ago by the late W. Andrews. It seems to present no impracticable features, as the transportation of soil and stones in the process of hydraulic dredging demonstrates. It involves very simple means and materials—A head of water, steel piping of moderate proportions, coal broken below a given size, and some means of separating the liquid and solid materials at the point of delivery. The fuel has been found to travel satisfactorily with water in proportion of 50 per cent of the total volume, in the pipe and in that proportion and with a sufficient head of water the capacity of a single steel pipe 20 inches in diameter would be six millions of tons in a year. The installation of such a pipeline in duplicate, would offer less difficulty and far less expense than a water conduit as it could probably be laid on the surface, following some railroad right of way. The grade is all in the direction of the flow. It is to be observed that recent experiments have also demonstrated the feasibility of transporting fuel in pipes, by means of an air blast, when the material is in a dry and powdered condition. Fuel in that form can be transported in pipes of as small a size as three inches in diameter. Great interest is now being exhibited in the process of pulverizing low-grade fuel for power purposes, which may render available for such service the vast stores of lignite, as well as making it possible to utilize the wastage of coal mining. The process of pulverization is simple, and could be conducted economically at the mines, with power produced by burning the small or waste grades of fuel. The larger sizes would thus be released for transportation by the pipe line method.

Storage of Coal

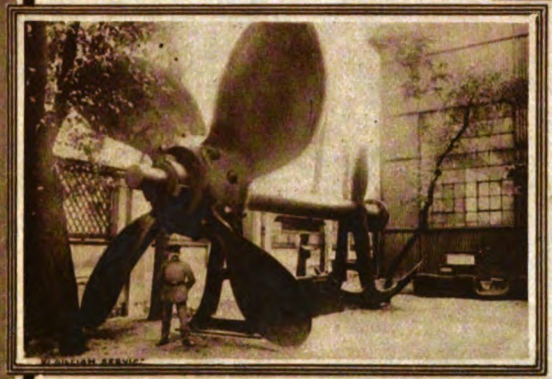
This part of the subject has an importance quite apart from the question of production or transportation, as a precaution against the danger of shortage, and the protection of the poorer part of the population from the excessive prices they are compelled to pay for their small supplies of fuel. The effect of a large storage would be beneficial to the operation of the mines, affording the means of more regular mining, and continuous employment during slack season.

The storage of a whole season's supply involves no very large area of land, even if the material should be, for protection against fire, divided into a number of sections. Seven million tons would, if piled to an average height of 25 feet occupy a ground area of about 2 miles in length by 1,000 feet in width, a space readily available in the Hackensack meadow district. A complete system would involve individual storages in the several boros of the City, thereby affording a desirable security against the effects of ice and delays due to water transport in the harbor.

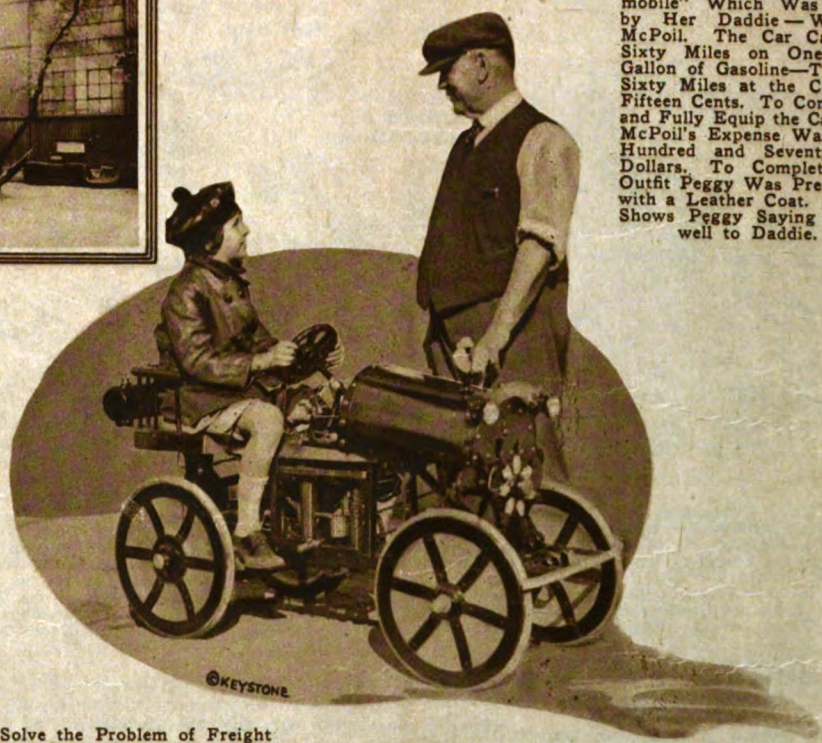
SCIENCE



This Miniature Locomotive Is Perfect in Every Detail. A Miniature Reproduction of a Modern Boston & Maine, Pacific Type Passenger Locomotive, Remarkable for the Completeness of Its Details, Has Been Built by Norman E. Beers, a Machinist in the Employ of the B. & M. Yards in Ayer, Mass. The Model Has Been Almost Two Years in the Making. This Photo Shows Raymond Beers, the Creator's Son, Beside the Model.



Ocean Liner's Huge Screw. The Enormous Size of this Giant Ship Screw Can be Realized by Comparing It With the Man Standing Beneath. The Photograph Was Taken in Hamburg Where the Screw Was Made for One of the Giant Ocean Liners. The Screw As a Means of Propulsion for Vessels Was First Used in China Centuries Ago. The Device Was Greatly Improved on by the Middle of the Eighteenth Century and in 1841 John Ericsson, the Famous Swedish-American Mechanician Successfully Employed Steam in Screw Propulsion.



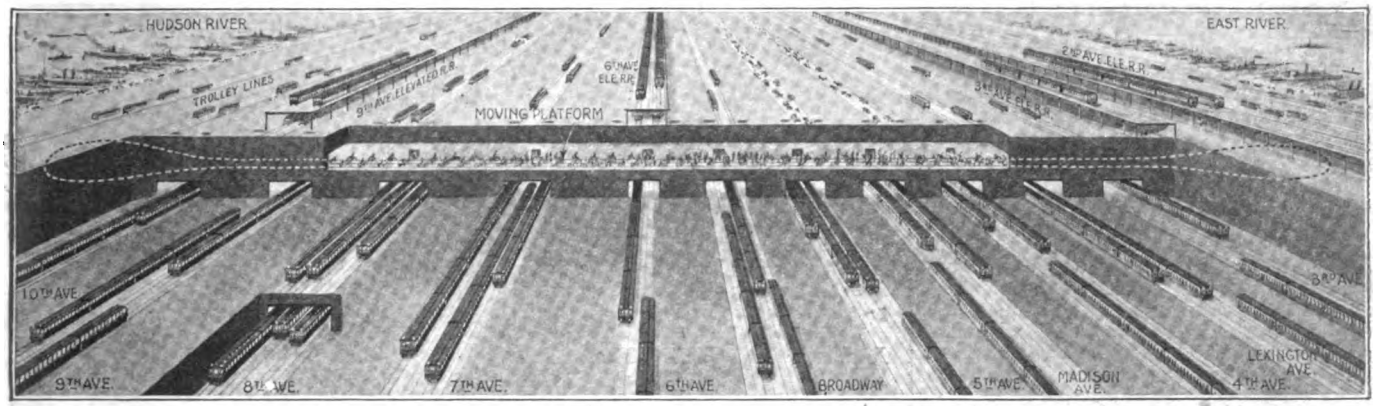
Miss Peggy McPoil Off for a Joy Ride in Her "Automobile" Which Was Built by Her Daddie — William McPoil. The Car Can Go Sixty Miles on One Half Gallon of Gasoline—That Is Sixty Miles at the Cost of Fifteen Cents. To Construct and Fully Equip the Car Mr. McPoil's Expense Was One Hundred and Seventy-Five Dollars. To Complete the Outfit Peggy Was Presented with a Leather Coat. Photo Shows Peggy Saying Farewell to Daddie.

A Freight-Car Auto Truck! To Solve the Problem of Freight Congestion, An Enterprising Firm of Long Island City Automobile and Auto Truck Body Builders, Built This Auto Truck Freight Car Body, Which Has Proved Its Usefulness. It Is Designed to Carry Big Loads.

What Do You Think Created This Magnificent Display Against the Black Mantle of Night? Not Fireworks—But An Illuminated Airplane Which Maneuvered About—Dipping, Gliding, Looping the Loop, and What Not. The Camera Has Preserved for Us a Beautiful Picture of the Resulting Display—Better Than the Human Eye—Owing to the Cumulative Effect of All the Light Paths. The Photographic Plate Shows Them All—While the Spectator Sees But One of These Light Paths at a Time.

New York's Subways a Century Hence

By H. WINFIELD SECOR



A Glimpse of New York's Subway System as it Will Undoubtedly be a Century Hence, Perhaps Within the Next Fifty Years. As Shown, There Is a Subway Operating on Every Avenue Running Along Manhattan Island, Besides Several Elevated Railroads, Which May by That Time be Double or Triple Decked—Not to Mention Double and Triple Decked Streets. A Continuous Moving Platform Has Already Been Designed and Considered to Distribute Traffic Across Town to the Different Subways, Surface and Elevated Transportation Lines.

THE accompanying prophetic drawing by Mr. George Wall shows in a vivid manner a sectional view thru Manhattan Island, when the subways of New York, fifty to one hundred years from now, will undoubtedly honeycomb the entire island. There are at present in some places three, and in some places four arteries of subway traffic running northward along Manhattan Island, narrow as it is. As the artist has clearly shown in the illustration above, the time will undoubtedly arrive, perhaps a great deal sooner than we are inclined to believe, when practically every street will have a subway running below it, underground.

In a recent interview with Reginald Pelham Bolton, a well-known consulting engineer of New York City, and who, it must be said, possesses a far greater range of vision than many of our traffic experts, there were outlined some of the wonderful changes which are undoubtedly in store for the Manhattanites in the years to come—possibly within the next twenty-five to thirty years.

Picking up one of the official subway maps, Mr. Bolton, with a sweep of the hand, stated that the present congestion of the subway lines, the way they are being laid out and built, is not logical, at least so far as the immediate future needs of Greater New York City are concerned. He mentioned that there is entirely too

(*Continued on page* 1129)

My Turret Astronomical Observatory

By HON. JAMES D. HARTNESS

Governor-elect, State of Vermont

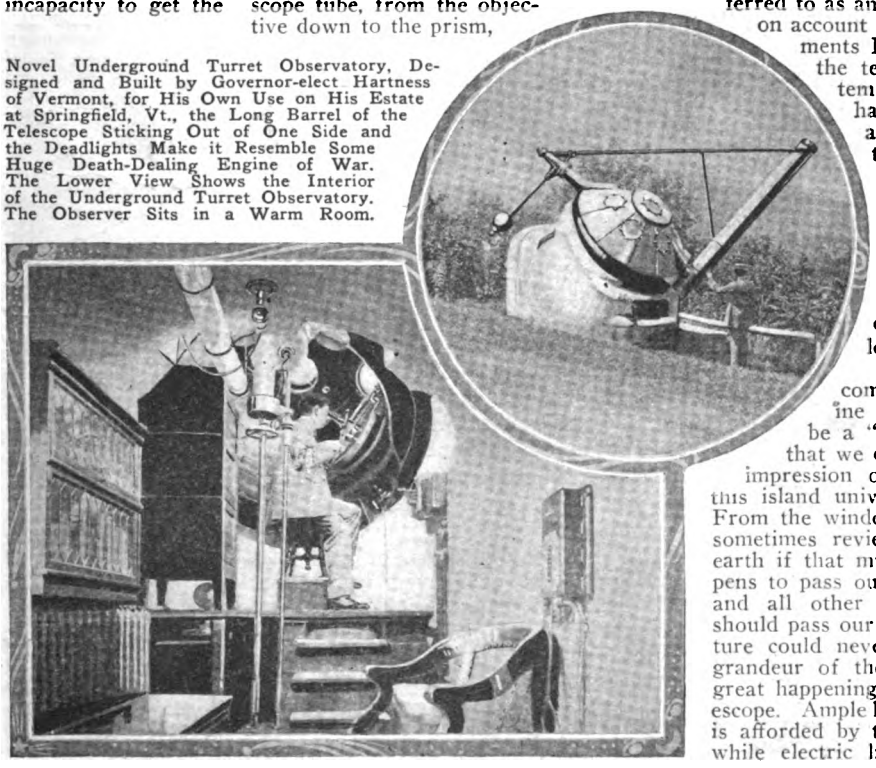
THE Turret Observatory grew out of my experience in the use of a telescope in cold weather. I found that even with the warmest clothing I became thoroly chilled thru at even a moderately low temperature and that when observing in zero weather, to say nothing of still colder weather, which is common to many of our northern states, there was not only great discomforture but also an incapacity to get the best results.

Having had more or less experience in designing machinery, I studied the problem, and after looking over what had been done, I arrived at the conclusion that the turret such as used on a battleship would exactly meet the requirements. Of course the structure of the turret and its mounting had to be designed for this new use. The general result is very satisfactory, at least to an amateur.

The telescope is a refractor, having a ten-inch Brashear objective. The focal length is 140 inches.

The optical train is the same as for the standard telescope, except that a prism is introduced at a point about twenty inches from the eye-piece. Aside from the absorption of this prism, the efficiency of the telescope for optical purposes would be equal to the standard telescope when used with a prism at the eye-piece—the prism at the eye-piece being smaller of course than the one located one-seventh the distance to the objective.

The temperature of the air in the telescope tube, from the objective down to the prism, will be the same as that of the outside air. From the prism into the eye-piece it takes the temperature under the influence of the turret temperature and the inner room. The turret is made of cast iron and weighs one and one-half tons. It is partially jacketed on the inside with wooden lagging. The observing room is kept at a comfortable temperature.



Novel Underground Turret Observatory, Designed and Built by Governor-elect Hartness of Vermont, for His Own Use on His Estate at Springfield, Vt., the Long Barrel of the Telescope Sticking Out of One Side and the Deadlights Make it Resemble Some Huge Death-Dealing Engine of War. The Lower View Shows the Interior of the Underground Turret Observatory. The Observer Sits in a Warm Room.

The Turret Telescope is frequently referred to as an underground observatory on account of the underground apartments I have in connection with the telescope. The whole system of underground rooms has a combined length of about one hundred and twenty feet and the observatory is connected to my residence with a tunnel a little over two hundred feet in length, making it possible to pass from the observatory to my residence in comfort, regardless of the weather.

I believe the time will come when one of the genuine luxuries of the home will be a "window to the skies"—so that we can make and keep a deep impression of the objects comprising this island universe—the visible heavens. From the windows to the street we may sometimes review the greatest show on earth if that much advertised show happens to pass our home, but if that show and all other attractions of the earth should pass our homes, the combined picture could never equal the majesty and grandeur of the celestial show with the great happenings within reach of the telescope. Ample light for the turret chamber is afforded by the deadlights in daytime, while electric lights illuminate at night.

The Radium Institute of Paris

THE Radium Institute of Paris, whose building was not completed when the war broke out, is today the most remarkable among similar establishments actually existing in England or in Germany; as much by the scientific eminence of the managers, Madame Curie and Professor Debierne, as by the perfection of the instruments installed lately in its laboratories.

The Radium Institute is composed of two distinct departments. In one are studied the scientific properties of radium, while the other is devoted to its medical applications. Doctor Regaud, who is in charge of the latter department, which is a branch of the widely known Pasteur Institute, endeavors to cure cancer and tumors by application of Radium and X-rays.

We will first visit the Curie wing. In this laboratory shown to visitors, radioactive bulbs are measured and tested by the piezo electrical quartz method. The operator measures in absolute value the amount of radium contained in each bulb submitted to examination by physicians. In one of the photographs a bulb under test is shown resting on the condenser at the right hand side of the photograph.

In the chemistry laboratories, the visitors may see the prolonged and delicate operations, the numerous fractioning, and repeated crystallizations which are necessary in the preparation of radioactive substances (radium, polonium, actinium, uranium, thorium, etc.). In another photograph Madame Curie can be seen watching the distillation apparatus, in which uranium nitrate is purified, while she is inserting a few milligrams of polonium between two metallic discs. In still another photograph the lamented scientist's wife is shown heating a barium solution containing radium.

The room in which the extraction of *radium emanation* is effected, is the most extraordinary in the Institute. To the left is a cabinet whose sides are lined with lead, in which are preserved the radium compounds. These precious substances are kept in little vials fitted with curved glass tubes, these tubes being connected to mercury manometers. On the day we paid our visit to the Institute $200,000 worth of the precious substance which could have been held in the hollow of the hand was enclosed in a receptacle in the cabinet.

From right to left in the photograph, showing this room, is the group of special pumps of high tension used to obtain a vacuum in the tubes, succeeded by the apparatus for measuring the gas pressure in the emanation vial. The operator, standing in front of this glass gage watches the variations, while the bulbs are being filled. The radium emanations are generally kept in liquid air bottles and the special plant needed for the production of liquid air is installed in the subcellar of the Institute.

An electroscope is used to measure the value of the 24 emanation vials prepared daily at the Institute; the operator using a stop-watch in order to keep the time with great accuracy during the operation.

But owing to the yet unknown effects of these substances upon the human body, the experimenters have to use special tables. These tables are made of oak, and inserted in the joints of the wood are lead screens placed horizontally and vertically to stop the powerful rays during the course of the operations. As can be seen in one of the photographs, the operator introduces the little emanation vial with a tong into a lead tube which makes it harmless for the carrier. In the room where Madame Curie gives her lectures, a view of which appears herewith the following instruments are seen on the table:

In the center, is an amplifier which makes it possible to hear certain particles being emitted by the radium; next come some cathode ray tubes hung on a horizontal wire. On the right are a projection lantern and a coil, with its accessories for the production of currents at high tension used in the experiments made during the lectures.

Among the other elaborate apparatus is the most powerful electromagnet in the world, which has a power of 100,000 gausses.

The X-ray department installed in the Pasteur wing is also remarkable; in one of the X-ray rooms we saw a patient under treatment for a tumor. His head is placed at about 8" from the Cooldige tube which is fitted with a protective screen; the doctor watching the operation thru a window is also protected by a lead screen. In the room where the physician operated on his patient, was an apparatus delivering 120,000 volts for treatment of patients.

To show how complicated are the researches made by the scientists of the Radium Institute a view is shown representing a set used for experiments on X-Ray of long wave length. For these experiments such instruments as gas generators, vacuum pumps, X-ray tubes, and special wavemeters are necessary.

Let us hope that with this remarkable installation the prominent scientists of the Radium Institute of Paris will soon be able to successfully combat the dread disease known as *cancer*.

German Said to Make Perfect Diamonds

It has taken a German chemist to discover the secret of the diamond. Some time ago there were rumors that an important German firm had not only acquired a patent for the production of these precious stones, but had actually manufactured diamonds in such quantities as to warrant the conviction that yet another of Nature's mysteries has been definitely unveiled.

It is now known that the firm in question is the Dynamite Company, formerly Alfred Nobel of Hamburg.

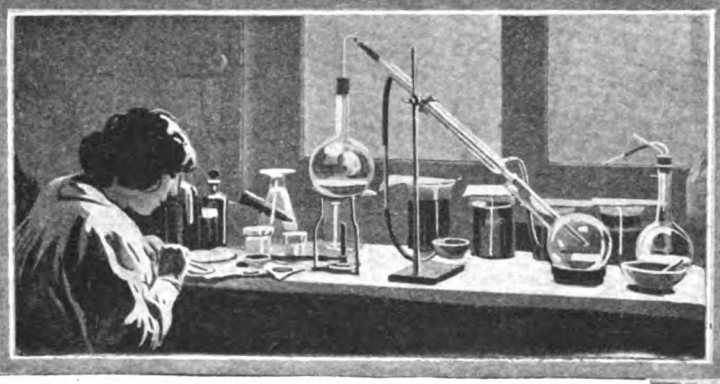
No details are available as to the nature of the process, though it is believed to differ very considerably from those hitherto tried. I am assured that not only have many diamonds of good size already been produced by it, but also that the cost of production is such that it will be possible to make them very profitably. In quality, too, the artificial stones are said to be equal to any which come from the mines. Indeed, I believe experts have declared the quality of some to be even better than the average natural stone.

The cost of production, of course, is considerable, but is still very much lower than the ruling market price.

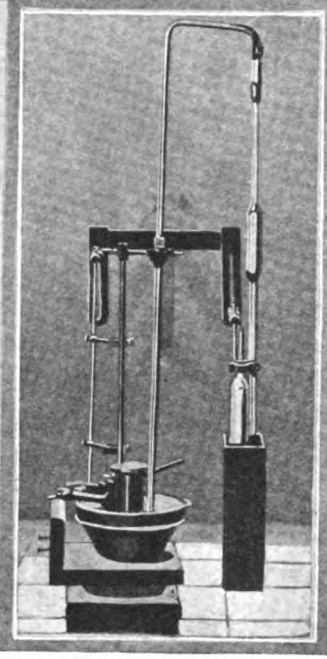
In the diamond market, which is naturally highly interested and not a little alarmed at the news, it is stated today that it is believed the price will be as much as 40 per cent lower.

There has been and is a great business done in diamonds in Germany, and many merchants have large stocks on hand, and they fear a rush to sell may be caused by the prospect of lower prices in other quarters. However, such a fall is not expected, as it is thought that the prices of the artificial stones when they come on the market will be put at a figure only "Just low enough to break the British monopoly," as one merchant said.

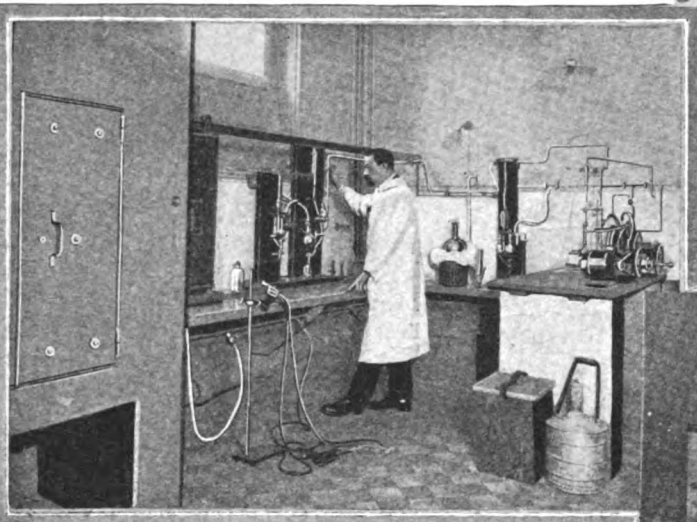
The company referred to has not yet sold any diamonds and is producing only at the rate of a few hundred carats daily. Only a few privileged experts have been permitted so far to see the manufactured stones. It is hoped there will soon be a weekly production of between 20,000 and 30,000 carats.



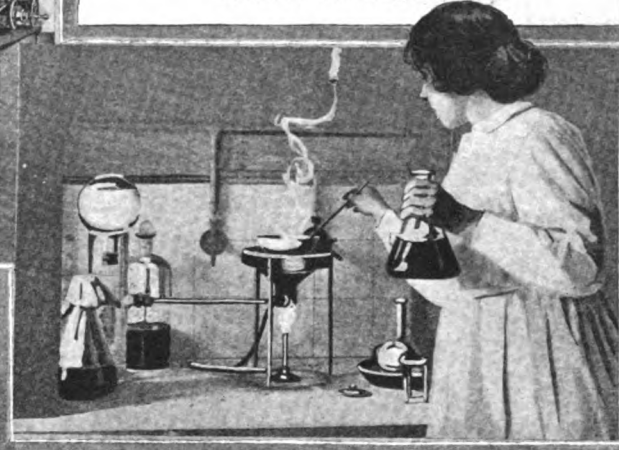
Madame Curie, Who Continued the Search for the Element Radium After Her Husband Died, Is Here Shown Working at a Laboratory Table, Preparing Polonium. Polonium Resembles Bismuth, and Was Separated From Pitchblende by Madame Curie, Even Before Radium Itself Was Discovered. It Is Much More Powerful in Alpha Rays Than Radium, But Its Life Is Only About 208 Days, Whence it Loses Its Entire Activity.

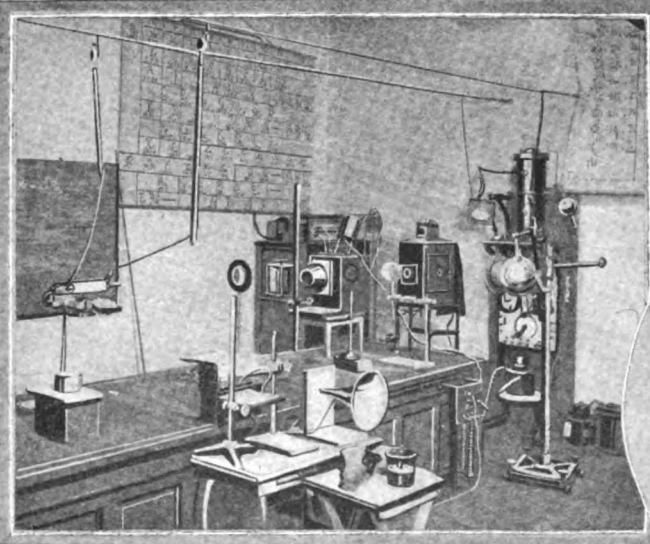


The Phial Shown Above Contains $200,000 Worth of the Costly Element, Radium. So That None of Its Emanations Shall be Lost, it Is Suitably Fitted With Glass Tubes and Other Connected Apparatus, Which Conserve All the Energy Possible. A Square Lead Container Protects the Operator From the Action of This Large Quantity.



Radium Emanation Apparatus for Obtaining the Emanations of Radium and Sealing the Radio-Active Substances Into Glass Containers in the Form of a Gas. In the Lead Safe at the Extreme Left of the Photo Is a Large Quantity of Radium Which Was Dissolved in a Liquid. Connected to the Phial Containing This are Glass Tubes Suitably Fitted With Mercury Containers and the Exhaust Pump Illustrated at the Right Creates a Constant Vacuum, Giving Off a Radium Emanation in the Form of a Gas.

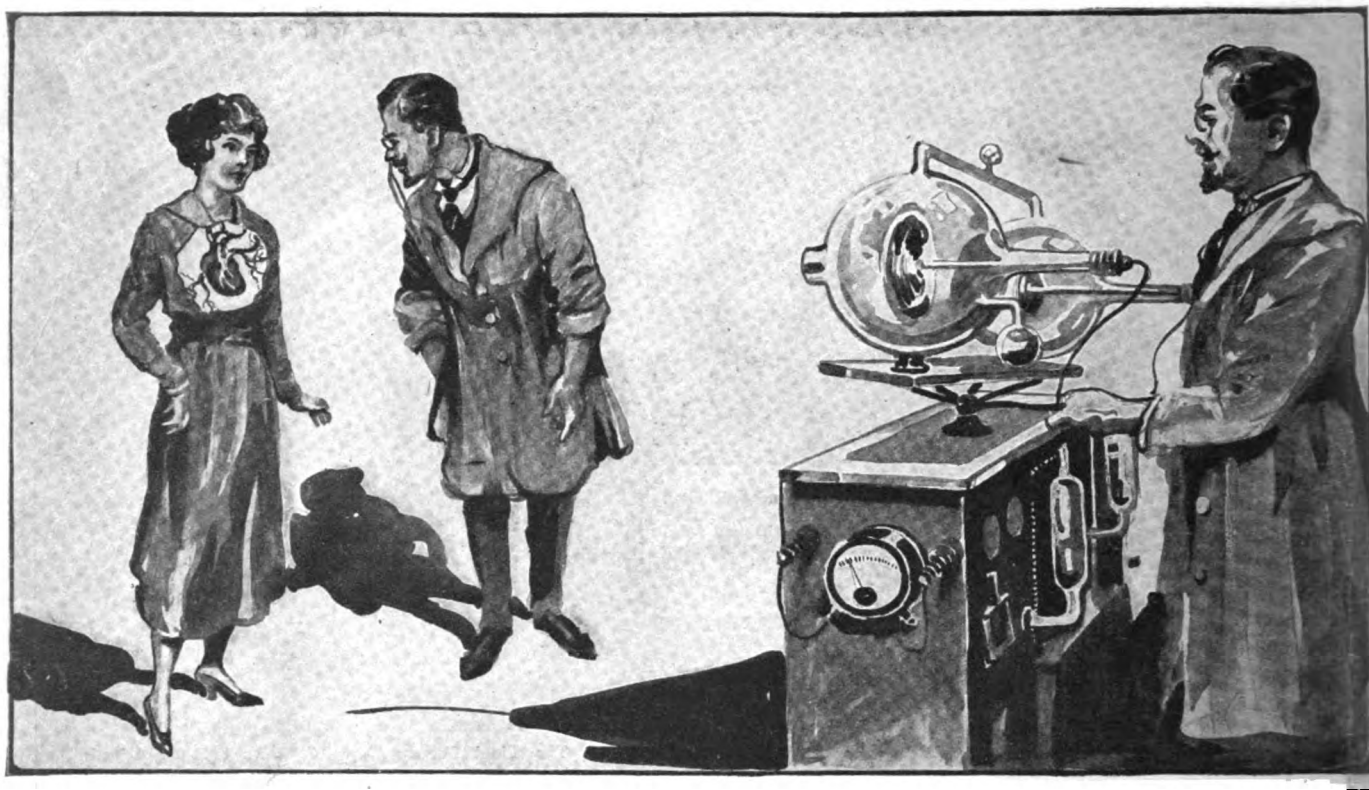




The Room in Which Madame Curie Carries on Her Famous Lectures on Radium. All Conceivable Forms of Apparatus Which Can Demonstrate the Presence of Radium or Any of the Series of Radio-Active Substances are at Her Command. On the Wall Is Seen a Chart Used in the Lecture Courses.

Madame Curie Heating a Uranium Solution. Uranium Activity Was Discovered by Henri Becquerel. M. Becquerel Wrapt a Photographic Plate in Dark Paper and Placed it on a Phosphorescent Substance, Which Was Then Exposed to the Sunlight. By Chance, He Chose a Particularly Phosphorescent Body Containing Uranium.

Apparatus Doubly Fitted With a Lead Screen, Showing the Operator Introducing Radio-Active Tubes Into Phials Which are to be Used for Experimental and Medical Purposes. Generally, Heavier Tubes are Used as Containers as These Filter Some of the Rays and at the Same Time the Tube Is Strengthened.



Tomorrow the Diagnosing Physician Will be Able to Tell Exactly What Ailment You May be Suffering From—Thanks to the "Transparascope." By Employing Vibrations of a Sufficiently High Frequency, Far Higher Than That of X-Rays, for Example, Scientists of Today Believe That It Will be a Relatively Simple Thing to Render an Object Invisible to the Human Eye. The Heart, Lungs, Stomach, et Cetera, Will All Be Exposed for the Physician's Inspection Without Recourse to the Knife.

COMING INVENTIONS

The Transparascope

By H. GERNSBACK

Member of American Physical Society

ONCE upon a time the good fairy Hypatia, who had kept Prince Charming from harm thru all his adventures, bestowed upon him a magic cap with these words: "This cap, my prince, must only be used in time of great danger. By wearing it you will become invisible, and thus your enemies will see you not."

Thus run many fairy tales of the past as well as the present. It is a favorite subject not only with children, but with grown-ups as well. But fairy tales have a strange way of coming true these latter days when inexorable science daily blazes away with new wonders, putting in the shade the wildest fairy tales of yesterday. Not only have we the invisible stunt in our fairy tales, but, of course, they do it in the movies, and even on the stage today. Like flying, the art of turning invisible seems to be a secret wish of human nature for some unaccountable reason.

Speaking scientifically, is it possible to make ourselves invisible by any agency known today? We believe we may answer in the affirmative, and the day will surely come in the not too distant future when it will be possible to make our entire bodies, as well as any other object, totally invisible to the eye.

Let us first see what really makes things visible and invisible. Luminous bodies give out light; they radiate light. Illuminated bodies reflect and diffuse light. Some examples of luminous bodies are the sun, a candle, an electric light globe. An example of an illuminated body is the moon or a piece of white paper lying on the table, which we could not see were it not for the diffused light of the room striking it. The paper in this instance throws back the light; thus we see the piece of paper. The case of the moon is analogous.

TABLE OF VIBRATIONS
WHOSE EFFECTS ARE RECOGNIZED AND STUDIED

	Number of Vibrations per Second	
1st Octave	2	
2nd "	4	
3rd "	8	
4th "	16	SOUND
5th "	32	
6th "	64	
7th "	128	
8th "	256	
9th "	512	
10th "	1,024	
15th "	32,768	
20th "	1,047,576	UNKNOWN
25th "	33,554,432	
30th "	1,073,741,824	ELECTRICITY
35th "	34,359,738,368	
40th "	1,099,511,627,776	UNKNOWN
45th "	35,184,372,088,832	
46th "	70,368,744,177,644	
47th "	140,737,468,355,328	HEAT
48th "	281,474,976,710,656	
49th "	562,949,953,421,312	LIGHT
50th "	1,125,899,906,842,624	CHEMICAL RAYS
51st "	2,251,799,813,685,248	UNKNOWN
57th "	144,115,118,075,855,872	
58th "	288,230,376,151,711,744	X-RAYS
59th "	576,460,752,303,423,488	
60th "	1,152,921,504,606,846,976	
61st "	2,305,843,009,213,693,952	
62nd "	4,611,686,618,427,389,904	UNKNOWN

This Elaborate Table of the Known Vibrations Shows How Far Man Has Studied Nature's Great Secrets. Who Knows What Wonders of Science Lie Veiled Beyond the Upper Limit of the Present Vibration Scale?

Certain media, such as water, glass, diamond, air, free space, rock-crystal, etc., are *transparent*. Oiled paper, thin porcelain, etc., are called *"translucent."* Other solids are called *"opaque."* Thus, for instance, stone, wood or gold are termed "opaque," but no body is entirely opaque. Sliced thin enough, all bodies, without exception, become more or less translucent. A thin gold leaf when held against light becomes quite translucent, the light shining thru with a greenish cast.

Light is reflected from smooth, bright surfaces, as is well known, but no matter on what surface the light falls a certain amount of light is always absorbed by all bodies. An analogous case is a water hose turned on a carpet hung against the wall Most of the water will splash away: in other words, will be reflected. A goodly part will soak into the carpet.

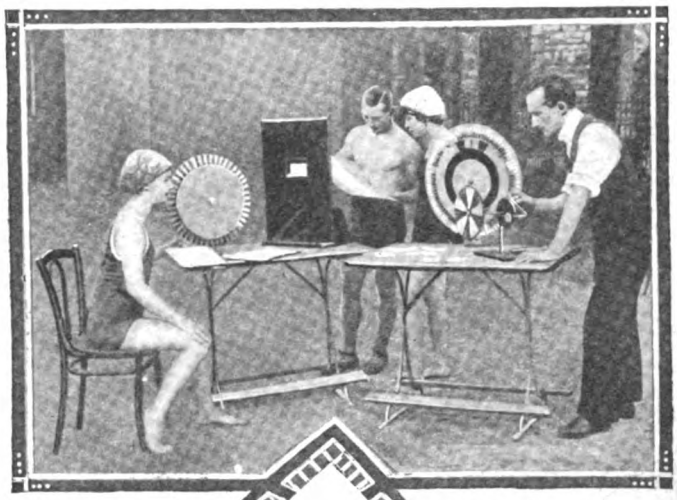
The case with a mirror is very similar. Due to the very small wave lengths of light, even the best mirror to these light waves is very rough and uneven. Therefore, the light is reflected from its unevenness. If a mirror or reflector was absolutely and perfectly smooth, *it would be invisible*. We would simply see in it images of other objects, but the mirror itself could not be seen.

We can now understand why ordinary objects, as, for instance, the human body or a building, are opaque to our eyes, altho we have just seen that light rays penetrate all bodies more or less. If you do not believe this hold your hand between your eyes and the sun. You will see the light shining thru partially. In other words, your flesh becomes partially translucent. We showed already in our April, 1919,

(*Continued on page* 1122)

Science Measures the Athlete

DAME SCIENCE has shown her hand in a radical and new departure in some of the European countries, applying new methods to the measurement of the strength and vitality of athletes. The accompanying photographs show the scientific apparatus, most of which is operated by electricity, being used to test the stamina and many other important factors which should always be considered, and which are frequently lost sight of altogether, in amateur athletics at least. Tests for the strength of the eyes as well as for astigmatism and color blindness are included.



Top Photo Shows Young Lady Swimmer Undergoing Scientific Test at German High School. The Colored Targets are Revolved at a Certain Speed and the Effect Visualized by the Contestant Carefully Noted. The Mind Has as Much to Do With the Athlete's Performance, Claims Science, as Has the Body.

Other tests cover the action of the lungs and heart, the quality and degree of hearing, distance and space tests, quickness of thought and decision, fatigue of the muscles, et cetera.

One of the accompanying photos shows several female athletes undergoing tests to determine their fitness to enter a swimming contest.

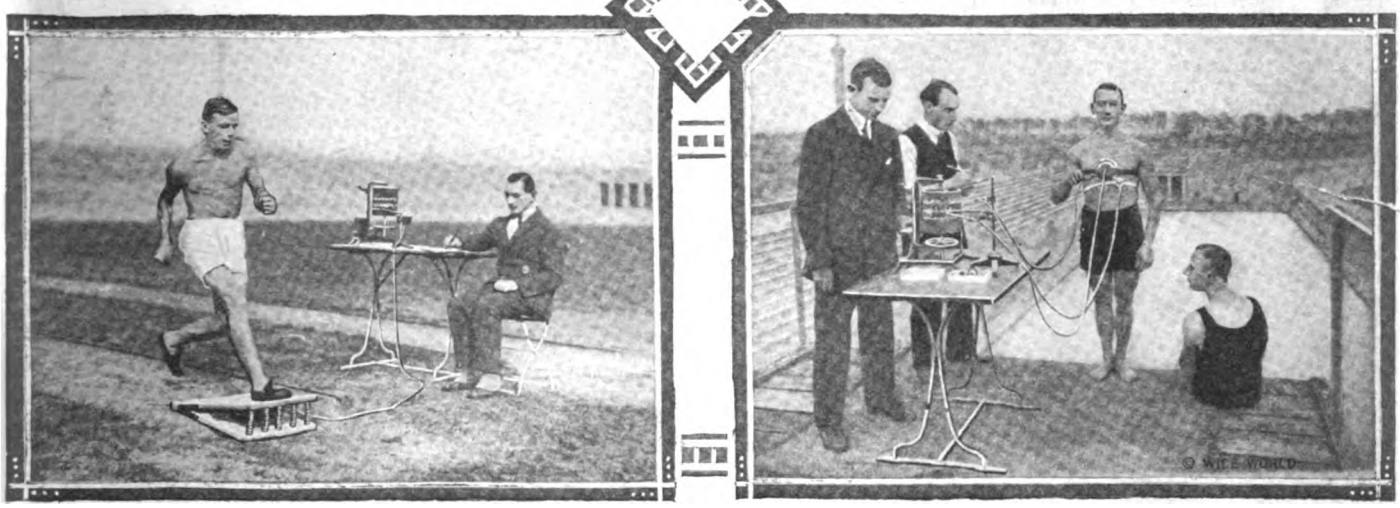
Another photo shows a swimmer undergoing a thoro test by the scientists, preparatory to making a dive of nearly 100 feet. The heart must be perfectly normal, before the swimmer or diver is allowed to enter any such nerve-straining test or feat as this. He is shown standing at the top of the tower of the swimming school and before being allowed to jump off in his swift plunge toward the pool, he is remorselessly tested by the unfailing instruments for nervousness, pulse and heart action and blood pressure.

If all of these factors do not check up to normal according to the curves drawn by the needle on the instrument, he is not permitted to undertake the feat.

Another photograph shows a board operating with springs and electrical contacts, ingeniously arranged to determine various important factors in an investigation as to the hindrances encountered in a "broad jump." The spring board with its multiple electrical contacts is connected up to a sensitive register or recording instrument, and the athlete is told to make the jump. The compression of the spring is registered automatically, and also the atmospheric pressure against the body in motion. Then the curves and the position of the body are changed while jumping, so as to eventually diminish atmospheric pressure as much as possible.

Lower Left Photo Shows Electrical Recording Instruments Used in Studying the Various Phases of Jumping.

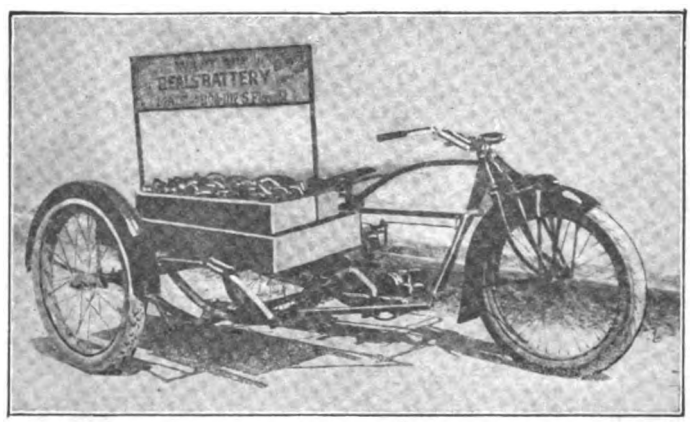
Below: A High Diver Undergoing Scientific Tests for Lungs and Heart. His Vision Is Also Very Carefully Measured.



Electric Drive for Motorcycles

WE give here a photograph of a successful experiment in driving a motorcycle by electric power. The motorcycle has a side-car, and the side-car carries four storage batteries which furnish the motive power, with space enough left for four additional batteries. The batteries are of the usual automobile starter type of 13 plates per cell; we charge them at 24 volts with a stage connector, therefore the batteries are never removed from the motorcycle.

The motorcycle engine has been removed and a 6-volt automobile starter motor substituted, but it is operated at 12 volts to obtain the necessary power and speed for the requirements of the motorcycle.



Here We Have the Electrically Driven Motorcycle. This Motorcycle Is Driven at a Speed of 15 Miles per Hour or More by a 6-Volt Automobile Starter Motor. The Motor Receives Its Electrical Energy from a Set of 12-Volt Storage Batteries of the Ignition Type.

It travels about 15 miles per hour and is capable of making about eight deliveries per day; it seldom runs down providing it is charged when not in use.

There have been many attempts made to develop a successful, or we might call it a satisfactory, form of electrical storage battery driven motorcycle. We illustrated one several months ago, developed by an English concern, and no doubt some American genius will eventually evolve one which will fulfill the requirements of our motoring public. The electric motorcycle illustrated in the present photograph is not built commercially.

Photograph and description contributed by Mr. Lester C. Beals.

The X-Ray Fluid

By JULES H. STEAN, Ph. D.

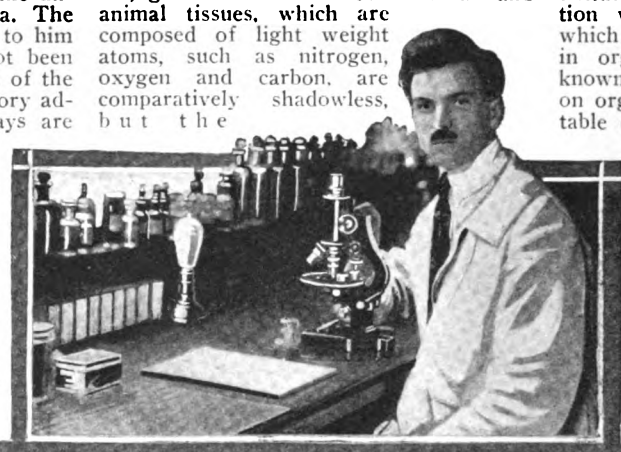
A New Invention That Makes Bodies Transparent

IN the year 1895 when the x-ray was discovered by William Conrad Roentgen, Professor of Physics at Wuerzburg, Germany, the discovery marked a distinct epoch in medical science, and the reported possibilities of what the x-ray was expected to accomplish savored almost of the occult.

Roentgen called his discovery x-ray as the letter x is a representation of the unknown in the mathematical formula. The nature of the x-ray was unknown to him and even today scientists have not been able to determine the exact nature of the mysterious rays. The principal theory advanced at present, is, that the rays are violent ether pulses, set up by the sudden stoppage of the cathode rays, as they strike upon the walls of the tube. In other words, x-rays are considered, in general, of the same nature as light waves, but lie, due to the short wave length, outside the visible spectrum. A definition of the x-ray is: A radiation emanating from a highly exhausted tube when a high tension electric discharge is past thru a vacuum tube. The x-ray is, therefore, the result of a high rate of vibration, of which little is known. These rays can only be recognized upon a sensitized photographic plate, and upon such chemicals as Calcium, Tungstate or Willimite, while the radiation from the x-ray tube cannot be reflected or polarized.

Therefore, radiation from the x-ray tubes produces shadow pictures or radiographs, so that the reproduction on the photographic plate represents only a shadowgraphic form of the body thru which the x-ray has past.

As these rays penetrate all matter according to its density and mass, the picture produced is simply a record which has registered the relative density of the object thru which the rays have past. The picture on the photographic plate will therefore differ in appearance as affected by the density and structure of the object. However, a curious fact remains, that while some substances produce a kind of shadow, others do not, unless the x-ray passes thru a considerable thickness of them. Carbon, for example, with the atomic weight of 12, is practically shadowless when photographed with the x-ray, while glass, containing lead, atomic weight 207, gives a dense shadow. Human and animal tissues, which are composed of light weight atoms, such as nitrogen, oxygen and carbon, are comparatively shadowless, but the bones, which are heavier calcium compounds, produce a marked dense picture with the x-ray photograph.



While the discovery of the x-ray and its action brought valuable information to the medical profession, especially in the examination of the living body, little could be done with the anatomical specimens. A number of specimens for the study of the blood-vessels were produced by injecting metallic salts into the blood vessels and x-ray pictures were produced from those specimens. While this method has a certain value, it cannot be applied with every specimen, as the detail of the tissues is lost. Besides, it is still a shadow picture, which is flat and uninteresting and not the original which can be examined at will from every angle.

Here is where the x-ray fluid sets in and fills a long-needed want in the study of anatomy. X-ray fluid not only penetrates animal and vegetable bodies, but preserves the bodies of the same.

In the years past many attempts have been made to produce a fluid which would make specimens transparent and also act as a preservative. No definite result however has been accomplished.

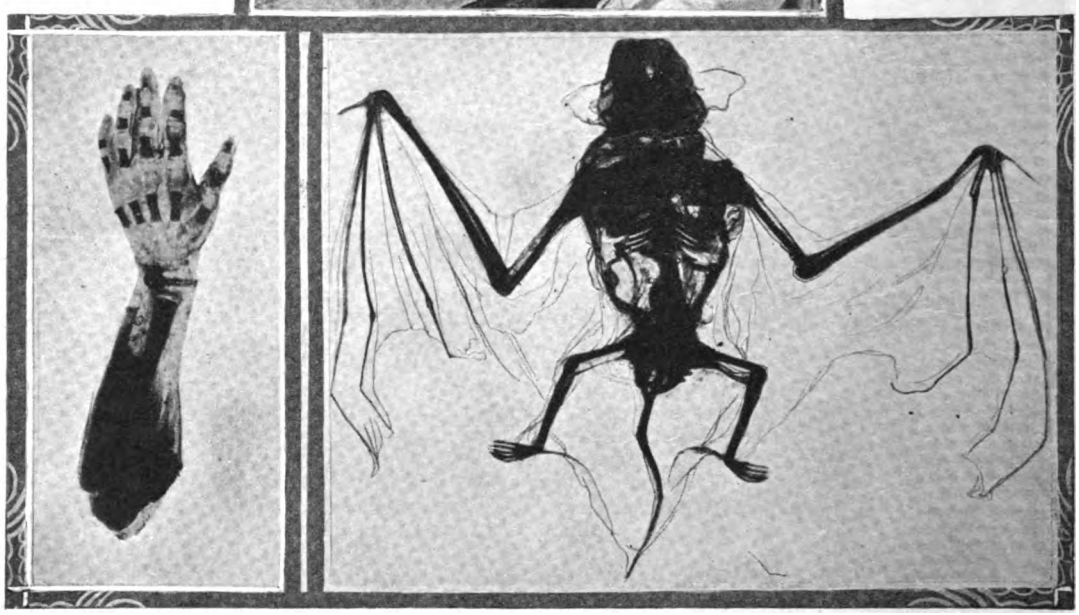
The action of the x-ray fluid is based upon the principle of refraction. The fluid itself is composed of a number of chemical liquids which surround and penetrate the specimen, making it transparent or semi-transparent at will. It may be considered a law that different tissues or textures have different indices of refraction which differ materially. The law which applies to the index of refraction in organic bodies, and which is well known, may to a certain extent, be applied on organic bodies as follows: If a vegetable or animal body is surrounded and saturated with a liquid whose index of refraction is about one-half of the index of refraction of the body itself, the result is a lesser reflection of light and approximate transparency.

The most difficult part in making animal or vegetable bodies transparent lies in the fact that the texture or tissue, muscle or bone, all have a different index of refraction and this results in some parts acquiring perfect transparency, while other parts appear opaque. This apparent disadvantage, however, is also, an advantage, as we will see.

If a fluid could be found which was able to penetrate every animal or vegetable body evenly, that is, something which would make bodies entirely transparent without being influenced by the different structures, the value would be nil for the simple reason that all the details would be lost and the prepared body would appear much like glass; having lost its prominence which lies in the differentiation of the body structure. *The value of a fluid for this work lies in its power of regulating the transparency of the tissues and structure.*

This can best be illustrated in the cuts. Take for instance the bat. An x-ray would show the bones, while tissue and cartilage would be visible as a shadow only. The x-ray fluid, however, produces an entirely different picture. We see in the photo the skeleton of the animal, parts of the inside body, and in wonderful detail the wings which have changed to thin

(*Continued on page* 1142)



Left: Arm and Hand of a Foetus Which Was Immersed and Preserved in the X-Ray Fluid. This Fluid Renders All Things Transparent and Was Discovered by Dr. Jules H. Stean, a Doctor-Chemist-Psychologist of Alsace-Lorraine Now Residing in Worcester, Mass.

Right: A Bat Immersed in the X-Ray Fluid Which Has Rendered It Transparent. This Discovery Will Revolutionize the Study of Anatomy.

Top View: Dr. Jules H. Stean, Discoverer of Fluid Which Surpasses the X-Ray. When the X-Ray Is Turned Upon Human Hand, It Will Reveal the Bones in Silhouette; Submerge a Hand in the X-Ray Fluid, and Not Only the Bones Appear Clear-Cut and Visible from Any Angle of Approach, But the Veins, Arteries, Muscles and Tissues Will Stand Forth in Well-Defined and Easily Distinguishable Lines. — Photos © by Keystone.

Talking on a "Thread"

UP to the present time sound discs and sound rolls for recording and reproducing sounds, such as talking, etc., have been known under the name of "dictaphone." Mr. E. Stieger, a Swiss engineer, realized the imperfection and disadvantages of such sound-wave producers and tried to find a substitute for these cumbersome media which would be of an extremely compact form and at the same time overcome the disadvantages as to fragility and difficulty with respect to transportation.

All this and still much more has been accomplished by Mr. Steiger, with the invention of the so-called "talking thread" on which even a child may take up and reproduce a conversation without any difficulty. This sound-wave producer is so compact and requires so little space that a thread which carries a five-minute talk may be placed within a watch casing.

It is, therefore, possible to take up and register office dictation as well as correspondence and to send it directly by mail as communications or as a substitute for letters. This "talking thread" is also of especially high value as regards lessons in languages and for communication with blind people.

The thread is not at all liable to be destroyed when encased, used and forwarded, and is not affected by the greatest changes in temperature.

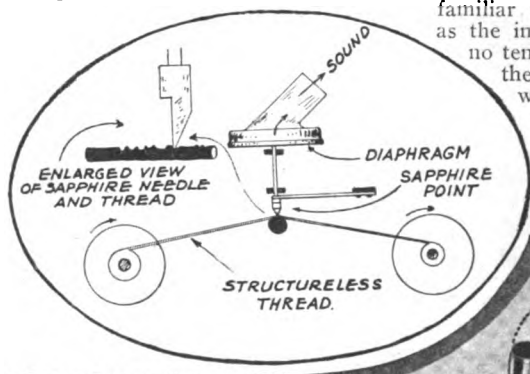
Some of the interesting technical details of the "talking thread" phonograph are described in the American patent issued a short time ago.

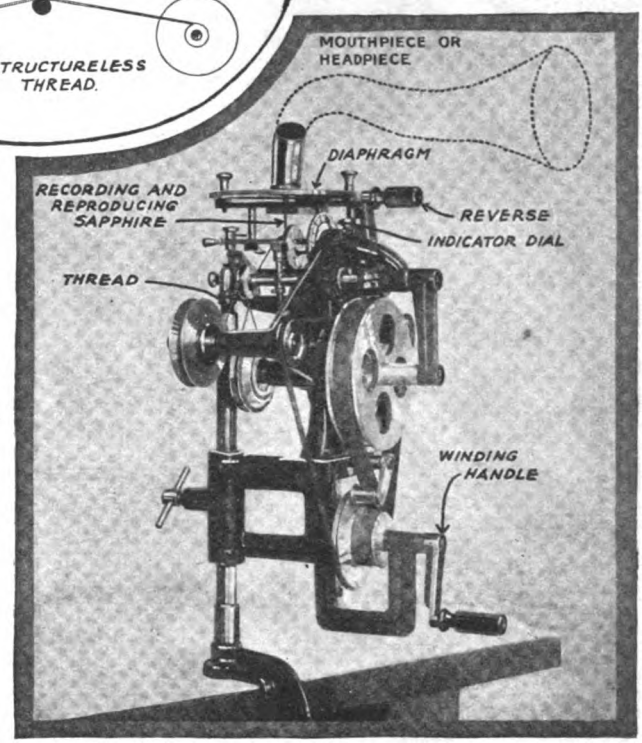
To those familiar with the recording and reproduction of speech in the usual phonograph, it is clear enough how this machine might work. But if we cause the recording point or stylus to impress ridges or depressions in the new celluloid thread, and if these undulations, corresponding in pitch and in tone to the variations of the voice, are drawn along under the edge of the reproducting stylus the sounds will be reproduced or translated from the moving thread.

How the "Talking Thread" Works

However simple this may be, the moot question arises after a little reflection, as to how the thread always passes back under the reproducing stylus without turning on its axis as it is reeled or unreeled on the spools of the machine.

It seems almost incomprehensible that this thread should unreel itself, as the winding mechanism of the machine is reversed, and the thread caused to always keep its *top face* (as we may call it, and which carries the vocal lines or record) uppermost so as to engage the lower end of the stylus which is attached to the diafram of the sound box.





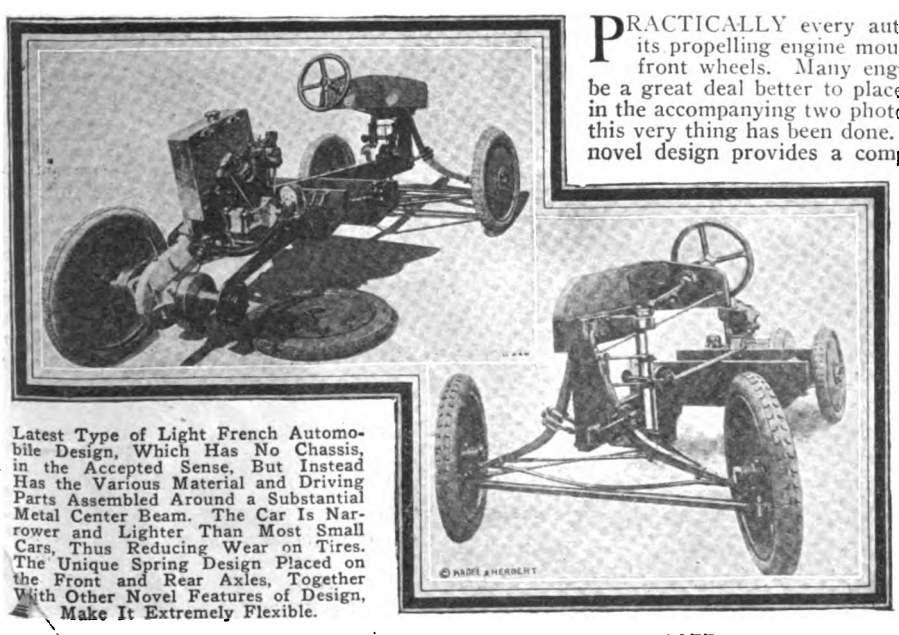
The Latest Idea in Talking Machines Is Shown in the Accompanying Diagram and Photograph. It Actually and Literally Records Speech on a "Thread," But This Thread Is the Most Wonderful Thread That You Ever Read About. It Is Absolutely Structureless and for This Reason It Will Unwind in One Direction or the Other From the Spools in Exactly the Same Position as That in Which It Was Wound Upon the Spool. The Voice Vibrations are Recorded by a Saffire Needle on the Moving Thread in the Manner Apparent; in Reproduction. These Indentations on the Thread Again Move Under the Needle and Cause the Diafram to Give Forth the Corresponding Sounds.

This is accounted for when we come to the description in the patent issued to the inventor, wherein he mentions the all-important fact that the thread used is of a *structureless* nature, that is, similar to the composition of which violin strings are made, which many of us are quite familiar with. Such a thread or string, as the inventor points out, will manifest no tendency whatsoever to twist, hence the same side of the thread will always face outward or uppermost, whichever way you please to call it—both during the recording and reproduction of the voice.

The thread must be made very uniform in diameter, and should also possess an extremely smooth surface, as otherwise there would be heard, of course, noises and other disturbances in the machine when it came to reproducing the voice.

(*Continued on page* 1147)

An Auto Without a Chassis

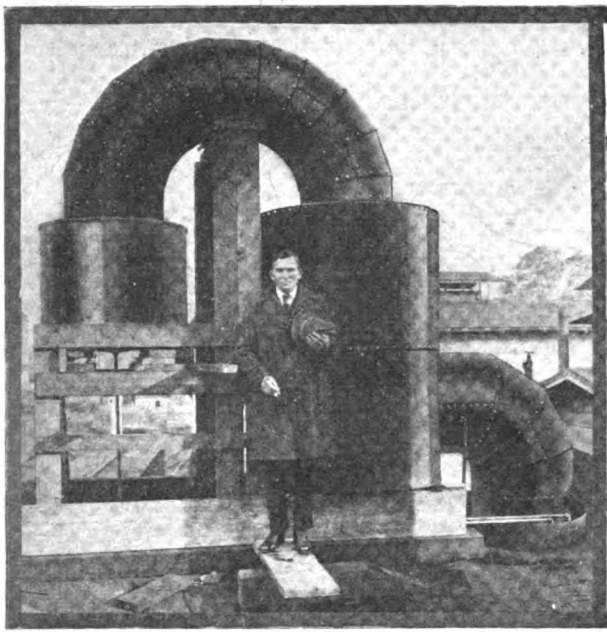


Latest Type of Light French Automobile Design, Which Has No Chassis, in the Accepted Sense, But Instead Has the Various Material and Driving Parts Assembled Around a Substantial Metal Center Beam. The Car Is Narrower and Lighter Than Most Small Cars, Thus Reducing Wear on Tires. The Unique Spring Design Placed on the Front and Rear Axles, Together With Other Novel Features of Design, Make It Extremely Flexible.

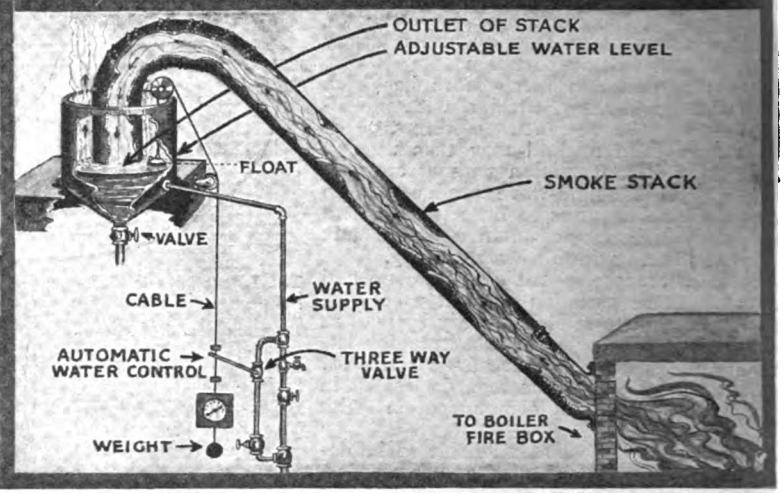
PRACTICALLY every automobile that we meet with now-a-days has its propelling engine mounted in the front of the machine or over the front wheels. Many engineers have suggested that it might possibly be a great deal better to place the engine in the rear of the machine, and in the accompanying two photographs of a recent French automobile design this very thing has been done. It is also surprising to note that this recent novel design provides a complete automobile without the body, less the chassis in the usually accepted sense. The machine is assembled around a substantial metal center beam. The front wheels and steering gear are the usual type, while the battery and other gages are mounted on the dash panel as the left-hand photo shows. The two-cylinder engine, with its radiator, mounted on the rear of the machine, drives the differential gear and rear axles thru an enclosed chain drive. Powerful cantilever springs support the rear axle in a very resilient manner, so as to provide extreme flexibility and easy riding qualities. The front axle is likewise given easy riding qualities by means of two long springs in the manner shown in the right-hand photo. This machine is provided with the latest thing in steel wheels and, above all, presents many highly desirable qualifications which would seem to warrant close study by American designers.

New Draft Device Saves Fuel

By HAROLD A. MOORE



Photograph At Left Shows the Inventor As Well As the Latest Installation of His New Chimney Draft Device, Whereby It Is Claimed That a Very Large Percentage of the Fuel Ordinarily Burned in Smelting or Other Furnaces, May Be Saved. The Diagram Below Shows the Simple Parts of the Invention.



THE illustration herewith shows the Anderson draft regulating device, which is said to have been successfully used on a cinnabar furnace in Washington. The principle on which it operates is the regulation of the draft by changing the height of water in a vessel, into whose top the end of the smoke pipe enters, being bent over so as to be vertical. The plane of its end is thus parallel with the surface of the water, and by a float or other similar type of regulation, the water level can be changed so as to modify the draft. The higher the water is, the less draft, and vice versa.

The photograph shows the device as installed in a large cannery plant. The diagram which is made up from the patent drawings, is self-explanatory.

The level of the water is shown quite close to the aperture of the pipe and this really constitutes the outer end of the smoke stack of the furnace.

It is evident that a very delicate regulation of draft can be produced by such a device and a diagram is shown indicating how the automatic feature can be attached. The float, rising and falling, opens or shuts the cock admitting water to the

(*Continued on page* 1141)

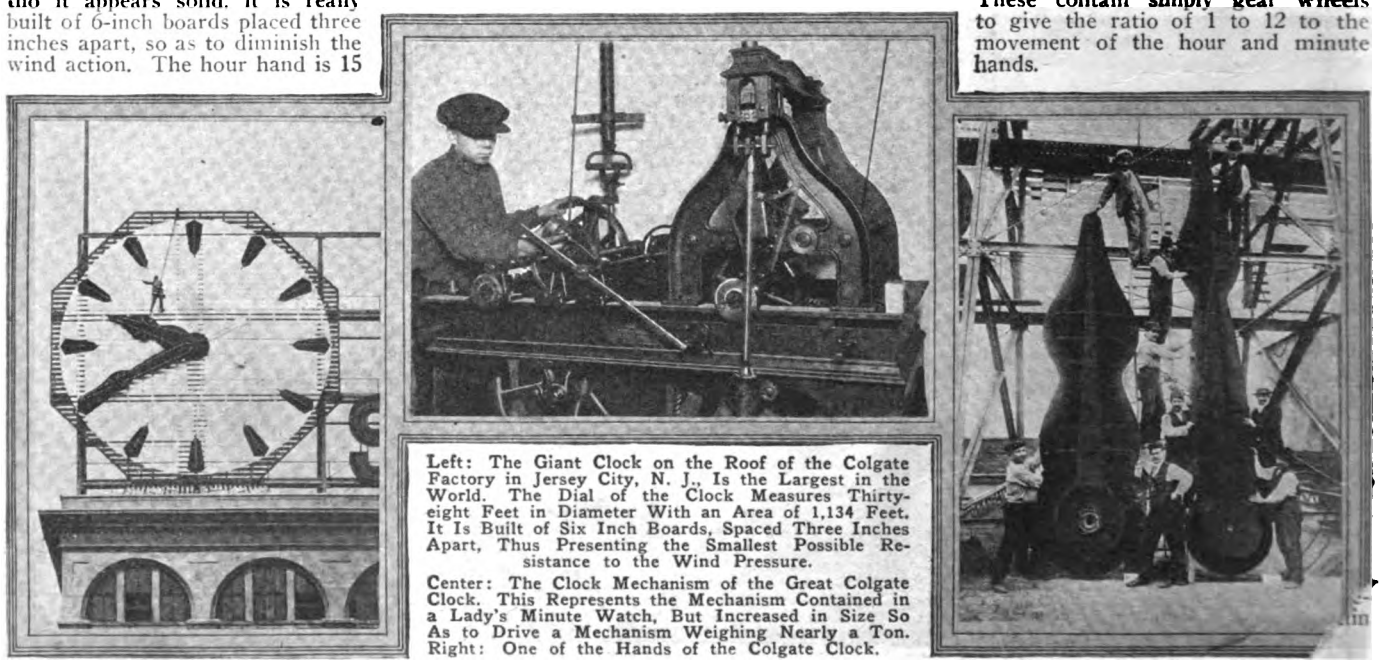
World's Largest Clock

Of the thousands of people who go across and up and down the Hudson River in ferry-boats every evening, between New York and New Jersey, comparatively few, perhaps, realize that the famous Colgate clock which beams upon them from the Colgate factory on the water's edge at the New Jersey side, is the largest clock in the world.

The dial is 38 feet in diameter, and altho it appears solid, it is really built of 6-inch boards placed three inches apart, so as to diminish the wind action. The hour hand is 15 feet in length, and at its widest point is 3 feet 10 inches across. The minute hand is 20 feet long, and has a counterpoise, the two weighing 640 pounds. The tip of the minute hand moves 23 inches per minute, covering in a day a travel of a little over one-half a mile.

The clock is extraordinarily accurate, seldom varying more than 30 seconds in a week. The driving mechanism is actuated by a weight weighing over half a ton. It is regulated by a pendulum 8 feet long, weighing over 400 pounds. A metal frame work, some 4 feet long, carries the movement.

From the clock work which is situated well below the clock, a shaft runs thru the roof to the works back of the dial. These contain simply gear wheels to give the ratio of 1 to 12 to the movement of the hour and minute hands.

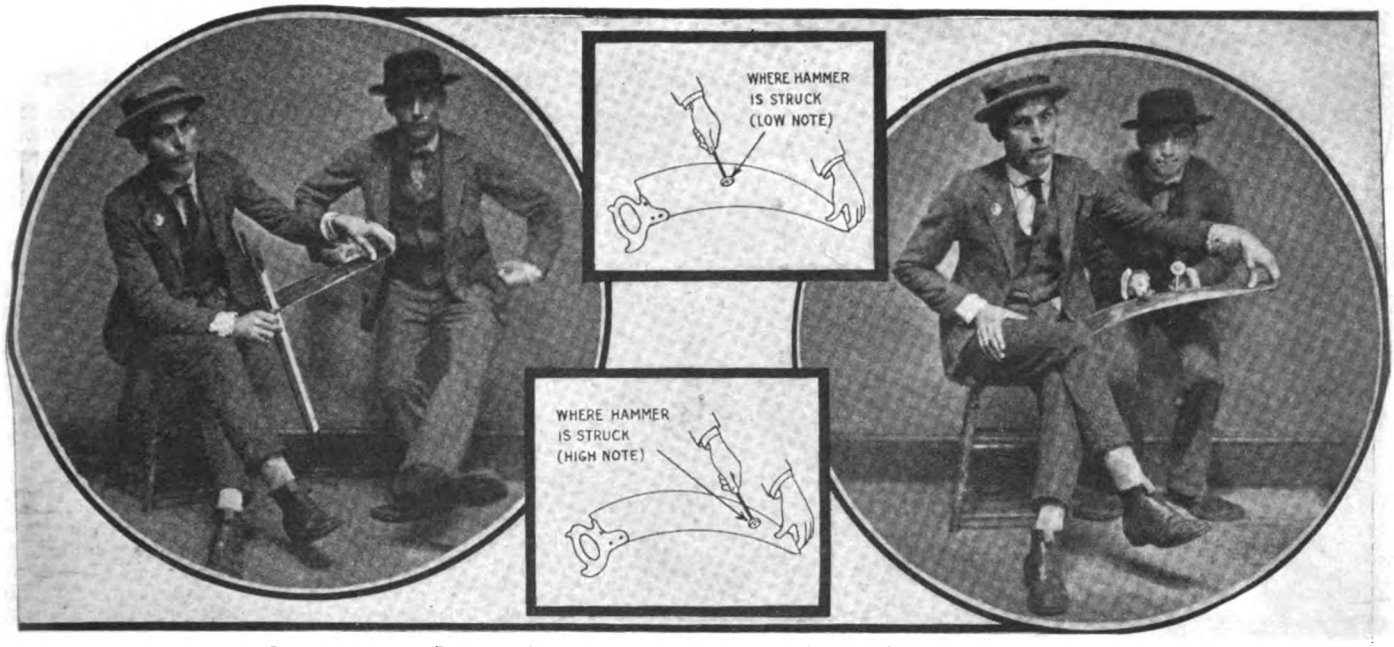


Left: The Giant Clock on the Roof of the Colgate Factory in Jersey City, N. J., Is the Largest in the World. The Dial of the Clock Measures Thirty-eight Feet in Diameter With an Area of 1,134 Feet. It Is Built of Six Inch Boards, Spaced Three Inches Apart, Thus Presenting the Smallest Possible Resistance to the Wind Pressure.

Center: The Clock Mechanism of the Great Colgate Clock. This Represents the Mechanism Contained in a Lady's Minute Watch, But Increased in Size So As to Drive a Mechanism Weighing Nearly a Ton.

Right: One of the Hands of the Colgate Clock.

Weird Music from a Carpenter's Saw



Music Like That From a Ukulele May Be Produced From Any Carpenter's Saw. In the "Greenwich Village Follies of 1920" One of the Charming Innovations is the Rendition of Several Selections by the Two Artists Shown in the Photos, and the Sweetest Music Imaginable is Produced by Simply Striking the Saw With a Felt Hammer or Else Bowing the Edge With a Violin Bow, Bending the End of the Saw as Well as the Entire Blade to a Different Arc for Each Note. With a Little Practise, You Will Be Surprised How Readily the Successive Notes of the Scale Can Be Played, and With a Sonority Sufficient to Fill a Large Theatre or Hall. Several Saws May Have to Be Tried Before a Real "Musical" One Is Found.

A REAL new musical instrument has been brought to the attention of the public thru the efforts of "Pee Wee" Myers and Ford Hanford in the *Greenwich Village Follies of 1920*, presented by the Bohemians at the Shubert Theater in New York City. This musical instrument is an ordinary carpenter's saw. The saw is of steel and according to Mr. Hanford, it was purchased in a "hock-shop."

During the entertainment, the writer went back stage to the dressing rooms of these extraordinary artists, and the following little history was extracted from Mr. Hanford, relative to his discovery of the common saw as a musical instrument.

"Coming from a western town," he said, "I knew that music could be produced by hammering nails into a board to different depths—the shorter the nail, the higher the tone. When these nails are bowed with a violin or cello bow and set into vibration, they produce a very peculiar note, and with a little practice, a real tune can be played upon these nails.

"Later on when purchasing a saw, I observed a carpenter buying a similar tool. He bent it and struck it a blow with the handle of a knife. The saw that vibrated the best, he purchased. I thought I would try the same scheme, and when I got hold of a saw, bent it in a similar manner and struck it a blow. Again striking it, I noticed that a different sound ensued. the cause of these two differences being that the saw had bent so as to conform with an arc of a different degree.

"Upon arriving home that night, I found that by striking the saw and bending it sharply, I could obtain a complete run of notes from the lowest to the highest, which on this saw was quite poor.

"After obtaining a collection of these carpenters' tools of all shapes and sizes, I experimented with the musical production of sound and obtained very satisfactory results. Later on, various hammers were tried and also the bass viol bow, well resined, was found to produce even finer music than when the saw is struck with a soft hammer.

"Eventually I learned to play this instrument well enough to enter my name on the theatrical circuit, and now I am here."

First, a clear vibration may be obtained all the way up the scale, but it will be found that the higher the note, the nearer to the end of the saw the hammer must strike.

Secondly, the saw may also be bowed with a violin bow and the position of the bow will vary with each note in order to obtain the same volume and quality of the note; likewise bowing nearer the tip gives a note higher than the one just played.

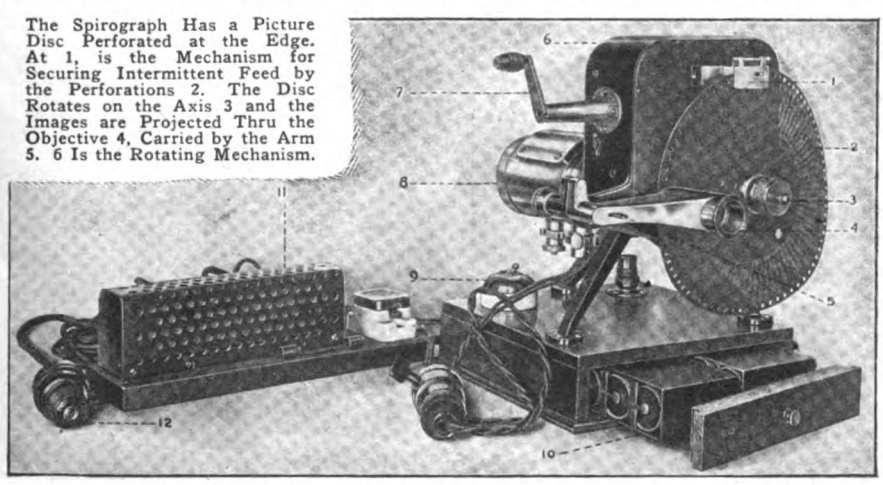
The Spirograph--Home "Movie" Projector

THE ordinary moving picture projector using long films is handicapt by the fact that the films are so combustible as to be almost explosive. The law and regulations of the fire underwriters' association have taken cognizance of this and the use of the moving picture machine is hedged about with quite rigid and necessary restrictions.

In the new Urban projecting machine there is no film. A glass disc 8 to 10½ inches in diameter, the latter it is hoped will be the average size, has photographed upon it, in a long continuous spiral, transparencies of the moving pictures. It is exactly comparable to a phonograph disc. In use, it is mounted on a machine and is rotated, the requisite intermission being produced by a suitable reciprocating mechanism contained in a bracket above the disc, as shown in the cut.

Practically on a level with the axis of the disc, is a projecting lens, which in operation slowly traverses the disc radially, as it rotates, so as to project the views successively upon the screen.

A 10⅜-inch diameter disc will contain 1,300 pictures, which is equal at the regulation spacing, to 81 feet of roll film; but in the roll film, when titles are to be given a good deal of space is lost, as they have to be repeated over several feet of film, so that they involve 15 to 20 per cent pure waste.



The Spirograph Has a Picture Disc Perforated at the Edge. At 1, is the Mechanism for Securing Intermittent Feed by the Perforations 2. The Disc Rotates on the Axis 3 and the Images are Projected Thru the Objective 4, Carried by the Arm 5. 6 Is the Rotating Mechanism.

The Divining Rod-Is It a Fake?

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

A Reproduction of an Old Print Taken from "De Re Metallica," Showing How They Viewed the Application of the Divining Rod 500 Years Ago, for Discovering Precious Metals. The Ancient Author Advises the Readers of His Book to Pursue the Regular Method of Detecting Ores by Digging and Sampling Rather Than to Depend Upon the Divining Rod. The Divining Rod is Not Given Credence by Scientists of Today.

ONE of the best treatises on the much-debated divining rod was presented to the *American Institute of Mining Engineers* in 1883, by the eminent mining engineer, Rossiter W. Raymond. It was publisht *in extenso* in the tenth volume of *"The Engineering News,"* New York City, in 1883. Since then a very valuable paper has been issued by the United States Government under the auspices of the *United States Geological Survey* of the Department of the Interior. The author is Arthur J. Ellis.

There is an astonishing amount of literature on this much-talked-about subject and the eminently unscientific appliance has a large coterie of adherents and of those who believe in its powers. It is claimed that an expert with the divining rod, walking over a subterranean current of water, will be able to detect its presence and exact location by the motion of the rod. This power is extended by many believers to include metals and ores, and it is also claimed that it can be used to detect and trace the flight of criminals.

If it works at all as claimed, we then have in this rod a profoundly unscientific instrument for which science affords not the least theory of such action as claimed for it, and which possesses the peculiarity of being absolutely subject to human control, and subject to very minute—almost imperceptible, muscular movements of the operator.

So true is all this, that a real scientific test of the divining rod is impossible, because its every movement is subject to the movement of the hands of the operator.

The first two illustrations, Figs. 1 and 2, are from photographs showing the operation of the rod. The divining rod is a forked twig. It may be held in the hands in various ways, but the manner shown in the illustrations is typical of the "dowser's" practise. This is the name given those who practise with this instrument. It will be seen in the first illustration that the end of the rod points upward, and in the second cut it is pointing downwards.

Even if the photographs of the hands are minutely studied, practically no change in their position can be seen, but their position *was* changed—they *did* move, and the motion of the rod was entirely due to the voluntary action of the person photographed under the direction of the author.

The action of the divining rod is based on mechanical movements which analyze about as follows, if we use some simple experiments:

To the center of a lead pencil, Fig. 3, a paper index may be secured with paste, as shown. If the pencil is held in the two hands horizontally, the index may be made to wave up and down by the very slight motion of finger and thumb. It can be rotated so as to make the index move up and down exactly as does the free end of the divining rod. The motion of the finger and thumb is easy to see because of the large diameter of the pencil.

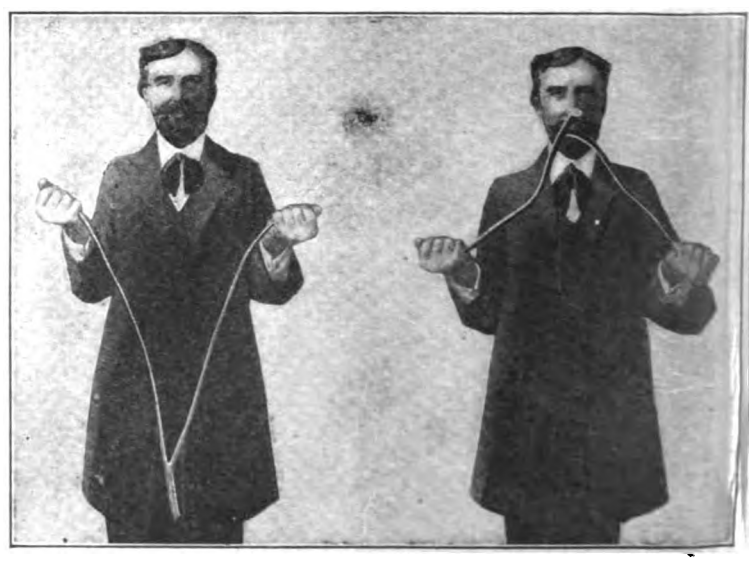
If for the pencil, we substitute an iron wire, Fig. 4, the motion of the fingers and thumbs required to produce the same rotation will be less, altho quite perceptible. Now take a piece of wire and bend it as shown in Fig. 5, holding it in the two hands as illustrated in the sketch. A slight downward pressure on *BB*, or an upward pressure at *AA*, will move its bent end, *C*, up. The reverse pressures will produce the reverse effect. If the bent portions of the wire are exactly in line with each other, as shown by the dotted lines, no effect on *C* will be produced by the changes of pressure just described. If, now, the bent rod is grasped between *A* and *B*, as shown in the illustrations of the real rod (Figs. 1 and 2) and held quite loosely, an almost imperceptible motion of the hands will operate the rod.

If, instead of grasping the wire loosely, it is tightly held, and if it is elastic, it will work still better. Again we may attach an index to a straight elastic rod such as a knitting needle, and by bending it slightly in the clenched hands, holding it in the required way, it will be found to be astonishingly sensitive to the smallest imaginable motions.

The elasticity of the rod plays a definite part in making the motions of the hand practically imperceptible. Now, going back to the rod at Figs. 1 and 2, there we have the ends bent outward as in our Fig. 5. The wood is highly elastic and the slight movements of the hand, which would escape any but the closest observer, will cause the ends of the rod to move up or down exactly as the operator desires.

While the divining rod has been and still

(*Continued on page* 1139)



Figures 1 and 2. To Demonstrate That but a Slight, Unnoticeable Movement of the Hands is Required to Cause the Twig Used by the "Dowser" to Move at Will, Cut a Twig of the Form Indicated. By Noting the Position of the Hands in This Picture, You Will See That the Person Demonstrating the Divining Rod Has Not Turned or Changed the Position of His Fingers to Any Appreciable Extent. Scientists of Today Believe That the "Dowser" Merely Fools Himself.

Is Electrocution Humane?

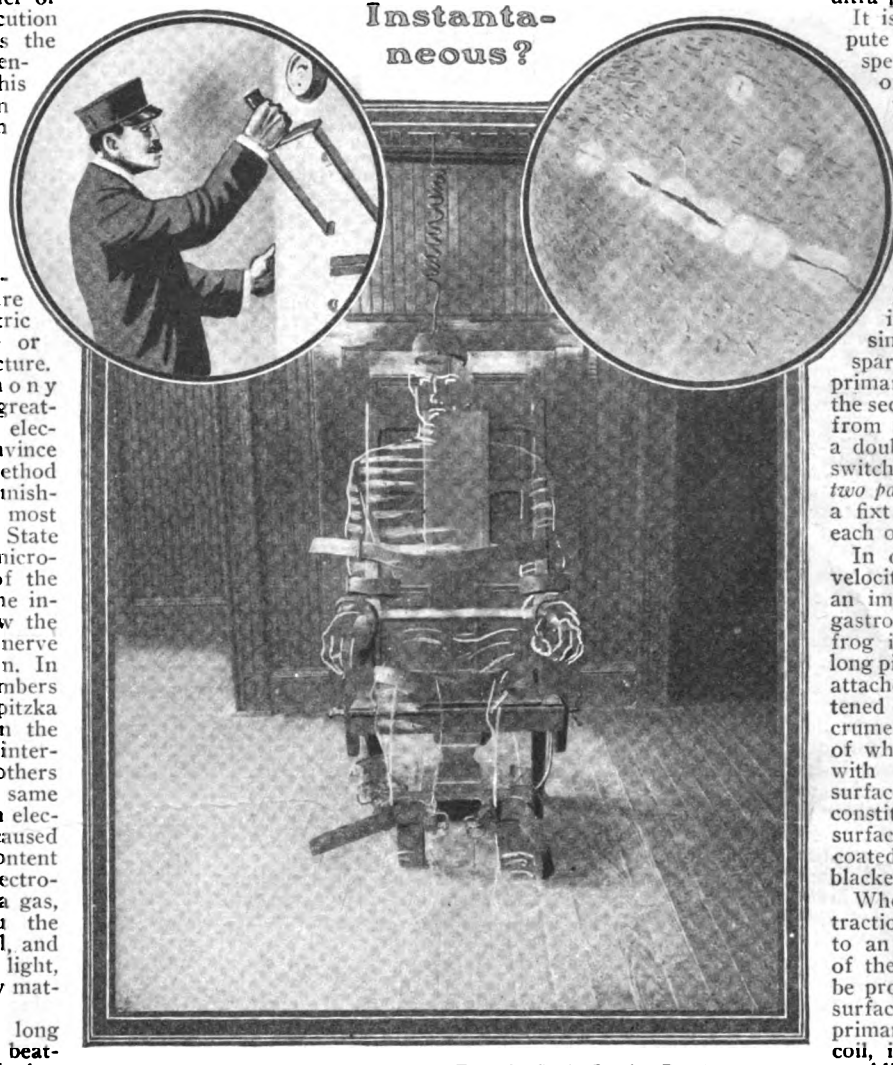
By JOSEPH H. KRAUS

Is Death via the Electric Chair Instantaneous?

WE have often wondered whether or not electrocution really causes the person sentenced to die by this means, any physical pain or mental distress. From facts obtained from persons who had been severely shocked by electricity, we learn that they experience a most excruciating torture. Whether this applies to persons who are killed via the electric route, has been more or less a matter of conjecture.

Dr. Edward Anthony Spitzka, probably the greatest living authority on electrocutions, would convince us that the electric method of applying capital punishment is by far the most humane course for any State to pursue. Years of microscopic examinations of the brain and nerves of the individual failed to show the slightest indication of nerve destruction in the brain. In only a few out of numbers of cases, has Dr. Spitzka discovered a lesion in the brain which has been interpreted by him, and others working along the same field, as being due to an electrolytic action which caused the plasma or fluid content of the blood to be electrolytically converted to a gas, which gas past thru the walls of a blood vessel, and was found as large, light, round areas in the grey matter of the brain itself.

Death often occurs long before the heart stops beating, it having proved that the heart of every human being will continue to beat for a considerable time after the actual death of the individual. This beat produces a slight murmur often heard in the physician's stethescope, and is said to be due to the "animal heart" of the individual. An animal's heart, we all know, will beat or continue to throb even after it has been removed from the body of the animal, if placed in proper solutions advantageous to itself, for instance, one of ordinary salt in water called a physiologic saline solution.



Above Is an Actual Photograph of the Electric Chair In the Death House at Ossining, New York. None Return After Having Passed Thru the Little Green Door and After They Have Been Strapped Into This Chair. In the Upper Right-Hand Insert Is a Microphotograph of the Only Lesion Ever Discovered In a Person Electrocuted. It Appears In the Cross-Section of the Brain Here Shown and Seems to be the Result of an Electrolytic Action Liberating Oxygen From Blood Plasma. The Oxygen Has Penetrated Thru the Blood Vessel Into the Brain Tissue and Is Seen as White Blotches.

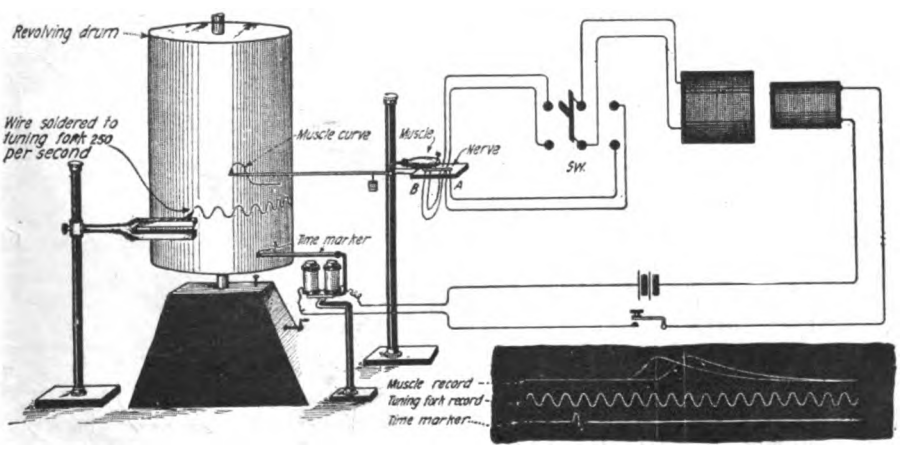
The fact that not even a union between two nerves or a nerve and a cell has been destroyed by the tremendously powerful shock proves that death is practically instantaneous. Such nerve destruction could obviously be seen under a microscope, but up to the present time it has not been found in spite of man's most extensive researches with ultra powerful microscopes.

It is rather easy to compute the difference in speed of nerve impulses or electrical stimulations traveling thru nerves and to compare these figures with those indicating the speed of electricity. We have shown how this is done with animals in the diagram presented herewith. For producing the *shock* a coil very similar to an ordinary spark coil, except that the primary is movable within the secondary, is used. Leads from the secondary pass to a double-pole, double-throw switch where they lead to *two pairs* of small bare wires a fixt distance apart from each other.

In order to measure the velocity of propagation of an impulse thru a nerve, the gastrocnemius muscle of a frog is prepared, leaving a long piece of the sciatic nerve attached. The muscle is fastened to one end of a fulcrumed lever, the other end of which is held in contact with the rapidly moving surface of a revolving drum, constituting a stylus. The surface of the drum is coated with paper previously blackened or smoked.

Whenever there is a contraction of the muscle due to an electrical stimulation of the nerve, a record will be produced on the moving surface. In series with the primary of the induction coil, is a *time marker*, resembling to a very great extent, an ordinary electric bell with the exception of the circuit breaker and which has in place of the clapper, a quill point. This is also placed in juxtaposition with the revolving drum.

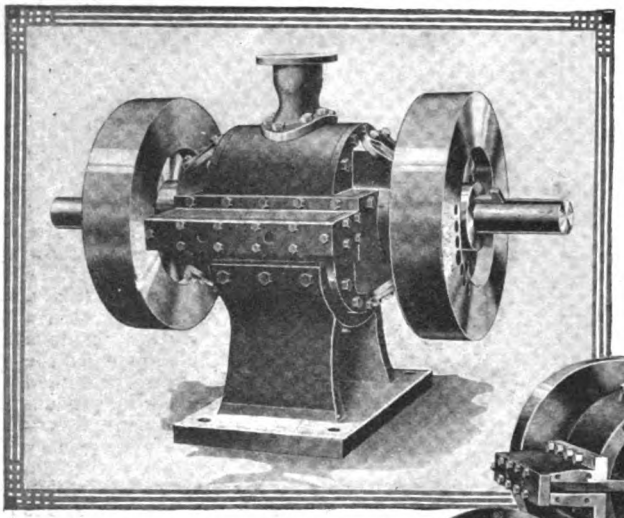
When, now the key in the primary circuit is closed, a current is induced in the secondary of the coil practically instantaneously. At the same time, the time marker produces a vertical notch on the rapidly revolving surface. Tracings are now taken of the contraction first when the double-pole switch is thrown in such a way that the nerve



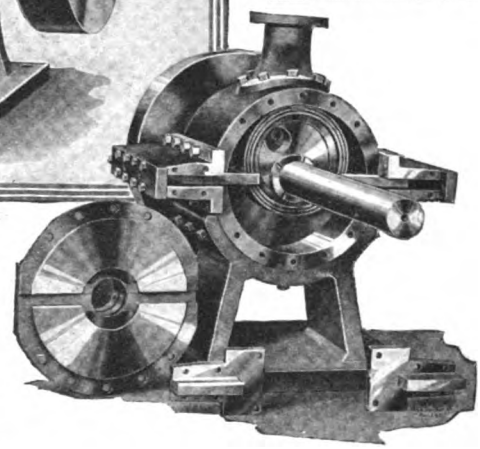
Here Is Shown a Method of Making a Record for Demonstrating the Speed at Which a Nerve Can Transmit an Impulse. A Muscle Is Fastened to a Recording Device and the Nerve of That Muscle Is Stretched Upon a Board. Here Two Sets of Contacts are Placed In Juxtaposition With the Nerve. When the Switch Is Thrown to the Right the Nerve at A Is Excited Upon Pressing the Key; It Will Take a Definite Time for the Muscle to Contract and Form a Curve on the Record. When the Nerve at B Is Excited, the Time of Contraction Is a Little Shorter. The Distance Between the Two Contacts Is Then Measured and the Difference In Time for the Two Contractions Is Measured by Means of a Tuning Fork; In This Manner the Speed of Nerve Impulse Propagation Is Determined.

(*Continued on page* 1143)

New Rotary Steam Motor



At Left—External View of the New Bannon Rotary Steam Engine, Complete with Fly-Wheels, Which May Drive Belts Connected with Other Machinery, or Else the Machinery to Be Driven Can Be Directly Connected with the Shaft of the Engine. Photo Below Shows Interior of New Rotary Steam Engine, the Cap Being Removed From One of the Cylinders.



AN engine has been built—the first successful Rotary Steam Engine, which promises an enormous saving of materials required in its manufacture and in the saving of steam and labor required in its operation. It was invented and perfected by Frank A. Bannon, of Dallas, Texas.

Army officers, civilian engineers and others were invited to see the first test, which was perfect, it is claimed. The engine did all that was expected of it and more. The small motor, no larger than Mr. Bannon's hat, was put on the brake-test and it developed over 17-horse-power!

Another and larger engine was immediately built. It weighed about 600 pounds, was 24 inches high, 18 inches in width and 20 inches long, and when tested at 200 pounds steam pressure, developed more than 75-horse-power on the brake test.

Other engines of varied sizes, and designed for various uses, were built, so that soon Mr. Bannon had perfected engines from 1-horse-power to 500-horse-power and with a range of speed of from the very slowest movement to more than 3,500 revolutions per minute.

Briefly described, the Bannon Rotary Steam Motor is a very compact steam engine and in its construction there is used only about one-fifth the materials of a slide-valve engine of the same horse-power. Its compactness effects a saving not only in the material and labor used in its construction, but also a saving in foundations required and in space in the engine room. The most startling thing about this engine is that it has only three moving parts; an eccentric piston, keyed to the drive shaft, and two sliding gates, which operate with their ends forming contact with the perifery of the piston. These three simple moving parts are the heart and soul of the engine, and any man, whether a mechanic or not, can quickly tear down and rebuild a Bannon engine, because it is so simple and easily understood.

On the shaft of the two-cylinder engine there are two of these eccentric pistons, 180 degrees apart, which balances the shaft perfectly and eliminates all possibility of thrust on any bearing surface. Another startling thing about the engine is that there is positively *no reciprocating action* to overcome and consequently no loss of steam and fuel, which is always experienced in overcoming the reciprocal action of slide-valve engines.

The simple and elementary laws of mechanics have been employed thus for the first time in steam engines. The principle of the lever is employed by having the steam expand against a revolving eccentric piston in such a manner that the leverage of the piston greatly multiplies the steam energy.

This Rotary engine is not at all like a turbine, inasmuch as the turbine derives its power from the Kinetic energy of the steam, while the Rotary engine operates *on steam expansion*, and it will start off with any load that it will carry subsequently; this a turbine was never known to do.

The Rotary engine can be manufactured for less than one-fifth the cost of any other engine of the same horse-power and can be sold at a great saving to the industries putting it in use—for instance, a Rotary engine costing $500.00 will exceed in performance any other engine costing $3,000.00 or more, because of the wide range of speeds and the very high speed that it is capable of developing. No belts are required with this engine, for the engine can be coupled directly to the line shaft and this will do away with slipping belts and the waste of energy thus occasioned. The Rotary engine works longer on each impulse of steam than any other engine, for each impulse drives the shaft *three-fourths of a revolution*, and as there are two impulses per revolution in each cylinder an overlap of 90 degrees always results.

Flying As A Coming Sport

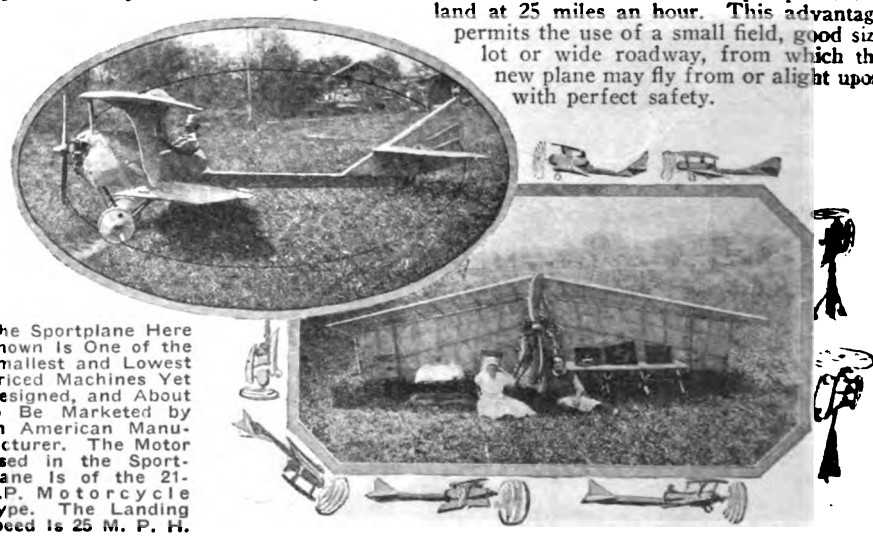
FLYING thru the air, a fascinating sport that has thrilled millions of people thruout the world, will shortly become popular, owing to the foresight of several aircraft builders, who have devoted their efforts to the manufacture of a small, moderate-priced Sportplane, that comes within the reach of a man or woman of moderate means.

$2,000 is the average price of the Sportplane, and the operating cost per hour for fuel is 60 cents; whereas the large airplanes sell from $6,000 upward, with the operating cost for fuel averaging $3.50 per hour.

The Sportplane will require a building or hangar 25 feet wide by 20 feet deep by 7 feet high to house it when not in use. For the city man or surburbanite who may find time to fly only on week ends there is no need to erect the hangar mentioned above, since with ten minutes' work, one person can remove the four wings from the body and keep the Sportplane in a shed 9 feet wide by 20 feet deep and 7 feet high. Reattaching of the wings to body in preparation for flight will require twelve minutes' time, also a one man's job, no assistance being required, and since there are no turnbuckles to tighten, no bolts and nuts used, there is no danger of loosing any parts, since all pins, etc., are attached to the wings by small chains and cannot get lost.

The motor used in the Sportplane is a special 21 H.P. two cylinder-air-cooled, simple and easy to run and very reliable. Its location at the forward end of the plane permits ready adjustment. The parts are easily obtained at most any agency, which are located all over the United States.

The landing speed of the Curtiss is 38 miles an hour, whereas the Sportplane will land at 25 miles an hour. This advantage permits the use of a small field, good size lot or wide roadway, from which the new plane may fly from or alight upon with perfect safety.

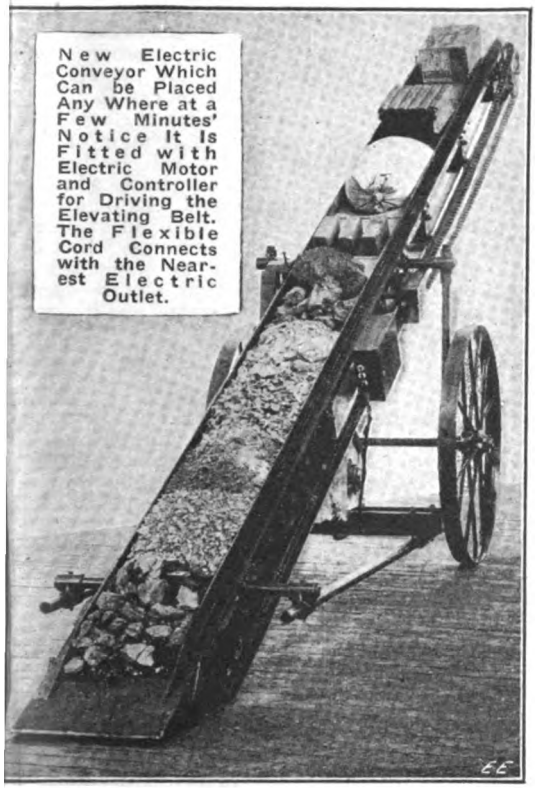


The Sportplane Here Shown Is One of the Smallest and Lowest Priced Machines Yet Designed, and About to Be Marketed by an American Manufacturer. The Motor Used in the Sportplane Is of the 21-H.P. Motorcycle Type. The Landing Speed Is 25 M. P. H.

Portable Electric Conveyor

To secure economical operation and greater efficiency in handling material, labor must be supplanted by machines, and these selected which are best adapted for the particular work. Men with wheelbarrows are too costly to use in storing, moving or loading material, but, at the same time, the old style conveyors required a great deal of labor in shoveling the material up into the receiving hoppers.

A new type of portable electric motor-driven conveyor, which cuts down the labor of feeding one-half, is shown in the accompanying illustration. The most distinctive feature of this machine, called the *Scoop Conveyor*, is the scoop on the feeding end, which can be pushed or completely buried into the material to be conveyed. This makes it possible to simply scrape the material onto the carrying belt instead of lifting it up by shovelfuls into the feeding hoppers of ordinary conveyors. The figure shows a 19-foot 8-inch length scoop conveyor with a 16-inch width of belt and driven by 2 H.P. electric motor.



New Electric Conveyor Which Can be Placed Any Where at a Few Minutes' Notice It Is Fitted with Electric Motor and Controller for Driving the Elevating Belt. The Flexible Cord Connects with the Nearest Electric Outlet.

As may be seen from our illustration, the scoop conveyor is strongly constructed, light in weight, compact and portable. The steel frame holding the rollers and conveying belt is mounted on the wheels so the balance is perfect. One man, by inserting the pipe handles into the ends of the horizontal members, can easily lift and move the machine.

The electric motor or gasoline engine mounted under the frame transmits power to the conveyor by means of a chain and sprocket connection to a shaft extending beneath the conveyor. From a sprocket on the other end of this shaft the power in turn is transmitted to the driving sprocket, located at the upper end of the conveyor.

The carrying belt is a high grade of heavy duck and rubber conveying belt and duck cross strips. These transverse cleats are provided to prevent the material from slipping back down the incline. The scoop conveyor is made in three different sizes, 13' 8", 19' 8", and 24'. The width of the conveying belt may be either 12" or 16".

Now the Flying-Bicycle

M. Paulain, a French cyclist of note, recently won the flying-bicycle contest held on the Longchamps race track, near Paris, France.

Right:—Who Said That a Man Could Not Lift Himself by His Own Energy? This French Cycle-planist Proved It. A Flying-bicycle Race Was Recently Held in France. M. Paulain, a French Cyclist of Note, Recently Won the Flying-bicycle Contest Held on the Longchamps Race Track, Near Paris. A Bicycle, an Upper Wing and a Lower Wing with Supporting Struts and Stays Make Up the "Aivette," as This Peculiar and Interesting Flying Craft Is Called by Its Designer.

The photograph shows the designer and his odd craft, modeled closely on the lines of the familiar airplane.

A bicycle, an upper wing, and a lower wing and supporting struts and stays make up the "Aivette," as the peculiar outfit is named.

The feet working the pedal wheel at greet speed supplies the motive power. After speeding along on a level stretch for some distance sufficient speed is obtained to cause the machine to rise in the air and sail along thru space, until motive power weakens. A distance of 40 feet is easily negotiated with the Aivette, which provides a lot of sport.

Subway Tracks Wear Fast

In a recent issue of New York's enterprising little subway journal, "The Subway Sun"—published now and then by the Interboro Rapid Transit Company, as its headline announces, there recently appeared an interesting article for the education of the subway "straphanger's brigade" and also the "settees," the following interesting information regarding the rapid wear on the track rails.

Listen to the logic of Mr. Theodore P. Shonts, deceased President of the Interboro and formerly Editor of "The Subway Sun":

"The subway is the safest railroad in the world, and we keep it safe. One thing, for example—steel rails. The life of a subway express track rail is about three years, one-third being replaced each year. It is done at night. Such rails on the big steam railroads last about ten years. On sharp subway curves we replace rails in about ninety days.

"We have been using about 38 miles (3,000 tons) of the best 'open hearth' rail a year on the subway, and about 30 miles more on the elevated. Subway rails cost $30 a ton in 1914, but they cost $47 a ton now."

Here's What Happens to a New York Subway Rail After 3 Months' Service on City Hall Loop.

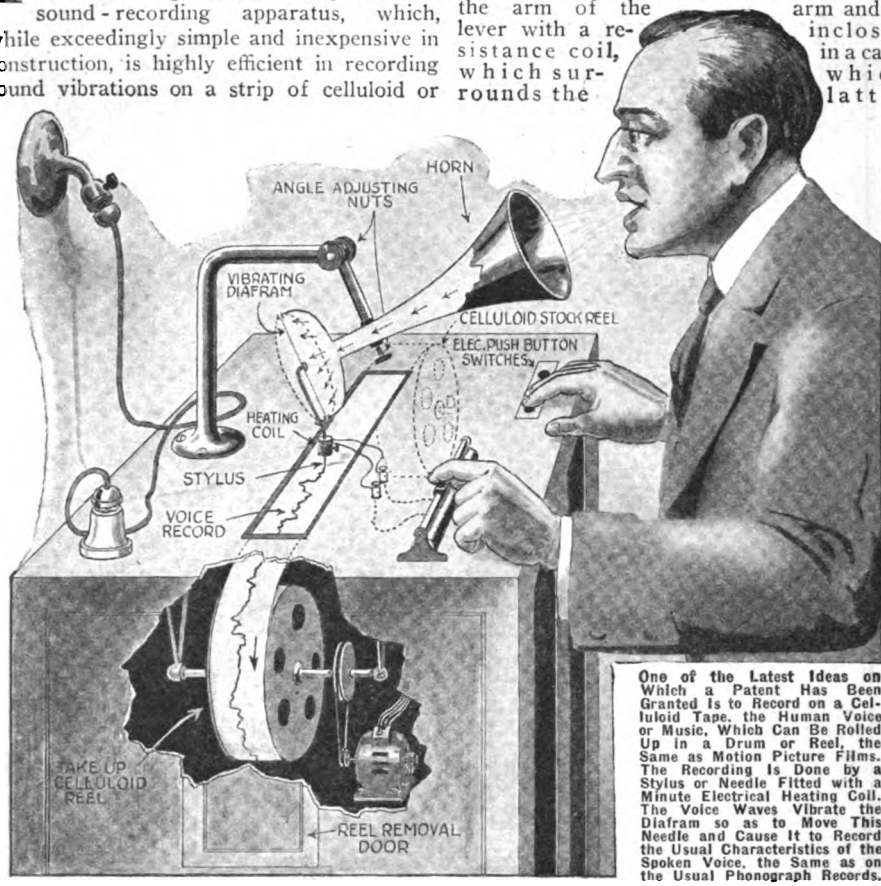
And the accompanying illustration, copied from our estimable contemporary, shows what happens to one of the Interboro's choice steel rails after three months' service on the City Hall loop of the New York subway.

It's a wonder some genius doesn't awaken to the fact that for half a century we have had the same old story when it comes to car rails. There ought to be a way of minimizing the wear, especially on loops or curves, such as by providing auxiliary rails against which wheels on the side of the car could bear as the train negotiated the curve or loop, et cetera. There ought to be another way of designing the rails and improved methods of hardening them. Why not make them hollow and bigger?

Records Sound on Piece of Tape

THIS invention pertains to a new means for recording sounds and provides a sound-recording apparatus, which, while exceedingly simple and inexpensive in construction, is highly efficient in recording sound vibrations on a strip of celluloid or other material and this accurately and delicately so that the variations in the sound are faithfully brought out.

In furtherance of this idea Mr. Christian Moore, the inventor and patentee, provides the arm of the lever with a resistance coil, which surrounds the arm and is inclosed in a case, which latter is adjustably fixt upon the arm thru the medium of a set screw, as shown in the illustration. From this it follows that the resistance coil with its case may be expeditiously and easily fixt in an adjustable manner on the arm of the stylus lever, and hence the position of the resistance coil relative to the stylus may be nicely varied, according to the extent to which it is desired to heat the stylus in order to produce the best recording results on the material of which the strip or body is composed.



One of the Latest Ideas on Which a Patent Has Been Granted Is to Record on a Celluloid Tape, the Human Voice or Music, Which Can Be Rolled Up in a Drum or Reel, the Same as Motion Picture Films. The Recording Is Done by a Stylus or Needle Fitted with a Minute Electrical Heating Coil. The Voice Waves Vibrate the Diafram so as to Move This Needle and Cause It to Record the Usual Characteristics of the Spoken Voice, the Same as on the Usual Phonograph Records.

Manifestly, when the switch is closed and current is sent thru the convolution of the resistance coil, the stylus will be heated and in that way will be adequately adapted to accurately record sound vibrations on or in a strip or body of celluloid or other material suitable to the purpose. It will also be readily seen that by manipulating the switch, or else a rheostat, that the operator is enabled to quickly and easily vary the heating of the stylus and in that way produce the best results in the record-making.

It will further be noted that inasmuch as the resistance coil is carried in a case adapted to be handled as a unit, the resistance coil and its case may be expeditiously and easily fixt upon and as readily moved on the stylus lever when occasion demands.

The machine, as here shown, is provided with current-regulating rheostat, also electric motor for pulling record tape past the stylus and winding it upon drum at left. A suitable needle resting on the moving tape and following the record groove thereon serves to actuate a diafram in the usual manner and thus gives a reproduction of the speech thereon.

One of the interesting aspects of this method of recording vocal or musical selections, lies in the fact that the record in the form of a sliding film or tape is practically unbreakable, which is not the case with the present form of record. Thousands of words can be recorded on a thin and narrow celluloid tape and reeled up in the same manner as motion picture films. These reels can then be mailed or transported otherwise.

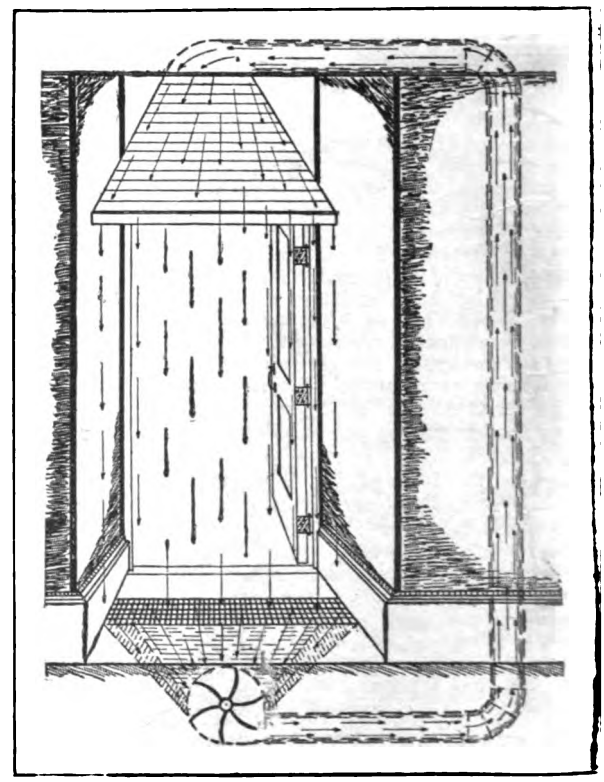
Wind Substitutes Ordinary Door

HENRY H. CUMMINGS, a Boston inventor, has devised a clever scheme for wind to take the place of the ordinary door for the purpose of preventing rain, snow, flies and other insects from entering stores and offices, etc. This invention is commonly known as the "doorless door" and consists of a constantly flowing air current produced by means of a motor-driven fan, situated below or behind a grill in the entrance to the premises and is arranged to draw the current of air downward from the upper portion of the door entrance. The air is then carried thru a duct or tube to a hood above the door and is next discharged downward, thereby creating a complete cycle.

It is a proven fact that when a quarter of a horse-power motor drives a 16-inch fan, which is connected with a duct nine to twelve inches in diameter, which provides a current of air under approximately 3-inch water pressure, a person standing in the doorway will not notice the current.

However, the current thus obtained is sufficient to keep out insects, rain, snow and chill air. Any store or office equipt with a *doorless door* will find a remarkable increase in business, resulting from its use—and better still it costs but *two cents per hour!* This is indeed a great boon to trade and will undoubtedly find great popularity in the business world, inasmuch as it is simple in construction and its cost of maintenance low.

Besides being an effective barrier against insects, rain and snow, this simply constructed doorless door is of clean and neat appearance, thereby actually inviting customers into the store. Most probably, by the time another summer makes its debut, hundreds of these doorless doors will be put into operation; and it will not be until then that its real value will be truly realized,—for no door serving its purpose as well as it does, can be had for such a nominal cost and effect such excellent results. And no longer will this cleverly devised insect and rain barrier be considered a new and novel contrivance, for it will be so extensively utilized that it will be considered as nothing unusual. ROSE HARRIS.



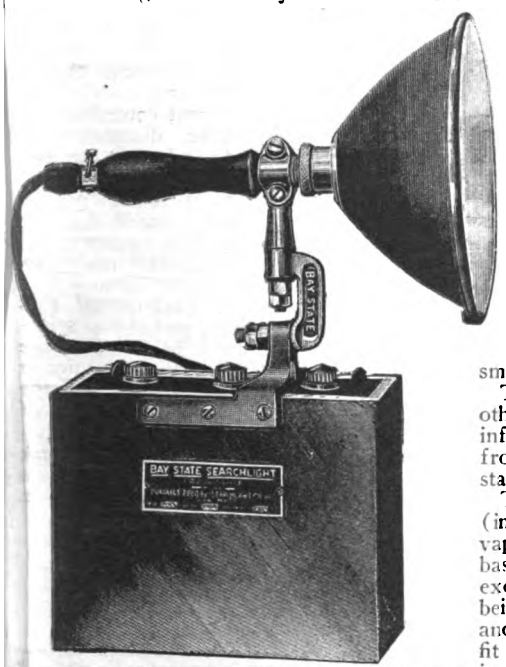
This Doorless Door Devised by a Boston Inventor, Consists of a Constant Current of Air Being Blown Downward by a Motor Driven Fan, and Thence Up Thru a Duct to a Hood Above the Door, Where the Air Is Again Discharged. Thus, a Complete Cycle Is Formed. This Extraordinary Door Prevents any Insects, Snow or Rain from Entering the Premises, and Its Cost of Maintenance Is Extremely Low. It Can Be Used in Both Winter and Summer.

NEW ELECTRICAL DEVICES

BATTERY SEARCHLIGHT FLASHES BEAM 100 MILES.

For use by repair departments in locating and repairing trouble on pole lines, in manholes and for trench work, a Boston concern is now making the portable battery searchlight shown in the accompanying illustration. This is a self-contained searchlight operated by a storage battery, which is of such a size as to permit the use of the lamp continuously for 2½ hours and much longer when burned at different times. The lamp is mounted on the adjustable bracket as shown, which makes it possible to direct the rays where needed. The lamp has a 7½-inch adjustable focus with single shell reflector which, on a recent photometer test the makers claim, gave 453,000 beam candle power. Under ordinary conditions the lamp is said to throw its rays a distance of 2,000 feet, and for signaling purposes the beam can be seen a much longer distance.

The maker points out that the battery can be charged from any direct current



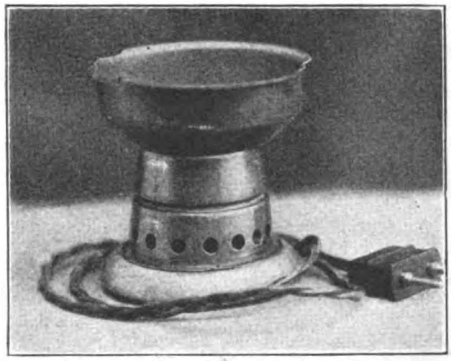
Portable Battery Searchlight Weighing But 16 Pounds, Which Throws Rays Nearly One-half Mile. Its Beams Has Been Seen 100 Miles Away in Actual Government Tests.

house lighting circuit by simply using one or more incandescent lamps as resistance. When recharging from an alternating current circuit, a rectifier must be used. The outfit weighs 16 lb., and can be easily carried by means of the handle provided at the connection of the lamp to its adjustable bracket. This is the searchlight that was used in the recent test from the top of Mt. Washington to Portland, Maine, 67 miles distant. The searchlight, however, was at the time seen by a ship out to sea 97 miles from the top of Mt. Washington. Many of these searchlights were used by U. S. Army and Navy during the war for signaling and multifarious other purposes.

ELECTRIC ATOMIZER PURIFIES AIR.

The electric atomizer here illustrated, otherwise known as an "electric hygienic disinfector and air purifier," is truly a source of health in every home; in fact, it is an up-to-date and modern need for every family, *whether healthy or sick.*

This new device, by constant hot evaporation of the strongest tablet or liquid preparation, produces an effective barrier against all acute and chronic diseases of the respiratory organs. The vaporization of only a few drops of expectorant or soothing remedies, either in liquid or solid form, as also the essences or perfume of flowers,



New Electric Atomizer Provided With Heating Coil in Base, and Very Desirable For Fumigating Sick Rooms, Scenting the Air.

is all that is necessary to obtain an instantaneous purification of the air. Even pure water can be utilized for the purpose of making the room fresh and airy.

The vapors thus produced constitute a modern healing process and have a soothing and healing effect in coughs, cold in the head, hoarseness, asthma and influenza, and are also most efficacious in the treatment of tubercular affections. These inhalations are indeed much more in advance of the usual oil and water syringes in cases of serious illness, due to the fact that they require all gases evolved to combine with the atmosphere, and thus the purified air will be drawn into the smallest branches of the bronchial tubes.

This remarkable air purifier has also another important use, and that is for the disinfection and elimination of all bad odors from sick rooms, bedrooms, damp floors, stables, etc.

This atomizer consists of a rubber cup (into which the desired liquid is placed and vaporized) and is mounted on a fireproof base. It is made with brass, nickel or silver execution, and is always ready for use, it being necessary to only connect the cord and plug arrangement included with the outfit to any electric socket, thereby furnishing the electric current for vaporization.

LAMP-SOCKET ELECTRO-MEDICAL TREATMENT.

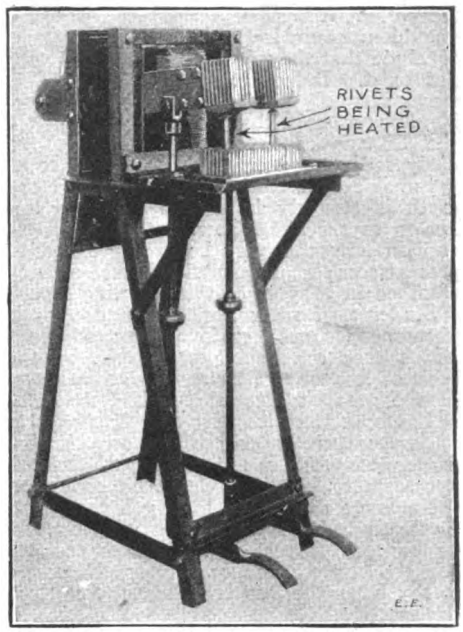
A new and novel outfit has recently been put on the market which permits the using of commercial electric current for medical purposes. It can be attached to any socket, the same as an electric lamp. A regulator

slider is provided, whereby simply moving it up and down over a coil of resistance wire wound on a porcelain tube, very fine current graduations may be secured. The resistance coil is protected by a nickel plated case, suitably perforated for heat dissipation.

When attached to an alternating current circuit, a true sinusoidal current is obtained. A galvanic current is obtained from the attachment when connected to direct current. It is possible to obtain from one to twenty-five milliamperes of current, either thru the metal handles or thru the sponges. For ordinary medical treatments, a current varying from ten to fifteen milliamperes is generally used. When attached to a direct current circuit, galvanic current equivalent to 30 to 40 cells is available, and when used on alternating current, as much current may be drawn as that produced by larger and more expensive outfits.

HEATING RIVETS BY "JUICE."

The coke forge and the oil-burning furnace for rivet heating promise to become



The Latest Idea in Rivet Heaters—It Operates by Electricity and Does Away with the Old Coal or Oil Fire and Forge, Besides Giving a Much Greater Output Per Hour.

things of the past, now that electrical engineers have devised a new electric rivet heater which in tests has proven much more efficient and economical than the old methods. A great saving of material and time as well as improving the sanitary conditions for the worker are the outstanding features of this new device.

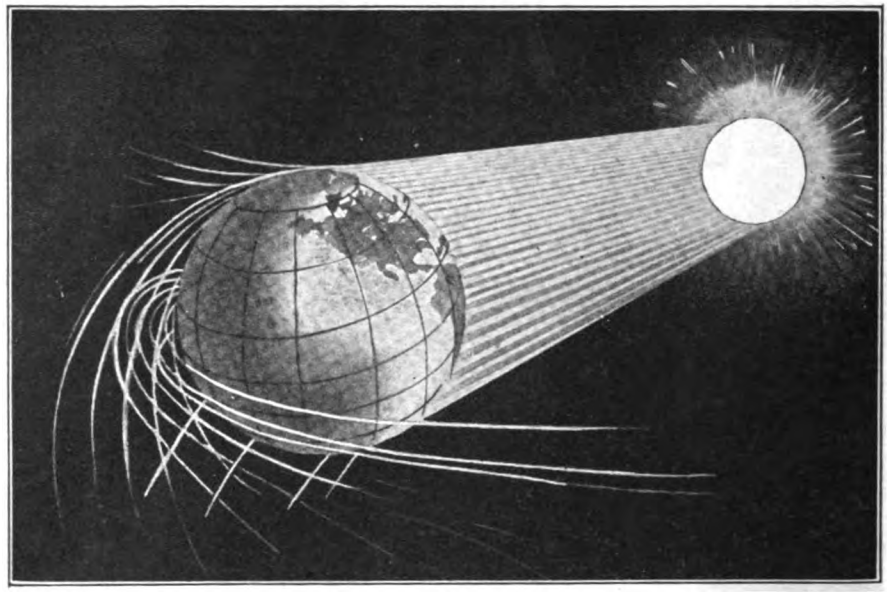
A first glance at this machine gives one the impression of a portrait camera on a tripod. The rivets are placed between two electrodes and this completes the circuit and they begin to heat, much the same as coils in an electric toaster. The electrodes holding the rivets can be operated separately by the use of foot pedals, thus the man operating the machine can take out a heated rivet from one side, replace it with another to be heated and then alternate to the other side for his next heated rivet. A switch on the back gives the variations of current to be needed in heating rivets of different sizes.

This machine is capable of heating 800 rivets per hour, believed to be the maximum number an operator can handle. It is said this number can be increased but at present there is no demand for a quicker heating.—*Photo courtesy General Electric Co.*

The Sun's Unknown Rays

By ROGERS D. RUSK, M. A.

WHAT mysterious rays does the Sun give off in addition to light and heat? We speak of the Sun as the center of energy of our solar system. It constantly radiates energy in various forms. Not only are light and heat received by the earth, but electric and magnetic disturbances are frequently detected. These are all forms of energy—but what is energy? We only know it thru its various forms, and because our senses do not immediately detect other forms we should not unwisely conclude that they do not exist. Indeed it seems not only possible, but probable, that the Sun is continuously radiating energy in forms we are as yet unable to directly detect, and that the earth is strongly influenced by these unknown rays. The following article aims to explain how this may be the case and to present some experimental evidence already obtained in support of this startling fact.



Electrified Particles Shot Off from the Sun Would be Bent Around the Earth in This Manner by the Earth's Magnetic Field.

Students of solar radiation find strange phenomena and curious contradictions which they are unable to explain on the basis of known radiations. The Sun is one of the greatest mysteries of the universe. It has been "burning" for countless ages at a temperature higher than any known flame, and yet it is not consumed. It does not seem to be the slightest bit cooler on the average than when history began. The Sun has periods of variable activity, marked by sunspot formations, when it radiates slightly varying amounts of heat. Strange to say when the Sun is hottest the earth is coolest.

If the Sun is radiating energy without its total quantity becoming less, then it is either an inexhaustible reservoir, or else it must be receiving energy in some unknown form as fast as it is radiating it in the forms we know. This, of course, is only a suggestion of what might be. Where the energy of the Sun comes from, we do not know. We do know, however, that, in so far as we are able to tell, the Sun has not cooled a fraction, and one estimator states that if the Sun's heat decreased so as to change the temperature of the earth by a single degree on the average, there would be a gradual return of the glacial period. The ice caps would creep down from the poles and the earth would become uninhabitable again.

That streams of electrified particles are shot off from the sun and affect the earth was first suggested by Prof. Birkeland in 1896, who attempted to explain magnetic storms and polar auroras by their means. This theory has been advocated by many scientists since and is the most popular explanation of auroras today. It is a well known fact that intense heat breaks up nearly all substances into electrified particles called ions, and the Sun's extreme temperature may even liberate free charges of electricity. If streams of these particles were shot past the earth they would be bent by the earth's magnetic field as shown in Fig. 1. The slower moving particles would be bent the most, and some even would encircle the earth. The possibility of these particles being shot off by the Sun, Lord Kelvin and Schuster denied, and M. Villard, who spent much time investigating the subject, suggested that the electrified particles were liberated from the clouds in our upper atmosphere and the function of the Sun was to liberate these particles by some unknown rays. There has been little confirmation either way as to this, however.

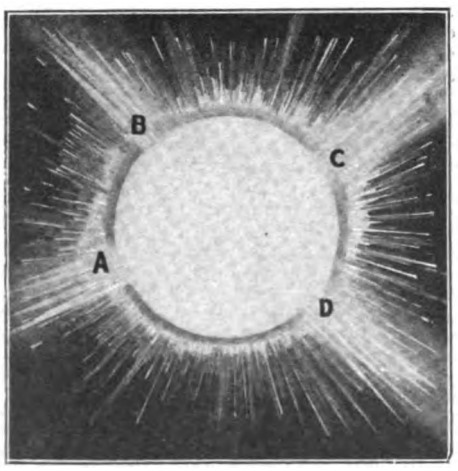
That streams of electrified particles are shot off by the Sun is an apparent fact, but whether these reach the earth or not is the problem to be solved. No one doubts that the heat of the Sun produces intense ionization, and eruptions have been witnest where luminous gas was thrown as high as 400,000 miles from the Sun's surface, traveling at a rate of 250 miles per second. If the luminous gas is thrown off with such violence it seems possible that the electrified particles may be projected much farther.

That such disturbances as these affect the weather on the earth has been believed for many years, and ye no one has ever dis covered what the con nection is. The sun spots which are als formed at these peri ods of solar activit disturb the earth' magnetic field. Th more numerous th sunspots are, the mor noticeable are th variations in th earth's magnetic field This relation is quit marked and has bee studied for nearl seventy-five years. I is also evident tha sunspots cause or ac company magneti disturbances on th Sun, which are in tense enough to reac the earth. The mos recent contribution t the discussion a to whether sunspot affect the earth' weather or not ha been made by Ells worth Huntington of this country, wh finds some interesting relations which sug gest the possibility of some unknown ray He also suggests an explanation of problem which has long puzzled scientist one as to why the earth is relatively coo when the Sun is relatively warmest.

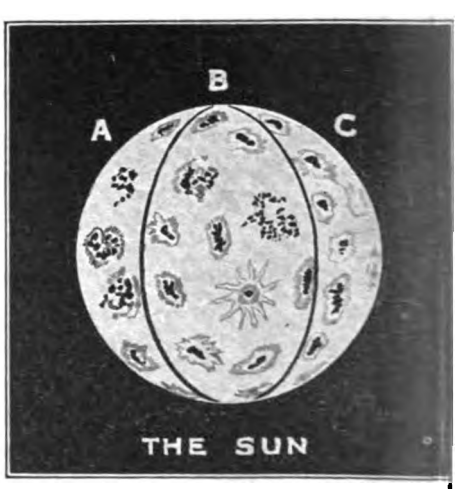
Of course the temperature of the Sun does not vary greatly, but it has long bee observed that sunspot activity and othe disturbances on the sun rise to a maximum and fall again to a minimum every eleve years. It is at this period of maximum activity that the Sun gives off more hea than at any other time. At the same time the earth is relatively cooler than usual This is a seeming contradiction, but Hunt ington suggests that this increased heating of the earth's atmosphere causes an in crease in its circulation, and hence make it seem as if the earth were cooler. There is also the possibility that there may b other agencies at work of which we know nothing, and this is more marked in further study of the sunspots themselves.

Our atmospheric storms are primarily areas of low barometric pressure which sweep across the country, and these areas o

(*Continued on page* 1144)



Fiery Masses of Ionized Vapor as A, B, C, D, are Frequently Shot Off From the Sun for Hundreds of Thousands of Miles in a Very Short Space of Time. Electrified Particles are Probably Projected Much Farther.



This is the Way Huntington Divided the Sun Disk Into Three Areas, and Found the Sunspot in the Outer Ones to be More Effective in In fluencing the Weather on the Earth.

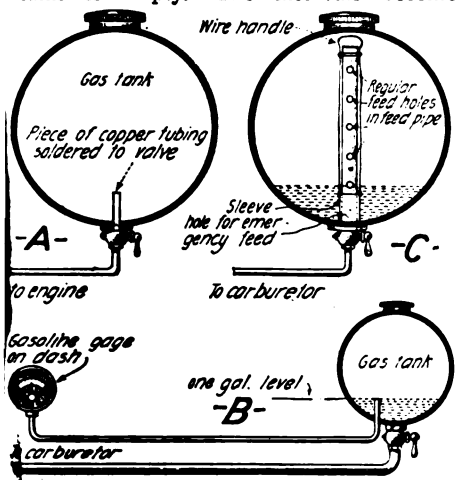
MOTOR HINTS

A "LOW GASOLINE" ALARM
Second Prize $15.00

After running out of gasoline one dark and chilly night, and walking many weary miles, the author has since used a device which gives warning about five to ten miles "this side of a dry tank."

It is very simply made as follows: Remove the gas line shut-off valve from the gas tank. Solder a piece of copper tubing (like that used for gas line) to the inside end of the valve, so it will project into the tank about one inch, as shown in the illustration. Then replace the valve and connect the gas line as before.

This little tube raises the outlet level. In drawing "A" showing the car with this device, the carburetor begins to "spit" at long intervals many miles before the tank is empty. The intervals become



Three Simple Schemes of Great Value to the Motorist in That They Will Serve to Warn Him Ahead of Time That His Gasoline Supply Has Fallen to a Certain Low Limit.

gradually shorter until the engine actually stops, but by this time a gasoline supply can have been found. Of course this idea is applicable only to gravity feed systems. The author used it on a Ford car.

Two optional ideas are shown in drawings B and C, for other low gasoline alarm schemes. For cars fitted with a gasoline gage or dial on the dash, the scheme shown in B will prove valuable. The piece of pipe is added inside the "gas" tank and is cut to a height corresponding to a one- or two-gallon level as shown. Thus, when the gasoline supply indicating needle begins to flutter, the autoist will know that invariably his gasoline has reached the low level.

The scheme shown at C is adaptable to cars having no gasoline gage. It may save a lot of wearisome walking along dark roads when the gasoline happens to give out at an unexpected moment, which, rest assured, happens to many others "besides those in love."

In the scheme shown at C, a pipe feeds the gasoline thru the line in the usual manner. This feed pipe should be fitted very tightly in the valve member in the bottom of the tank. At the lower end of this pipe is a tightly fitted shell, pipe or other member, which can, however, be slid up and down with a little pressure.

A wire handle is soldered or otherwise attached to this "slidable" tube and is arranged to come directly under the filling cap, in the manner shown. Normally, the slidable tube is kept in its lowest position, covering the emergency feed holes in the upright tube.

Contributed by
NORMAN B. TAYLOR.

$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.

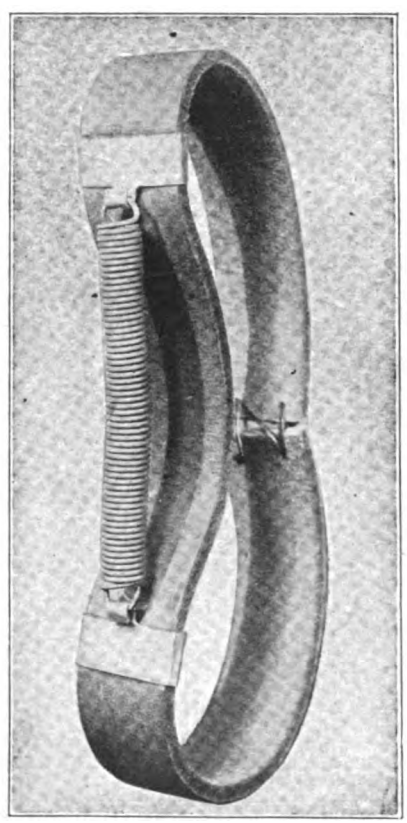
NON-SLIPPING FAN BELT
First Prize $25.00

All autoists know what it means to have the fan belt fail to turn the fan. In some cases it results in ruining the engine.

This device was placed on a Ford fan belt which was so loose that it would jump the pulley. The tightener here described, held the belt fast to the center of the pulley—and after having been run continuously for 18 hours, it was still as efficient as at the start.

As is evident, this device can be easily applied by making two brass or iron fasteners with hooks to clamp over the edges of the belt—setting the clamps with hooks about two inches farther apart than the length of the spring. This causes a tension on the belt at all times and takes up all the stretch that may manifest itself in the belt. Thus it prevents the belt from slipping, regardless of how far the belt itself may stretch. This statement is made from actual and thoro tests.

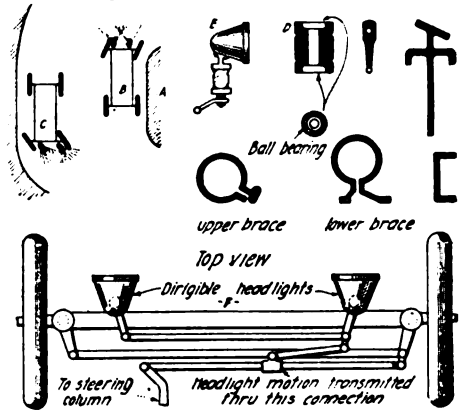
Contributed by
P. H. DE ROCHEMONT.



By Attaching Two Brass Clamps to a Leather Fan Belt, Which Clamps Are Connected by a Stiff Spring, Mr. De Rochemont Provides for Us a Belt That Will Not Slip.

MOVABLE HEADLIGHTS FOR CAR
Third Prize $10.00

The accompanying sketches show how the movable headlight system can be applied to your automobile. Figure "A"



The Third Prize Winner Shows How to Connect a Mechanical Attachment From the Steering Gear of Your Car to the Two Headlight Supports, so That the Headlights Will Swing in the Direction in Which the Car is Turning.

shows the contrast of two automobiles passing each other on a sharp curve of the road. The one with stationary headlights, B, does not throw light on the inside of the road, which might cause an accident; while the other car, C, illuminates the inside of the road, as well as the outside and tends to eliminate accidents while driving at night. As the front wheels turn the lights also turn, and if the car is running straight ahead the lights will also shine in that direction.

Figure "D" shows the parts necessary for the construction of these movable headlights, and "E" shows these parts assembled. Illustration "F" indicates how the steering and moving-light system is connected.

Contributed by
FRANCIS J. LORENZ.

TO KEEP THE WINDSHIELD FROM CLOUDING

A very good method to keep the windshield from clouding is to rub a half and half mixture of kerosene and glycerine on the clouded surface of the glass. A small bottle of this mixture tightly corked and put in a half-pound baking powder can with some waste for packing. Carry this along in the car and when it begins to rain pour a little of the mixture on the waste, and rub over the damp or wet portion of the glass. The mixture causes the water to spread over the glass and not in little drops, which are hard to see thru.

Contributed by ROY R. BARNES.

Home Mechanics

Conducted by WILLIAM M. BUTTERFIELD

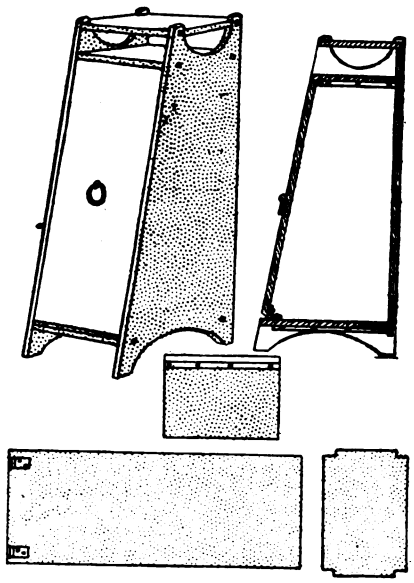
A Soiled Clothes Cabinet

A VERY useful *soiled clothes* cabinet and stand which can be used in the modern utilitarian and decorative fashion, is here shown. It is easily made, being fastened and put together with screws. The height is 32" with a 12" square bottom, and it can be made as shown or without these decorative features. A slanting front will be advisable for the purpose of keeping the door closed. Any kind of ¾" lumber can be used. The fastening screws are 2"x¼" with button heads. All the cleats will hold better if held with screws as indicated, the cleats being ½" thick with screws 1"x3/16" in size.

Ebony finish, or mahogany stain with hard oil finish is a good treatment for this article of furniture.

Window Sewing Cabinet

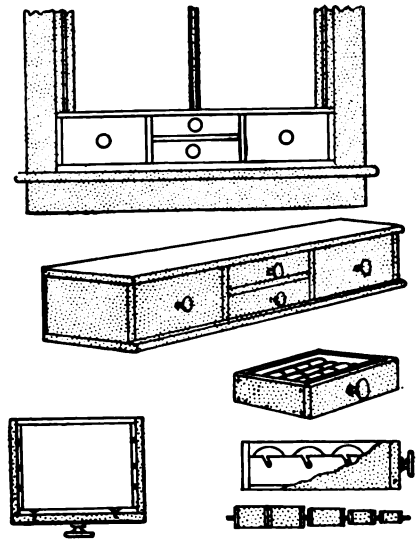
The device shown at the top of the next column consists of a frame fitting the inside of a window and four drawers to contain sewing, knitting, embroidery or other similar materials. The frame also serves



An Ideal Quick Acting and Neat Container for Soiled Clothes Is Shown in the Accompanying Illustration. This Cabinet, Which Has a Door Hinged at the Bottom and Acting in a Self-Closing Manner, Especially When Aided by a Spring, May Be Constructed With Any Thickness of Wood Which the Builder May Have Available. The Author Suggests the Use of ¾" Wood, but the Cabinet Will Serve Its Purpose Just as Well if the Sides, Back and Door Are Made From ¼" Stock.

the part of wind shield when the window sash is partly raised. It is made of eight pieces (seven of them ½" lumber, one ¼" lumber) nailed together so as to form a top, bottom, back and four openings for the drawers. Each drawer is made by first nailing together the sides, to which a bottom is fitted and nailed in place. Then a front piece of thicker wood is fastened with screws put in from the inside of the drawer as indicated—using ¼" lumber for the frame, 3/16" for the bottom and ⅜" for the front. Brass screw knobs are used for pulls, these screwing in at the front.

As a suggestion for an orderly disposition of sewing materials, etc., we show how spools of thread, darning cotton and the like may be strung on wire rods and then held in slots made in extra wooden pieces on the inside of one or more of the drawers. The thread or cotton can be unwound from the spindles thus made without removing them from the drawer; thus, a whole spool can be exhausted, as

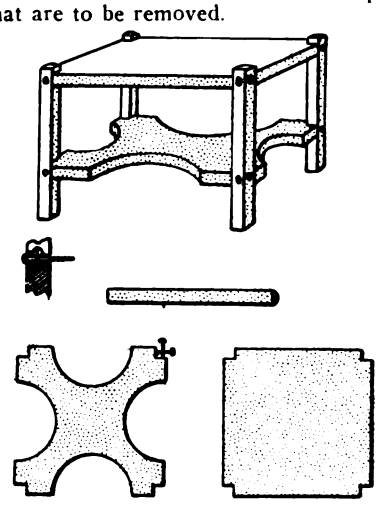


Here Is a Very Useful Window Sewing Cabinet Which the Home Mechanic Can Build From Odd Pieces of Wood. The Knobs for the Drawers Can Be Purchased in Any Hardware Store Very Cheaply and the Drawers Themselves May Often Be Purchased in the Form of Small Boxes, Cut Down Afterward to the Required Size. A Valuable Feature of the Design Here Suggested Is the Racks on Which the Thread Spools Are Supported, and Enabling the Seamstress to Unreel Any Desired Color or Grade of Thread from a Spool Without Moving It From the Rack.

in crocheting, without taking the spool from the rod, or the drawer from the frame, the latter being for the time only part way open.

Tabouret, Table or Foot Stool

A very easy way to make a tabouret, window table or even a durable foot stool is shown below. When these articles are made from the same sized top and bottom pieces, the difference in each being a question of length of legs, it is desirable to saw out all three tops and all three bottoms in two operations, each group being tacked together with long nails driven thru the wood in the corner parts that are to be removed.



The Illustration Herewith Shows a Design Capable of Being Changed, So as to Provide a Tabouret, Table or Foot Stool, Depending Upon the Length of the Legs. If a Table Is to Be Made on This Design, the Shelf and Top Should of Course Be Fairly Heavy, at Least ⅞ inch stock. The Finish Can Very Well Be Mission Stain, Rubbed Down With Oil or Wax, or the Stained Wood Can Be Varnished if the Builder So Elects.

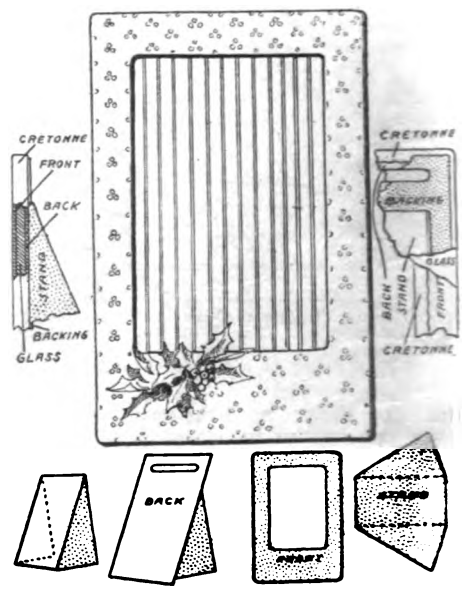
A band or jig saw should be used, following pencil lines ruled on the upper piece of each group. These pieces should be 12" square at least, and 1¼" to 1½" thick. The legs should be square with sides and flush with the top and bottom pieces, 31" long for table, 16" for tabouret and 7" for foot stool.

The screws (3"x¼") are put in as indicated. Mahogany stain with hard-oil finish will give the mission effect, best suited to pieces of furniture of this character.

Photograph Frame

To make a photograph frame that will stay put, and one that will have a smooth, solid appearance and will be easy to put together, is an ambition prevalent with a very large number of people at the end of every summer season.

Here is a scheme that will satisfy this desire in the form of a frame for the favorite snap-shots obtained in the mountains or at the seashore. The plans are



A New and Attractive Way in Which to Frame Pictures, and Providing at the Same Time a Simple Support at the Rear of the Picture. The Manner of Making the Frame Is Similar to That Used in the Passe-partout Process in Which the Glass Is Almost Entirely Covered by Cardboard Back and Front Pieces, Which Are All in Turn Covered With Paper, Cretonne, Silk or Velvet. Leather Also Makes a Rich and Desirable Covering for a Small Picture Frame of This Type, and May Be Decorated Either With Burned Figures by Pyrography or Else Painted With Colors.

equally applicable to any size or any shape of photo—the choice being with the maker.

The frame employs a kind of passe-partout process in which the glass is almost entirely covered by a thick cardboard back and front piece which are all in turn covered with an ornamental paper, cretonne, silk or velvet.

The figures at the bottom of the figure show the cardboard parts, the glass, back and front pieces, being one size. The end view at the left shows these parts in place, while the section of the back (at the right) illustrates how the outer finish is first glued round the front opening, as well as the method of gluing at the back when brought round the glass and cardboard. This view also shows the position of the cloth backing and the cardboard stand which is glued to the backing as shown.

Home Electrics

By G. L. HOADLEY, M. E.

THE meter readers of the average operating supply company are paid less as a general rule than the other employes. There are several reasons why this is so. In the first place, the work is light and women can compete with men; second, skilled labor is not required; third, the work is easily learned by any person of ordinary intelligence. The class of help obtainable under these conditions is, generally speaking, untrained, inexperienced, not very conscientious, not very accurate and temporary. Public Utility Commissions have found, after careful investigation that the average householder is justified as a rule in kicking about his bill. Most operating concerns maintain a good-sized adjustment bureau for their customers.

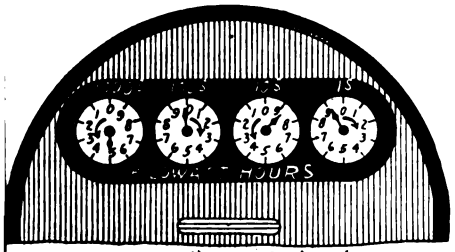


FIG. 1. Reading 4989 kw.-hrs.

To Read the Meter Shown Above, Write Down the Figures Indicated by the Dial Hands in Order, from Left to Right as Follows: 4-9-8-9, or the Reading is 4,989 Kilowatt Hours. But Meter Hands Are Sometimes Misplaced the Same as Clock Hands, as Shown in Fig. 2 Below, and This Phase of the Subject Is Carefully Discust in This Article.

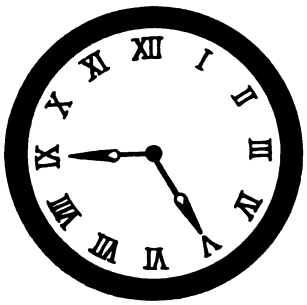


FIG. 2

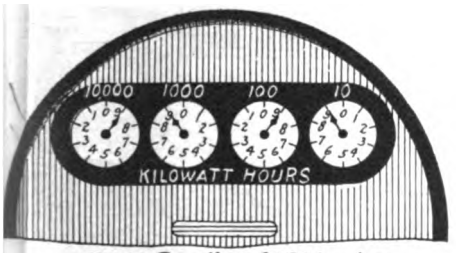


FIG. 3. Reading 8889 kw.-hrs.

Two Very Interesting Problems in Reading Meter Dials. 10-100-1000, Etc., Over a Dial Indicates the Value of One Complete Revolution of the Dial Hand.

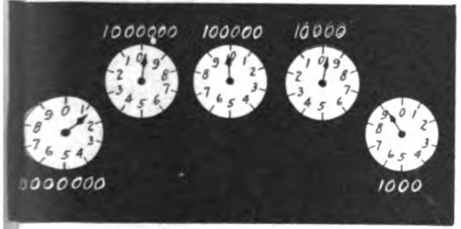


FIG. 4. Reading 999900

Reading the Household Electric Meter

Because of this unfortunate condition of affairs it is highly important that the householder should learn how to read the watt-hour meter.

To the average housewife, a watt-hour meter is somewhat of a mystery; it is a thing she has a wholesome respect for, and perhaps fears as well; and accordingly she holds aloof from it. She is not at all anxious to get another shock, such as she experienced some little time ago perhaps from the electric washing-machine, or possibly from the bathroom fixture.

However, the meter will not give any one a shock ordinarily, unless the cover is removed. Neither is the principle on which it operates so very mysterious. In reality it is nothing but a little motor with a clock mechanism connected to the motor shaft. Now, any adult person can read the time by the clock. It is just as easy but perhaps not quite as simple to read a watt-hour meter. You would not want it known that you could not tell the time of day by the clock; you ought to be able to read just as readily your electric meter and other meters that may be in your house.

There are a large number of watt-hour meters of different shape, size, appearance, etc., but the majority of them have four dials as shown in Fig. 1. The dial on the right reads in units; the next one over to the left reads in tens; the third one over reads in hundreds; and the one on the left reads in thousands. When the hand of the dial on the right makes one complete revolution, it passes over 10 unit divisions and is at zero again. As it reaches 0, the second dial moves up one division, and the register now reads 1 ten, or 10 units. Consider now the second dial. Suppose it makes one complete revolution. it has covered ten 10s or 100 unit divisions, and the third dial moves up one division of the hundreds scale equal to 100 unit divisions. A complete revolution of the third dial hand from the right will move the hand of the fourth dial up one division and register 1,000 unit divisions. To read the meter shown in Fig. 1, write down the figures indicated by the dial hands in order from left to right as follows: 4—9—8—9, or 4,989 unit divisions. Since the kilowatt-hour is the unit indicated by the register, the meter reading is 4,989 kilowatt-hours.

Sources of Error

Do not take it for granted that the figure *nearest* to the dial hand is always the right reading of the dial. In reading a clock, for example, you would not read the hour as 9 o'clock if the minute hand was on V as shown in Fig. 2, even if the hour hand is nearest to IX. So, in Fig. 1, altho the left-hand dial indicator corresponding to the hour hand of the clock, is nearest to 5, you must first look at the next dial to the right (corresponding to the minute hand) and see if it has passed 0. It hasn't, hence, your left-hand dial reading is 4 instead of 5 to which it apparently points. In general, then, if the hand of the next lower dial has just completed a revolution, the hand of the higher dial has past the figure; but, if the hand of the next lower dial has not completed a revolution, the hand of the higher dial should be read as having not reached that figure, even tho it points toward that figure.

Another precaution which should be taken in reading meters is to always check the reading. The hands on adjacent dials revolve in opposite direction, and it is quite easy to mistake the direction of rotation of the dial hand and get a wrong reading. In Fig. 1, for instance, the dial on the right rotates clockwise; the dial next to it rotates counter-clockwise, etc. In making a check reading it is better to start with the right-hand dial and read from right to left, setting the figures down 9894, which, when read backwards, 4,989, should check with the first reading.

Different types of meters may have different markings of dial values. 1s or 10s, etc., over a dial as in Fig. 1, indicates the value of each division of the dial. 10, 100, 1000, etc., over a dial, as in Fig. 3, indicates the value of *one complete revolution* of the dial hand. Some types may have five dials,

(*Continued on page* 1144)

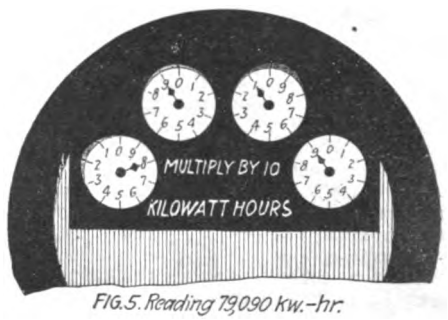


FIG. 5. Reading 79,090 kw.-hr.

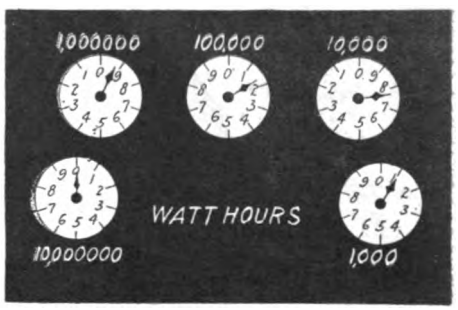


FIG. 6. Reading 9,918,100

The Latest Practise Is to Leave off All Dial Markings as in Fig. 5. Fig. 6 Shows a Typical Case of a Misplaced Hand in the Second Dial from the Right, this Dial Reading 8 and Not 7, as Might Be Supposed.

FIG. 7 Reading 8889

Figs. 7 and 8 Illustrate Two More Cases of Misplaced Hands, Which Will Give the Reader Good Practise in Mastering the Reading of His Electric Light or Power Meters.

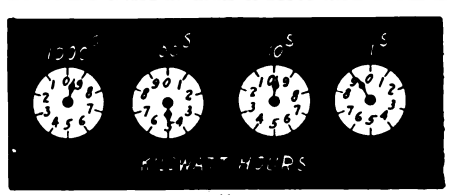


FIG. 8. Reading 9499

Popular Astronomy

By ISABEL M. LEWIS, M.A.

of U. S. Naval Observatory

The Magnetism of the Sun

IF any source of light be placed between the poles of a strong electromagnet and the emitted light be analyzed by an interference spectrometer, it will be noted that the spectral lines emitted by the source are split up into two or more components, differing in the polarization of their light waves. This is called the Zeeman effect. It is not too much to say that all that is known of the nature and intensity of the general magnetic field of the sun and of the special magnetic field existent in sunspots has been found out thru observations of the Zeeman effect when present in certain lines of the solar spectrum. This appears so far to be the one and only method available for the detection and measurement of magnetism in the sun and a most valuable agent it has proved to be at the Mt. Wilson Solar Observatory, where in recent years almost daily observations of the sun's general magnetic field or of special magnetic fields existing in sun-spot regions have been carried on with great success.

Since the Zeeman effect is of such superlative value in detecting and measuring solar magnetism we will consider briefly, how these observations are made at the Mt. Wilson Observatory, how the direction and intensity of the lines of force of any solar magnetic field are determined, and what conclusions have been formed up to the present time in regard to the nature and intensity of the sun's general field and of the intense magnetic fields found in sun-spots.

At Mt. Wilson observations of solar magnetism are being made continuously. This is one of the many fields of research that is being thoroly explored at this great observatory devoted primarily to solar research.

The 150 ft. tower telescope of the observatory is used for these observations of solar magnetism. A coelostat mounted at the summit of the tower reflects a beam of light from the sun to a second mirror from which it is reflected vertically downward to an objective of 150 ft. focal length which forms an image of the sun about 16½ inches in diameter in the observing room at the foot of the tower. This image falls upon the slit of a spectrograph at a height of three feet above the floor and passing thru the slit the light descends to a collimating lens of seventy-five feet focal length which is mounted near the bottom of a well about eighty feet deep which has been excavated beneath the tower. Here exists the even temperature and undisturbed condition of the atmosphere so vital to solar research of this nature.

Beneath this lens is a large Michelson grating of very high resolving power (622 lines to the millimeter). After falling on this grating the light returns thru the collimating lens which now acts as a camera objective and forms an image of the solar spectrum on a plate mounted beside the slit of the spectrograph. In one exposure a portion of the spectrum one meter long can be photographed.

The polarizing apparatus which plays such a vital part in all magnetic observations consists of a Nicol prism built in four sections with a total length of 130 mm. and a thickness of 8 mm. mounted just above the slit of the spectrograph in a stationary position.

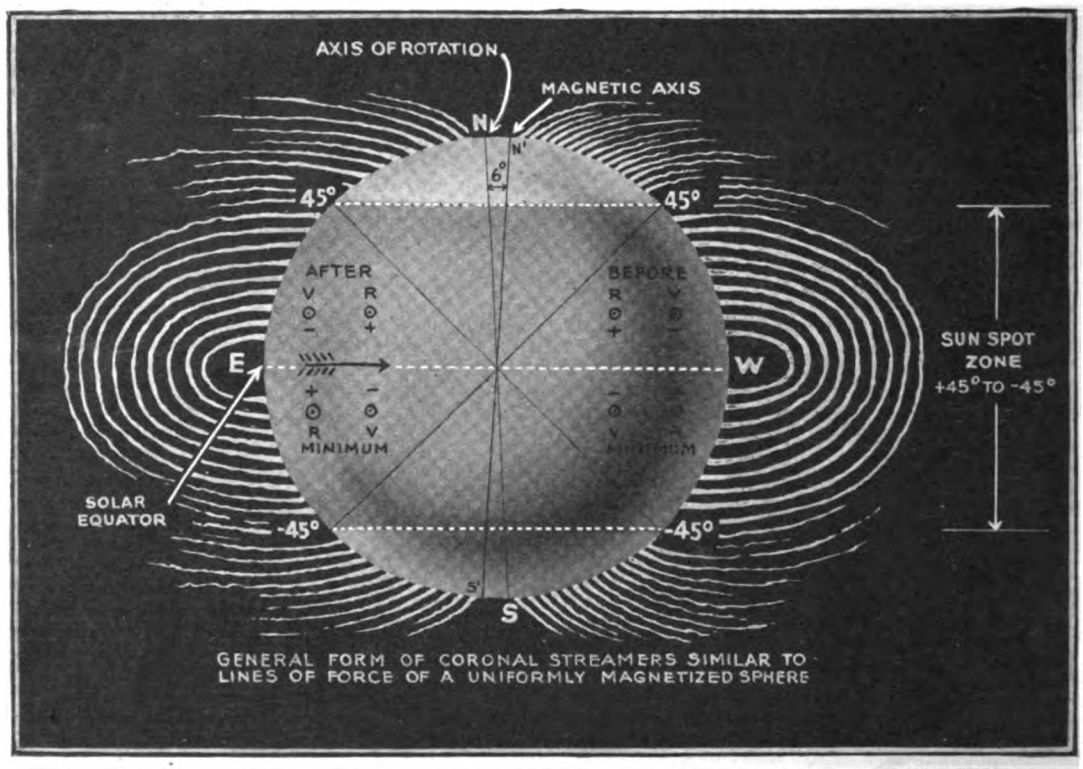
The effect of rotating the Nicol is brought about by means of half-wave or quarter-wave plates, single or compound, used in connection with the Nicol and adjusted above it.

This, then, is the essential equipment for observation of solar magnetism and with it photographic observations of magnetic fields in sun-spots or other portions of the solar surface are made on practically every clear day at Mt. Wilson.

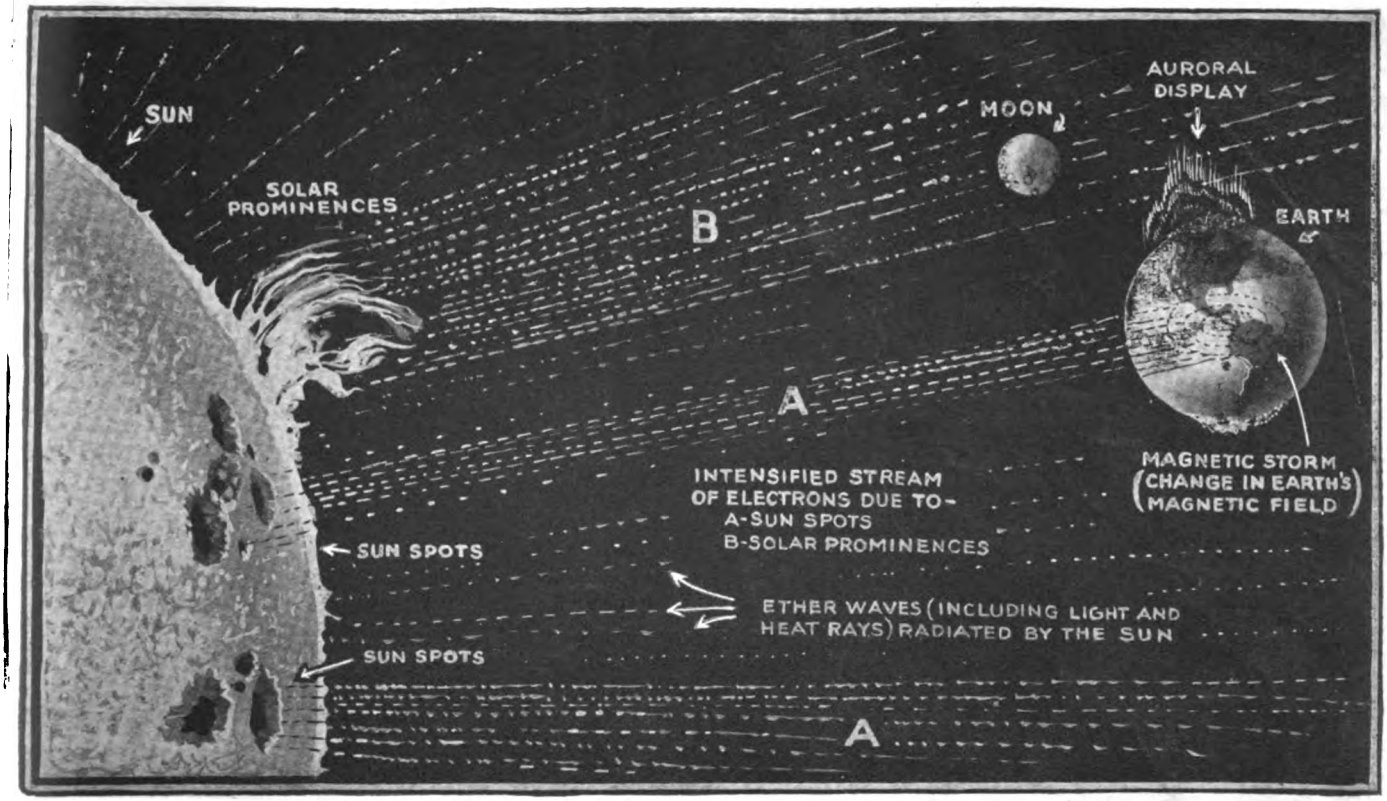
The plates are later measured and reduced and the results of the observations follow from the mathematical reductions which frequently involve long and complicated solutions.

The Zeeman effect may be evidenced simply as a widening or a doubling of normal spectral lines or a splitting up of a line into three or more components. The usual form in which it is observed is that of the Zeeman triplet, consisting of a central line called the p-component, in the normal position of the spectral line, and two outer lines called the n-components, or the red and violet components, symmetrically placed on either side of the central component.

When viewed *along* the lines of force of a magnetic field, the central component of a Zeeman triplet is absent (components of vibration parallel to the field produce no radiation, since a magnetic field has no effect on a charged particle moving parallel to the lines of force). The two outer components, however, are present with equal intensity and are circularly polarized in opposite directions. See Fig. 1. They may be regarded as due to charged particles rotating in circles of equal radius, and in opposite directions at right angles to the lines of force. By means of the Nicol prism and a quarter-wave plate mounted over the slit of the spectrograph it is possible to cut off either outer component and if the apparatus has been so adjusted as to extinguish one component a reversal of current will



This Diagram Shows the Position of the Sun's Magnetic Axis, the Distribution of Lines of Force Outlined by Coronal Streamers and the Distribution and Polarity of Sun Spots Before and After the Last Sun Spot Minimum. Direction in Which Sun Spots Pass Across the Solar Disc Indicated by Arrow. Polarity of Sun Spot Groups in the Two Solar Hemispheres Before Last Sun Spot Minimum Is Shown to the East of the Axis of Rotation; the Polarity of Groups Since the Last Sun Spot Minimum Is Shown to the West of the Axis, V, Indicating That the Violet Component of a Zeeman Triplet Is Transmitted by the Nicol When Observations Are Made Along the Lines of Force and R. That the Red Component Is Transmitted. The Minus Sign Indicates That the Polarity Corresponds to That of the North Magnetic Pole of the Earth and Positive Sign to the South Magnetic Pole.



In the Illustration Above, the Direct Effect of Sun Spots and Prominences Upon the Earth are Clearly Shown by the Dotted Lines, Each in the Path Taken by the Intensified Streams of Electrons and Ether Particles. Close Observation by Astronomers Has Shown That Whenever There are Noticeable Solar Prominences or Spots on the Sun, the Weather as Well as the Electrical and Magnetic Conditions of Our Earth are Changed or Varied. Coincident With Sun Spots or Solar Prominences, We Invariably Experience Magnetic Storms on the Earth; Thus Magnetic Storms are Thought to be Changes in the Strength of the Earth's Magnetic Field Caused by the Intensified Streams of Electrons Shot Out From Its Spots by Any Unusual Activity of the Sun. The Auroral Displays at the Poles Also are Now Thought to be Due, in Great Part at Least, to These Effects.

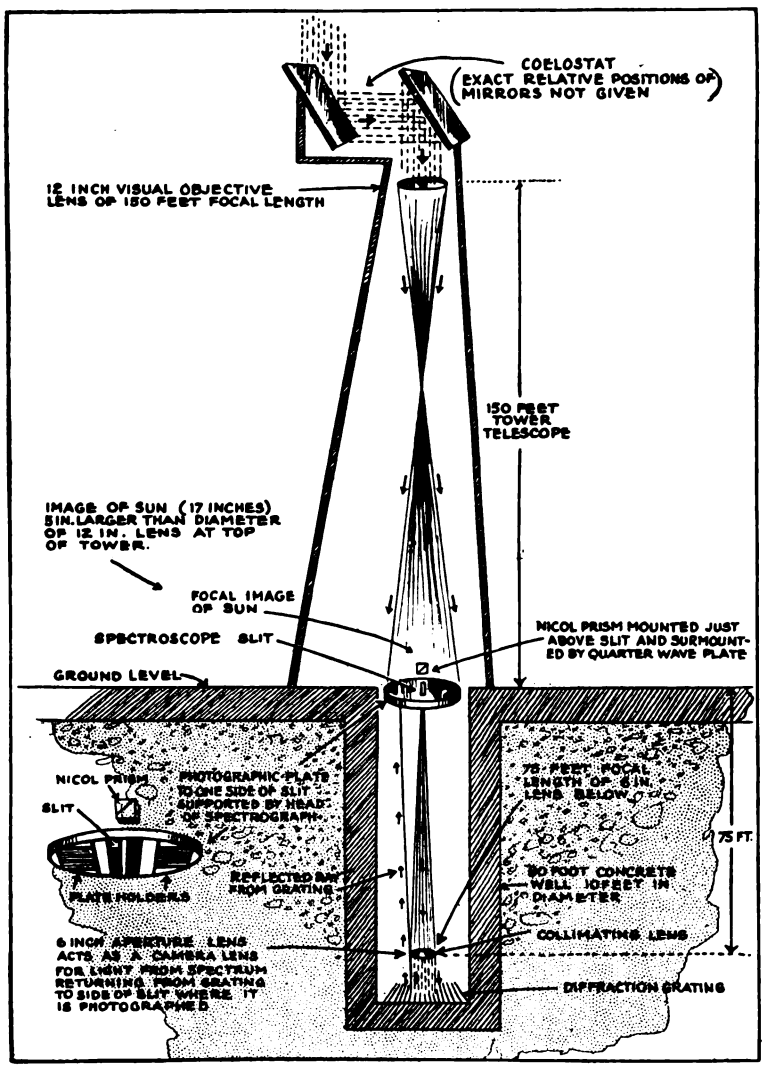
cause this component to reappear and the other to be extinguished. Here then is a means of determining the polarity of the magnetic field when observed *along* the lines of force. If the particles in the region observed are carrying a *positive* charge the component of greater wave length, the *red* component of the Zeeman triplet, will be circularly polarized in a *clockwise* direction; if the particles are carrying a *negative* charge the red component will be circularly polarized in a *counter-clockwise* direction (as viewed along the positive direction of the lines of force of the magnetic field). Evidently all one needs to observe is *which* component is extinguished for a definite position of the Nicol and quarter-wave plate to determine the polarity of the magnetic field.

If viewed at right angles to the lines of force the p-component is present and plane polarized, and its intensity is twice that of the two outer components which are also present and plane polarized but *in a direction at right angles to the plane of polarization of the central component,* since in this position their circular rotations are viewed end on.

If then the three components of a Zeeman triplet are present and the central component is twice as intense as the two outer components, the observer knows that his line of sight is at right angles to the lines of force of the magnetic field.

For intermediate positions it is possible to determine the polarity up to

(*Continued on page* 1124)



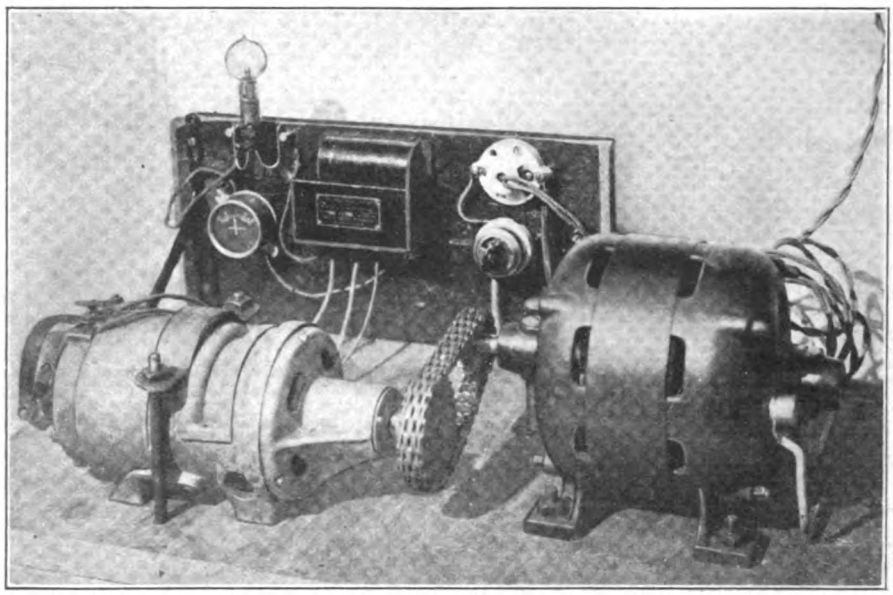
This Sectional View of the Huge 150-foot Tower Telescope Erected at Mount Wilson, Cal., Gives a Clear Idea of the Startling Dimensions of This Wonderful Instrument Created by Man and Used Particularly for Studying the Electrical and Magnetic Conditions of the Sun. By Means of a Specially Timed and Accurately Rotated Set of Mirrors at the Top of the Telescope Tower, the Sun's Image Is Constantly Reflected Downward Upon the Spectroscope Disc and Slit on a Level With the Ground Floor. Any Part of the Sun's Image Can be Focust Thru the Nicol Down Thru the Narrow Slit and the Solar Beam Passing Thru the Slit Is Focust Thru the Six-Inch Lens at the Bottom of an 80-foot Well on to the Diffraction Grating. The Rays of Light Reflected From This Grating, Pass Back Thru the Lens and Come to a Focus at the Plateholders on Either Side of the Slit at the Ground Level, Where the Images of the Reflecting Spectrum Rays are Photographed, and Thus Recorded for Further Careful Study and Research. The Magnetic Changes and Polarities on the Sun, and Particularly in Sun Spot Regions, are Analyzed by Means of the Zeeman Effect, Well Known to Students of Physics and Electro-Magnetism.

THE CONSTRUCTOR

Charging Ignition Battery at Home

By H. C. PETZWAL

THE accompanying photo will make the idea clear, and the specifications are as follows: The 110-V. A. C. motor running at 1,750 R.P.M. is connected with a silent chain to a (second-hand) automobile lighting generator, ratio 1 to 1.4 which reduces the generator speed to 1,250 R.P.M. The output of the generator at that speed is about 12 amperes at 8 volts. A cut-out is placed in the A.C. line to prevent the battery from discharging thru the generator in case the A.C. motor should stop, and also an ammeter to indicate the rate at which the battery is being charged. Any cut-out can be used as the speed of the generator is constant and there is no need of a control in its field circuit. The two charging clips are attached to the binding posts, which in the illustration carry a miniature lamp and which should be marked plainly positive and negative.



To Make a Battery Charging Set Like the One Shown, Procure an 8-Volt Dynamo, Delivering About 10 to 12 Amperes, and Arrange to Drive It With a Belt or Chain by Means of a 110-Volt A.C. or D.C. Motor.

In case of doubt as to which terminal of the battery is positive, simply connect up the clips without starting the generator, press the points of the cut-out together for an instant and watch the ammeter needle, if it shows *discharge* the connection is correct; should it show *charge*, reverse the charging clips on the battery. The capacity of this set is sufficient to charge any ordinary 6 volt battery; I have in fact put on as many as three of them in parallel with satisfactory results. For the drive I consider the silent chain the best, tho either a round or flat belt can be used with suitable pulleys. The driving motor does not necessarily have to be ¼ H.P.; ⅛ H.P. being sufficient to drive most of the generators. The working speed varies with the different makes, some of them going as high as 2,000 R.P.M.

The cost is not prohibitive as one can purchase all the parts in the second-hand shops, an automobile wrecking shop being the best. My whole set cost $8.75 not including the motor, which I also use to run my small lathe and grinder.

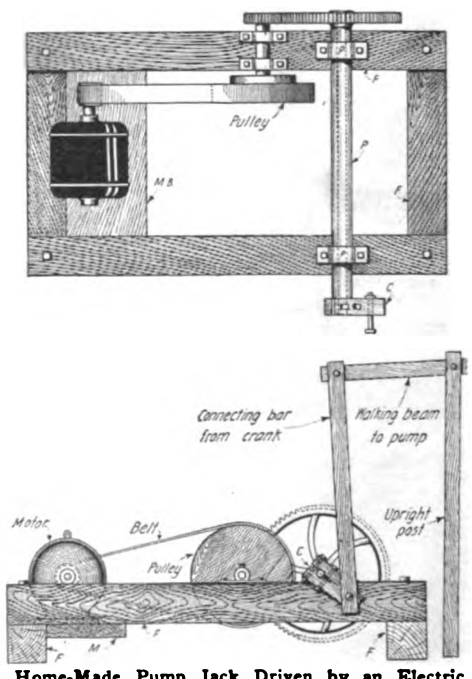
A Motor Driven Pump Jack

By FLOYD C. WELSH

HEREWITH are some drawings of a pump jack for use with an electric motor which was made from parts of an old cream separator; in most instances this will work the pump slowly enough without the necessity of a countershaft. A jack of this sort has been in use for some time, pumping water for about fifty head of live-stock.

The frame "F" is made of four pieces of 4"x4" timbers bolted together at the corners. A plank "M. B." is used as the motor base and is fastened firmly in front of one of the cross-pieces. The bearings are of babbit metal and cast in the ends of pipes P. P., which are fastened to the frame with iron clamps. The pipe for the main gears should be long enough to project two or three inches past the frame so that a box covered with tin or other waterproof material may be placed over the jack, to protect both motor and belt from rain.

A shaft for the large gear long enough to reach 2 inches beyond the pipe may be obtained from almost any dealer in machinery supplies. The pipe for the small gear and shaft (which are usually made in one piece) must be rather small so as to allow for attaching to it a pulley, made up of several thicknesses of thin boards screwed together. These boards are cut round and bolted together solidly, care being taken to make the grain of the wood run in different directions. The pulley thus formed is then bolted to the side of a worm-gear found on all cream separators.



Home-Made Pump Jack Driven by an Electric Motor. The Parts Are Made from Wood and Iron Pipe.

The crank is made of a block of hardwood with a hole bored in one end, large enough for it to slip freely over the end of the long shaft. The end of the wooden block is then split with a saw and the crank is fastened to the shaft by clamping its jaws together with two bolts. A hole 1/16" smaller than the diameter of the bolt to be used for attaching the connecting bar is bored in the other end of the crank shaft and the bolt is put in place and secured with a lock nut. The length of stroke of the pump is regulated by the position of the upright on which the walking-beam works.

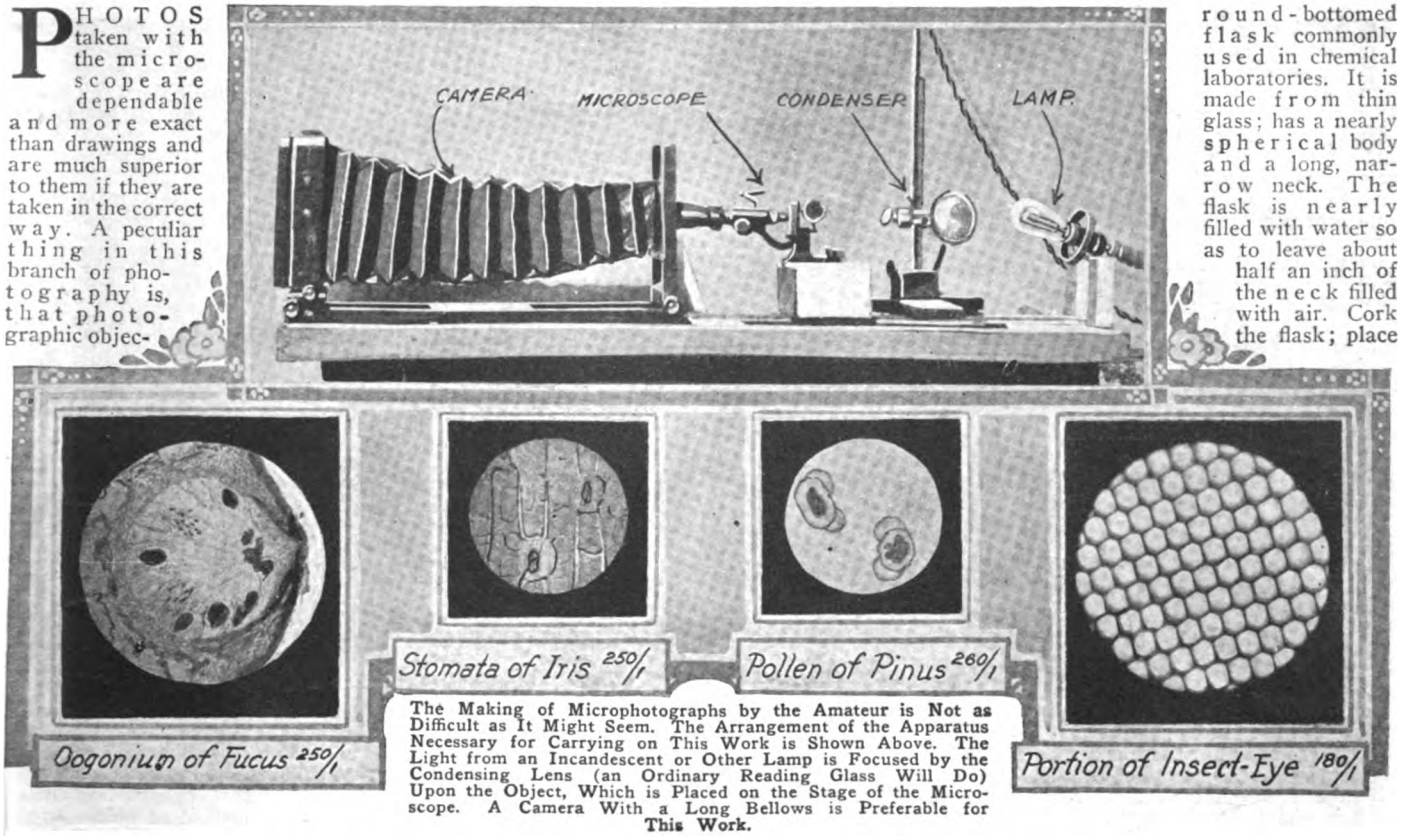
If this jack is properly enclosed to protect the motor, belt, and gears from rain or ice, it is always ready in any weather.

If desired instead of attaching the walking beam rigidly to the pump, a bolt may be inserted into the handle of the pump and a slot cut into the walking beam so as to enable the beam to be placed in position with the bolt. This allows for a certain freedom of motion at the pump handle and such accurate figuring as in the first case is not necessary. The pump, nevertheless, will move up and down with each motion of the walking beam. All bearings should be kept constantly lubricated.

Making Microphotographs

By DR. E. BADE

PHOTOS taken with the microscope are dependable and more exact than drawings and are much superior to them if they are taken in the correct way. A peculiar thing in this branch of photography is, that photographic objec-



The Making of Microphotographs by the Amateur is Not as Difficult as It Might Seem. The Arrangement of the Apparatus Necessary for Carrying on This Work is Shown Above. The Light from an Incandescent or Other Lamp is Focused by the Condensing Lens (an Ordinary Reading Glass Will Do) Upon the Object, Which is Placed on the Stage of the Microscope. A Camera With a Long Bellows is Preferable for This Work.

tives of any description are not used. All that is necessary is a good serviceable microscope, a camera box with bellows extension of adequate length, with its ground glass, and a plate holder. All this is shown in the cut. Upon the photographic table there is an ordinary camera having a double or triple bellows extension, firmly fastened to a table, along with the microscope and electric light.

Unscrew the lens of the camera, or take out the lens board. Make a similar board with a small hole about three-fourths of an inch in diameter. Take a short strip of light-tight cloth, roll into a cylinder which is just large enough to slip easily over the microscopic eye-piece, and let it be sewn together. This cylinder, which should be about three inches in length, is attached to the inner side of the board just made, so that it fits firmly and is light-tight as well.

Next a support for the microscope is to be provided. The right height of this support is found by trial and then a small box is made or procured and filled with weights so that it will not tip when the microscope is inclined in a horizontal position. Another important detail is to provide the box with some kind of a device which locks the base of the microscope firmly to the box.

But before microphotos can be taken, slides must be secured. These can either be bought or made. Sections of the substances to be photographed, that is very thin slices, are cut with a razor blade. They are treated with alcohol of 30 per cent., 45 per cent., 60 per cent. strength, stained if desired with eosine, etc., and finally placed in 95 per cent. and then in absolute alcohol. The section should remain at least from one to two hours in each alcohol bath. After it has been placed in absolute alcohol, it is placed in xylol, which removes all of the alcohol, and this substance lightens and hardens the object. Now comes the final step. The object is placed on a glass slide, a single drop of balsam dropt on it, and the cover-glass carefully lowered upon the object and a slight weight placed upon it to press out any superfluous balsam. Then the slide should remain in a horizontal position until the balsam has hardened.

When the slide has been made photos can be made from it. It is placed upon the stage of the microscope and clamped in place by the two springs. Now look thru the microscope as usual and find the particular section desired to be photographed. When this has been accomplished, place the microscope on the box, clamp it tight, and incline it so that it lies horizontal. Take off the camera lens and substitute the board carrying the cloth cylinder, slip the cloth cylinder over the upper part of the microscope, and turn the substage mirror to one side; it is not needed.

Since better photos can be made with artificial light than with sun light, and since the artificial light can be better regulated to suit the picture on hand, it has been found advisable to take such photos only at night. The illumination is always constant, it never varies from day to day, and therefore fewer pictures are spoiled either thru over- or under-exposure.

For enlargements up to 150 diameters a 40-watt lamp is sufficient. For larger diameters it is advisable to take a nitrogen-filled lamp of at least 75 watts, better still is a 100-watt lamp. Place the lamp in line with the microscope and at least a foot and a half away from the slide. If the lamp is placed too near the slide, it will heat the balsam, and if the balsam is not thoroly dry and hard, then the object and the cover glass will move and spoil the picture.

In order to prevent the object and the cover glass from moving, in other words, to prevent the balsam from becoming too hot, a globular bulb is inserted between the microscope objective and the source of light. This globular bulb may be a round-bottomed flask commonly used in chemical laboratories. It is made from thin glass; has a nearly spherical body and a long, narrow neck. The flask is nearly filled with water so as to leave about half an inch of the neck filled with air. Cork the flask; place on the ringstand or other holder, and arrange the bulb to intercept the light rays of the electric light bulb before they reach the microscope. This bulb will not only absorb a great part of the heat rays, but it also concentrates and focuses more light upon the object glass and so throws more light thru it, thus increasing the illumination.

When the ground glass on the camera has been illuminated as brightly as possible by the light passing thru the microscope, then take the ground glass out and begin focusing with a small hand lens, held in the plane of the plate-holder. When the lines are seen sharp and distinct thru the lens, the object is in focus and a picture can be taken. Focusing, of course, is done with the micrometer screw found on the microscope. The object cannot be focused sharply any other way.

After this has been done as accurately as possible and focusing should be done very carefully, place a piece of cardboard between the light and the microscope so that it is cut off. Then place the plate-holder in the camera, pull out the shutter and remove the cardboard. This will expose the plate. The time of exposure varies slightly with the object to be taken, and also varies directly with the square of the lineal magnification. All microphotos are time exposures, and the shortest time exposure is approximately five minutes, except for very transparent objects, taken with a low power, which require about three minutes. Development and fixing is done as usual.

The arrangement shown is adapted for transparent and translucent objects, and the majority of microscopic subjects fall under these heads. A totally opaque object will naturally give only a silhouette. But in the classes named transparent and translucent objects are included the vast majority of subjects which will interest the microphotographer.

Glass Tubing Notes

By CHARLES S. WOLFE

THE chap who dabbles in chemistry, and even the general experimenter, is likely to find himself quite frequently faced by the necessity of doing some more or less difficult stunt with glass tubing. Usually he can't do it. The magazines seem rather to avoid the subject, altho the editor did give us an article that took us as far as a T making.

As a rule, the local drug store will be able to furnish you tubing—in not over 12-inch lengths, and as old as the hills. This won't do you much good. Have a try at the chemical supply houses, it will pay you to wait a bit for delivery for the "newest" tubing you can obtain.

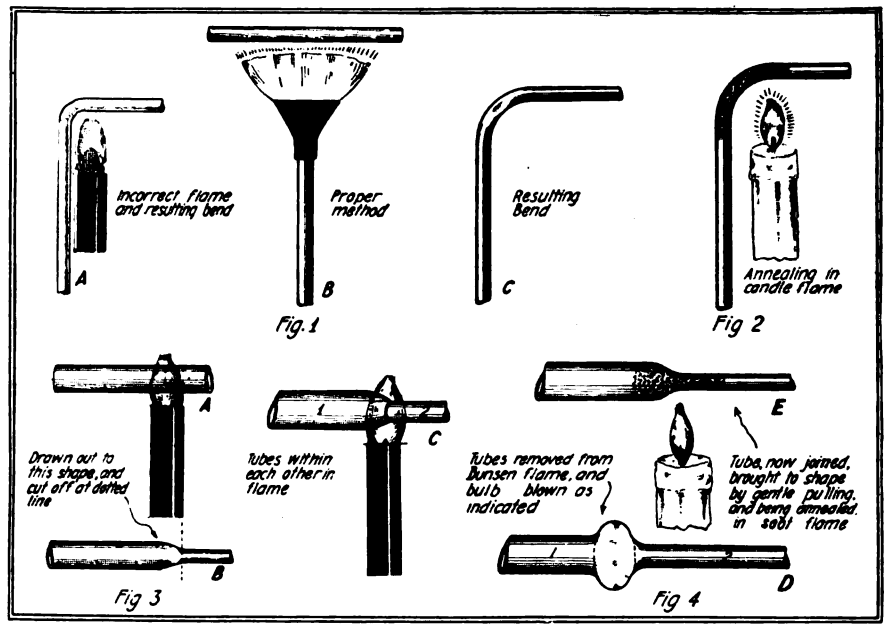


Fig. 1-A Shows Incorrect Way of Bending a Glass Tube; Fish-Tail Burner for Making Easy Curve Shown at B, and at C the Resulting Bend. The Bend Is Annealed in a Sooty Flame Such as That from a Candle, Fig. 2. Fig. 3 Shows Method of Joining Two Tubes. Fig. 4 Shows Fusing and Annealing of the Final Junction between the Two Glass Tubes.

I'm a little lucky along these lines, for there is a shop making barometers and apparatus of that nature within a few miles of me. I get tubing there in about 5-foot lengths of almost any diameter up to 1 inch. Look about your locality, and you may find such a place within striking distance. If you do, and your work does not specify an exact diameter or wall thickness, you will get the stuff quite cheaply. Five cents a length is the usual charge to me. Here is the secret. Tell them you can use odd sizes. These places take their glass "as it comes," that is, all sizes, and every car is sure to contain a lot of stuff that is of no earthly use to them. Use these, and the cost will be slight.

The commonest operation is the simple bend. The straight flame from the Bunsen is most often used, and it is not at all suited for the work. The glass gets hot in one little spot in such a flame, and you get your bend all at once, so to speak. It buckles rather than bends. I used to turn out some rare curves, regular forty-five degree drops. Equip yourself with a fish tail tip—cost about a quarter—and you will make graceful, sweeping bends, because a larger surface is made hot and pliable.

Lots of us, in spite of advice, make our bend and let it go at that. The glass just cools off. Every piece so done is not reliable. More, the chances against it standing up to its job are big. You must *anneal* your work. Burying in hot sand would do the trick, but the handiest method is to *soot* the work, which causes it to cool slowly. Many authorities tell us to shut off the air on our Bunsens until we get a yellow flame, doing the sooting in that. If I waited for my Bunsen to make soot enough to anneal a job, my arms would be numb from holding the glass. I take it the Bunsen family members all behave about alike, so most of you will have the same experience.

Have at your hand an ordinary tallow candle. Here is a real efficient soot producer. Get your work out of the flame and into the candle smoke, and SOOT it. Emphasis because it's hard to get too much on. Then lay it on the asbestos mat to cool.

Don't be without three or four of these circular mats. They cost ten cents each.

Another little point to observe is that it is necessary to keep the work turning while in the flame. This is a cinch when you're working on the middle of the piece, but it is far from comfortable when you have an end to deal with. The chap who works at the business rigs up a support that holds the glass, and twirls with the palm of his hand. You can work out the simple support for yourselves.

Some time you may wish to seal one tube within the other. Not such a hard job to do, providing beauty is not an essential of the finisht product. It takes quite a bit of practise to make those joints look good, but you can get away with a serviceable seal readily. If both tubes fit into each other nicely, it's simple. If not, it's up to you to make 'em. And there is where appearance usually gets it in the neck.

First take your larger tube, having it considerably longer than the finisht article is to be, and make a constriction by getting the glass to the right temperature, pushing it slightly together first, and then drawing out. Don't draw too darned hard, or you'll find yourself under diameter when you cut for joining. At that, it's a trick, frankly, that calls for practise, because the first time you try that constriction stunt you'll find the tube, instead of going nicely together to give the needed thickness of wall, will do its best to look like a lightning flash. You'll know what I mean when you try it. Keep her turning is the answer to this, and that calls for *PRACTISE*.

Having your constriction of the proper size, insert the smaller tube, get 'em hot, and you'll notice their tendency to stick together. Also to bend out of shape. As they get hot, they wiggle in an alarming manner.

The professional proceeds thusly. He keeps them revolving with the palm of his hand until they are pretty well fused. Deftly he removes them from the flame, turns them nearly vertical, and blows into the open end gently. The joint becomes a bubble. But even as the bubble forms, he pulls with his free hand, bringing the tubes back to size. (I brought my first twenty or so to a complete close when I tried it.) Then he blows again, and pulls. This he does several times, thoroly fusing the tubes. Then into the soot they go, straight as a die if it's professional work, and all bent out of shape probably, if it's yours.

Lantern Slides

"Tracing cloth and waxed paper are usable as lantern slides, altho their limited transparency produces a rather dark field, and the texture of the material shows plainly," says R. G. Hudson, of Kenyon College, in *Science*. Mr. Hudson has experimented with substitutes for glass lantern slides, giving special attention to slides which could be prepared quickly for temporary use.

He found that a satisfactory slide could be made by drawing figures or diagrams on thin white paper with india or colored ink. After the ink had become thoroly dry both sides of the paper were brushed over with a light-colored penetrating oil. The thin glazed white paper used for duplicating typewritten letters serves admirably for the paper and a light neatsfoot makes a satisfactory oil. These paper slides may be inserted in cardboard holders and with suitable projecting apparatus the results are all that could be desired.

The effect of the oil is to increase greatly the transparency of the paper and when new the texture of the paper is quite imperceptible. Figures of lesser sharpness can be made with a fountain pen or even with a pencil. Diagrams and pictures of appropriate size may be cut from magazines or bulletins and treated with oil as outlined above. These are more satisfactory, of course, if no printing appears on the back, but for temporary use the printing in many cases will not destroy the usefulness of a diagram.

I have also made good slides in the same manner by treating 3¼ x 4¼ photographic prints with oil. The projected pictures, while less bright than those procured with glass plates, present a softer effect and are especially interesting in the case of portraits. Since the usual photographic paper is quite heavy the lantern must be placed nearer the screen but if thinner paper could be obtained the results would be quite satisfactory if the usual distance were maintained.

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

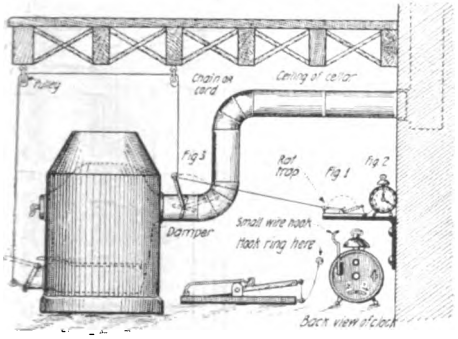
AUTOMATIC FURNACE REGULATOR

After having made and installed a furnace regulator as described herewith, the maker can lie in bed and dream on of the comforts of getting up with the house already warm, instead of getting up a half hour earlier to open the furnace draughts, when the house is cold and chilled.

Procure an alarm clock, a No. 1 rat trap, the kind illustrated in the figure, which sells for ten cents, several feet of small chain or flexible wire cord, two small pulleys and a piece of sheet iron ⅛" x 1" x 6". This is all the material that is needed. Other dimensions will vary with different furnaces.

A small piece of wire one and a half inches long with a small hook bent on top is soldered to the alarm winding key. A piece of cord is then fastened to the trigger of the trap. The trap is then set when ready to dampen fires for the night and the cord from the rat trap trigger is attached to clock, and the damper is closed.

When this is closed, it will also close the draught door; the alarm is set about half an hour earlier than your hour of arising. When the clock goes off, the key will revolve, pulling the string attached to the trigger, thus springing the trap. This opens the damper and draught door, and allows the fire to burn more rapidly.



An Ordinary Alarm Clock Combined With a Cheap Rat Trap, Solves the Problem of How to Build An Automatic Furnace Regulator. This Device Will Start Up the Furnace An Hour Before You Rise in the Morning, and Have the House Warmed Up Nicely.

Contributed by CARL S. MORGAN.

SECRET WRITING WITH ONION JUICE

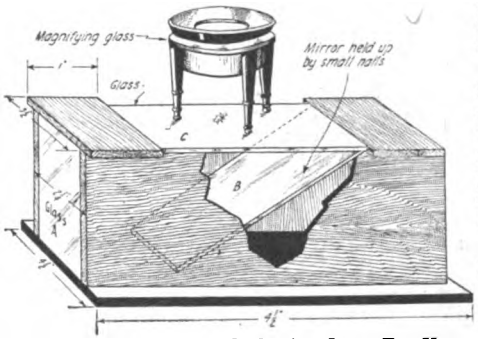
Squeeze the juice of an onion into a very small container. Then with an ordinary pen, dip and write. You will see what you are writing while it is fresh, but as it dries it will become invisible and to the uninitiated the paper will be an innocent blank. Your correspondent, upon the receipt of this invisible note, should heat a tablespoon and after wiping off the soot, rub the spoon's convex surface well over both sides of the paper and the writing will appear clearly in brown.

Contributed by C. NYE.

SECOND PRIZE, $3.00

MICROSCOPE STAND

Here is a sketch of a microscope stand which is very easily made from a cigar box and which aids very much in examining different objects, too small to be seen with the naked eye.



A Simple and Valuable Reflecting Stage For Use With the Ordinary Type of Magnifying Glass. It May Be Constructed From Cigar Box Wood, Together With a Small Mirror and Two Pieces of Glass.

The only materials required are a cigar box, cigar box nails, a glass mirror and a piece of glass.

This is how it works: The light comes in at A and is reflected upward by the mirror B. The object to be magnified is placed on top of the glass C and the magnifying glass is also placed above the object.

Contributed by FLOYD W. RAUSCH.

HOW TO REMEMBER POWER FORMULAS

By the following method the ordinary power formulas may be very easily remembered:

First—Draw four circles.

Second—Divide them in half by drawing a horizontal line thru them.

Third—Divide the lower halves into quarters.

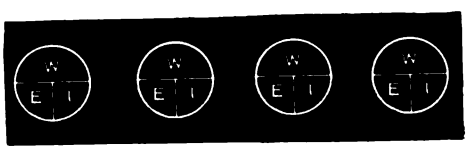
Fourth—In the following order place E^2, E, W and W in the upper halves.

Fifth—Write the word "WIRE" one letter in each lower left quarter.

Sixth—Place the following letters in the right quarters in the following order. R, R, I^2, and I.

After constructing the following form a few times it will never be forgotten. In the first w r equals E^2 and we would of course extract the square-root of the result, this would also apply to number three, W/r equals I^2 and not I.

Contributed by D. BLODGETT.



By Means of These Four Simple Diagrams Which Are Easily Memorized, a Number of the Most Important Electrical Formulae Can Be Kept Always on Tab.

THIRD PRIZE, $2.00

FULL SIZE COPIES WITHOUT A COPYING CAMERA

First rate photographic copies of magazine pictures, cartoons on comic illustrations can easily be made without a copying camera as follows:

If the picture has printing on the back it must be removed. This is best done by splitting the back from the front. Paste a heavy piece of paper to each face of the picture (front and back). When the paste is almost dry pull the two sheets quickly apart and the front half will be found to be separated from the back half.

Remove the picture from the heavy paper by soaking in warm water. After drying the picture iron it with a flat iron and paraffin wax (candle wax will do). This renders the picture translucent.

Place the picture in a printing frame in a dark room with either a sensitive plate or film with the emulsion in contact with the printed side of the picture. Make the exposure by burning a match completely about two feet in front of the frame. Develop the negative in a rather weak developer.

A Simple Process For Making Full-Size Copies of Magazine Pictures, Cartoons or Comic Illustrations Has Always Been in Demand by Every One of Us At Some Time or Other. The Author Describes in the Accompanying Article How to Do This Without a Copying Camera. The Photographic Copy of a Comic Advertisement Here Reproduced Was Printed Without Making the Paper Translucent With Paraffin Wax, and Which Resulted in the Reproduction of the Grain of the Paper.

From this negative, which reproduces every detail of the original faithfully, can be made as many copies as are wanted. The photographic copy here reproduced was made without making the paper translucent with paraffin wax, which resulted in the reproduction of the grain of the paper.

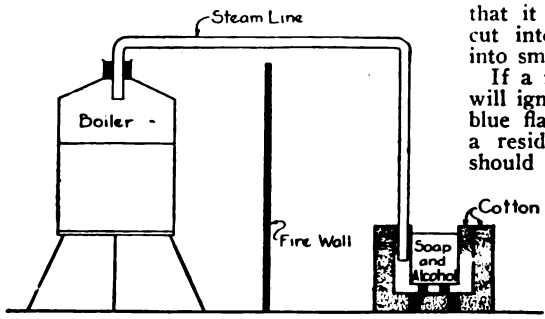
Contributed by WERNER W. BAUMEISTER.

Fascinating Experiments in Chemistry

By O. IVAN LEE

How to Make "Solid Alcohol"

A tin can of about a gallon capacity is the first requisite for this experiment, and means for heating water in it. A short metal or glass tube, preferably "L" shaped,



Apparatus Set Up for Making "Solid Alcohol."

is inserted in the cork fitting the outlet hole. To this is attached a piece of flexible metallic gas-tubing about six feet long, terminating in a tin can of about a quart capacity. (A lard can is about right.) Punch a nail-hole about an inch from the bottom and put in a couple of short sticks half an inch square. Now place a baking-powder can in the quart can, supporting it on the blocks of wood, and after inserting the free end of the gas-tubing between the tin cans, pack the upper portion of the space with cloth or cotton.

If possible, arrange to have the boiler can and double boiler on separate tables or benches; but if this can not be done, put a large board or metal partition between them. This is to serve as a fire wall against any alcohol vapor from the experiment creeping along the table and catching fire.

Previous to setting up the foregoing apparatus, grate or shave a cake of good white hard soap into small pieces, and dry it in an oven *at a very moderate temperature.* The object is to drive out the large amount of water which all soap contains, without melting the material. This may take some time; but it is better to take longer and be sure the soap is dry, than to try to hurry it and melt it. When the soap is perfectly dry and powdery to the touch, fill the baking-powder can about half full of (denatured) grain alcohol. Since a baking-powder can is not always even water-tight, it is just as well to take the precaution of testing it for leaks with some alcohol. Now get up steam in the boiler, and shortly after steam passes into the space between the two cans, the alcohol will boil. With a spoon, sift in the dry powdered soap a little at a time, stirring continuously. The soap will dissolve, altho the solution may be rather muddy looking instead of clear. Keep adding soap until no more readily dissolves, adding a little alcohol occasionally to replace that which is lost from boiling. If the solution does not boil as easily as at first, cover it up with a little saucer for a while. When as much soap as possible has been dissolved, turn off the steam and let the alcoholic soap solution cool. At a certain point, it will suddenly freeze and become completely solid. When perfectly cold, run a thin sharp knife around the inside of the can, or immerse it for a moment in a pan of boiling water, and you will be able to slide out a white cylinder of "solid alcohol." It looks much like soap, except that it is not quite so hard, and may be cut into convenient-sized cubes or sliced into smaller cylinders.

If a match is applied to one of these, it will ignite readily and burn with a hot pale blue flame for ten minutes or so, leaving a residue of soap. The "solid alcohol" should be preserved in friction-top cans until wanted for use, as otherwise the alcohol slowly evaporates. It is very popular with campers because of its safety and convenience, for after one has cooked a meal over burning "solid alcohol," the soap that remains may be used to wash the dishes!

A Good Secret or Invisible Ink

Almost every one has wished at one time or another for a good secret or sympathetic ink—one that is cheap and easily obtainable, really invisible when written, easy to develop and easy to read when brought out. An ink not generally known which answers these requirements is a solution of chlorid of ammonia, ammonium chlorid, or sal ammoniac as the electrician calls it. It is used for charging the wet batteries for ringing door bells.

SCOUTMAN G.

Dear Walter:

Secret Six commands your presence at the Sign of the Seven Stars at Moonrise.

John wants us to go fishing Saturday. Can you go?

Yours,

Charley

The Secret Summons.

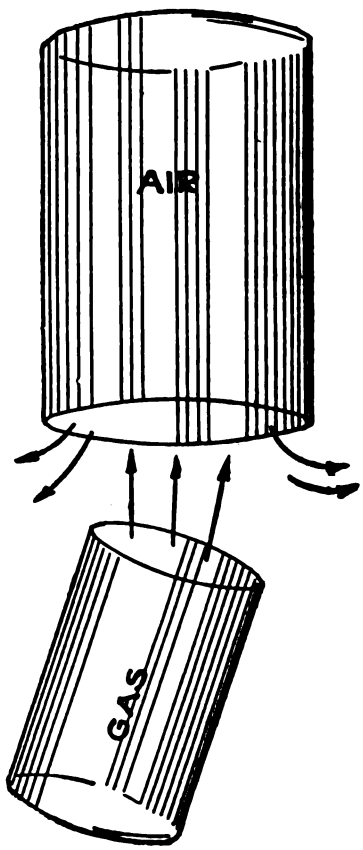
Make a strong solution of this chemical in a clean bottle, get a new pen-point (one that won't scratch) and clean the lacquer from it by scraping, sand-papering or washing in alcohol. Draw or write with the solution on a piece of clean white paper, viewing the writing horizontally against the light to make sure that the pen point has not "skipt." You want a pen which is absolutely dependable and won't miss a dot, since in use you will be writing "blindly."

When the ink has dried, examine the paper again very carefully to see if you can make out any trace of what you have written. Very likely you can. If so, add a little more water to the ink and try again until nothing whatever can be detected on the paper after the ink is dry. The idea is to get the ink of such a strength that it will soak *into* the paper without leaving any tell-tale crystals of sal ammoniac on top.

To bring out the writing, heat the paper written upon *strongly.* This can be accomplished by pressing with a hot flat-iron, or heating in an oven or over any burner. A little practise will soon give you the knack of it. The writing will appear brown to jet black, depending upon the amount of heating, and is absolutely indelible, the lines being virtually burned in.

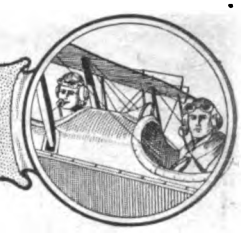
How to Make a Powderless Cannon

Punch a nail-hole in the bottom of a medium-sized tin can (2 lb. size) with a fairly tight-fitting cover. Take the cover off a smaller (½ lb.) can and hold it *upside down* over a gas-jet. Turn on the gas until the gas (which is lighter than air) has filled the can and overflowed at the bottom. Take the cover off the larger can, then, holding it upside down next to the small can, turn the smaller one right side up under the big one just a moment. (Not forgetting to keep a finger over the hole in the bottom of the big can.) Then slip on the cover of the big can still keeping it upside down, and lay it lengthwise on the ground. Put your foot on the can, take a long breath, and touch a lighted taper to the nail-hole. Results will be immediate, gratifying and harmless.



Transferring Gas From Small Can to Large One. The Bottom of the Large Can Has a Nail Hole Pierced Thru It.

RADIO DEPARTMENT



Grand Opera by Radio

By NELLY E. GARDNER

A BEAUTIFUL woman, of world-wide fame, stood before the wireless telephone, in the Hotel McAlpin, New York City, on the night of December 3rd, and poured into its receiving horn heartstirring notes that were heard by men far at sea. For Madame Louisa Tetrazzini, grand opera prima donna, had offered to sing for the officers and men of the United States Navy. So on that wintry night all naval and commercial vessels that were within 500 miles of New York—providing they had their instruments tuned to the proper wave lengths and had the wireless telephone attachment—enjoyed their own private concert by the operatic star.

Between 9.30 and 9.45 p. m., other radio messages were stopt, so that all ships within the definite radius might listen to the beautiful music, without interruption. During that quarter of an hour Madame Tetrazzini sang four songs—three according to the announced program, and one encore for good measure.

Mme. Tetrazzini Singing by Wireless to the U. S. Navy Sailors. The Sailors Were on Their Ships, at Anchor or Running About the Harbor, or in Navy Yard Buildings, While Mme. Tetrazzini Was in Her Apartment in the Hotel McAlpin, New York. A Radio Telephone Had Been Installed in Her Apartment and Her Voice Was Transmitted Thru the Ether to the Ships and Navy Buildings and Then Amplified Thru Loud-Speaking Telephones. The "Concert" Was a Wonderful Success, the Sailors Reporting They Could Hear the Operatic Star Perfectly.—©Underwood & Underwood.

Just before the clock in her apartment ticked the half-hour, Madame Tetrazzini's manager called the radio-communication office of the Third Naval District, in the Whitehall Building, to make sure that everything was in readiness. When his question, "All ready, Lieutenant?" was answered in the affirmative, the musicians took their places, the prima donna took her place in front of the large receiving horn—and one of the world's greatest wireless telephone concerts was on.

As she threw herself into the "Polonaise from Mignon," it seemed as if the singer had a vision beyond the walls of the tiny room on the sixteenth floor of that New York hotel. She was really sending her song out on the cold seas to the men in blue, and was trying to cheer them with the loving warmth of her voice. After she finished the joyous trills at the end of the selection, her manager immediately stept to the telephone, saying, "Hello, Lieutenant, that is the end of the first song. Wait thirty seconds, and Madame will sing again. All ready. We're off!"

"Mignon" was followed by the "Rondo di Sonambula" by Bellini. In this number, Tetrazzini takes the high "F" sharp, for which she is justly famous. Her third selection was the ever popular song, "Somewhere a Voice is Calling." It was an inspiring sight—to the little group of reporters in the doorway—to see that illustrious daughter of Italy standing before the telephone gazing at the sheet of music in her hand, and striving hard to pronounce plainly the words of our alien tongue, so that all the sea-going sons of America might understand! And it is a pretty safe guess that her song reached many a brave heart, and turned it to the thought of the sweetheart, wife or mother at home.

Madame Tetrazzini is not only a great singer. She is something infinitely greater—a loving, warm-hearted woman, and a "good sport," besides. When her program was finished, she stept to the 'phone, and in broken English, called, "Hello, Lieutenant, you want some more? Well, sure! I'm ready!" Then once more, the singer whose voice can command many dollars on the concert and opera stage, generously and without pay, sent her marvelous notes out to the ears of the thousands of men who were listening eagerly at the other end of the wireless. Again, in high spirits, and slightly out of breath, she called, "It's good? Yes, I am, Oh, 'complimenti.' You speak Italian? Thank you very much. I'm so glad. Very good, all right. My compliments to all the sailors."

Then, last of all, with a twinkle and a chuckle, she called out the latest Broadway phrase that has caught her fancy. You could never guess the final message of the dignified opera star to the young men of America whom she had entertained aboard our great ships! So we'll let you into the secret. Tetrazzini's good-night message to our men at sea was, "Oh, boy!"

What wonder if some one of them wanted to call back, "Some girl!"

The greatest care was taken in the preparation of the room for this, the world's greatest radiophone concert. Every curtain and ornamentation had been removed. A small upright piano and a few chairs were the only pieces of furniture and the floors were bare. No persons were present during the singing, except her manager and the three accompanying musicians, pianist, cellist and flutist. But clustered in the doorway, where they could see the little woman, but where they could not distract her attention, was a small group of guests and representa-

(*Continued on page* 1136)

Articles to Appear in February Issue of "Radio News"

The Lafayette Radio Station
Two Practical Radio Telephone Circuits
By John Scott Taggart
A Detector and Three-Stage Amplifier for Fifty Dollars
By E. A. White and L. Hopkins
Using an Amplifier as a Detector of Long Waves
By H. K. Dunn
Amateur Radio and Its Future
By Pierre H. Boucheron
How to Wind Duo-Lateral Coils
By W. T. Prather
A New Type of "B" Battery
By Harry Boyce, Jr.

Radio Weather Report

The Photograph Above Shows Mr. E. A. Stewart of the Physics Department of the Kansas State Agricultural College Operating the Powerful Wireless Transmitter and Broadcasting the Latest Weather Reports Via Radio to Thousands of Farmers. This Radio Weather Report is Broadcasted Every Morning at 9.55. All the Farmers Have to do to Receive These Reports is to Install a Simple Receiving Set.

FARMERS will not have to squint at the sky or wait for the paper hereafter to know whether they had better hurry and get in the crops. They'll get the weather by wireless. That is, they will if they care enough about it to put in a receiving set at a trifling cost and teach the hired man or the farmer's boy how to tune it in. E. A. Stewart of the physics department of the Kansas State Agricultural College, has established a wireless weather report service for farmers; the first of its kind. Every morning at 9:55 he sends out the day's forecast. All the farmers have to do is to equip themselves to receive it and it is reported that many have already done so. This picture shows the wireless weather forecast station in operation.

Farmers in general are more or less familiar with the operation and cost of experimental radio apparatus suitable for receiving weather reports as well as standard time signals sent out by the large government stations in various parts of the United States, owing to the radio experimental stations erected and owned by many of their sons.

The amount expended for the receiving set suitable for this service depends, of course, on how elaborate a station it is desired to install. It suffices to say that—thanks to the high sensitivity and reliability of the vacuum tube, or Audion, and its wonderful amplifying properties—small size, efficient receiving sets can be obtained at the present time at surprisingly low prices.

Many, of course, who have a little time and a thirst for experimental science, will undoubtedly find much pleasure in buying the parts and building their own sets, after specifications given in various handbooks available on the subject, as well as from articles publisht in the various radio journals.

New Loud-Speaking Telephone

THE Electro Amplifone here illustrated is effective for interior loud-speaking telephone and radio service. The instrument is adapted to operate on 110 volts D. C. or on a 6 volt storage battery current. It may be used on alternating current in conjunction with a tungar vacuum bulb rectifier. The two sockets in front accommodate two 10 volt lamps for resistance purposes. In the perfected electric control box the resistances are incorporated in the form of a variable potentiometer for 110 volt supply, or a choke coil for 6 volt storage battery operation. The equipment can be used with a hand microphone, chest transmitter or electric tone arm.

With a standard size control box of the type here shown, one up to any reasonable number of loud-talking receivers can be connected up and successfully operated without diminishing the volume of speech in any one receiver, it is claimed.

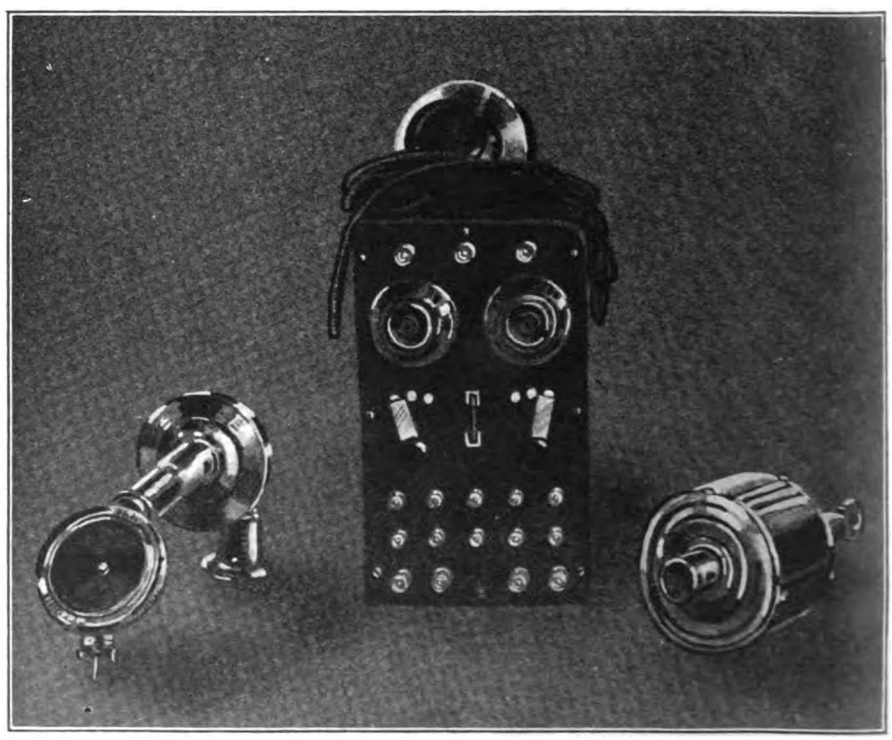
The shunt potential across the transmitter averages 4½ volts when operating this system on 110 volts D. C. The transmitter is of the single button form (granule type) consuming .22 ampere.

The receiver is enclosed in a heavy nickeled spun brass shell, measuring 3x3 inches. The receiver operates with a vacuum between two diaframs.

The receiver consumes 65 milli-amperes; the winding is of the high impedance type. For radio work, the receiver is fitted with the audion transformer enclosed in the shell, adapting it to connection in the plate circuit of an audion. A specially shaped metal horn has been developed for use with the loud-talking receiver. It has already found a large field of usefulness in hospitals and other institutions for such uses as transmitting music to the patients' wards.

The electric tone arm is fitted with an improved form of phonographic reproducer which can be reversed instantly to play either lateral cut or hill and dale records. It has been found by the designers of this apparatus that superior results are obtained by using the non-tapering form of tone arm.

With this loud-talking telephone apparatus installed in a public institution such as an auditorium, an ordinary talking machine used in conjunction with the special tone arm and the control box shown, together with a number of the loud-speaking receivers, as many as several thousand people can be entertained at one time. The makers of this apparatus have also devised a loud-speaking set for use by aviators and show window demonstration sales purposes.



New Loud-Speaking Telephone Which is Adapted for Use on Telephone Circuits as Well as Radio Receiving Circuits. The Combination Tone Arm and Transmitter at the Left is for Use in Transmitting Phonograph Music to Any Number of Loud-Talkers. The Transfer and Control Box is Shown at the Center With Hand-Type Transmitter Lying on Top. The Special Loud-Speaking Receiver Appears on the Right.

The Hall Jet Relay for Recording Radio Signals

By PROF. RALPH D. DONER

EVERYBODY knows that wind blowing over a body of water causes waves, but few persons understand the underlying principles involved, while a still smaller number perhaps are aware that such waves are closely related to the blowing of a flute or an organ pipe and to the recording of radio signals automatically. Let us examine the theory of water waves and see why this is so.

In Fig. 1, we have the motion of the wind represented by arrows. In each trough there is a whirl or vortex "V", rolling along on the surface of the water and "under the wind" just like the rollers in roller-bearings. The small arrows perpendicular to the surface of the water show the action of these air currents on the water, a pressure downward in the troughs, and a suction upward at the crests. Thus it is seen how the wind tends to maintain the waves. This action of the wind may be deduced also from Bernoullis' principle, namely "where the velocity (of the wind) is greatest, the pressure is least, and vice versa."

Suppose now that we replace the water by still air, Fig. 2, and the wind by a jet of air issuing from a nozzle. Here again we will find Nature providing roller-bearings in the form of vortices "V", so numerous and irregular that they form an almost continuous sheet separating the moving jet from the surrounding still air. These vortices begin soon after the jet leaves the nozzle, and are the result of extremely slight irregularities always present when a fluid issues from an orifice. They increase in size because, as we have just noticed, in a trough the pressure is greatest, which deepens the trough, and causes a larger vortex, creating a greater pressure, and so on.

Similarly a crest tends to grow larger and larger. The flapping of a flag is a good example of this, as well as the eddies caused by an oar in water. The result is a sudden break, flare or rupture of the jet. Such a self-stimulating action is said to increase exponentially. This wave form imprest on the jet by these vortices, travels at about half the speed of the air in the jet; hence it is apparent that any particle in the jet tends to vibrate more and more from the natural path of the jet, once it has been started, and this start is extremely small. It is found that the jet breaks when this wave form has attained only a very small amplitude compared with the size of the jet, and the jet appears to be undisturbed almost up to the break itself.

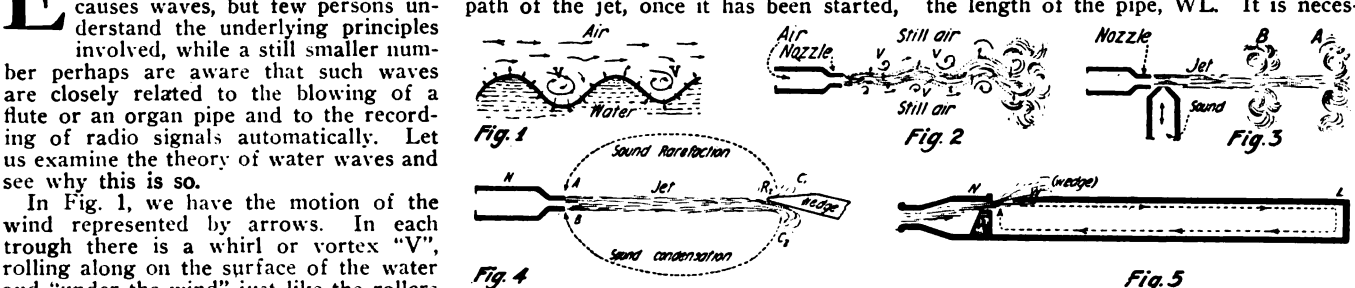
Experiments show that the vibrations of sounds in the neighborhood of the jet, cause these vortices to start sooner, more regularly, and with greater intensity, thus causing the break to occur nearer their orifice, as shown in Fig. 3,—"A" being the natural position of the break, and "B" the position when sound strikes the jet. It is also found that the more intense the sound the nearer "B" is to the orifice; and that the greater the velocity of the jet the sooner the break. Such a jet is called a "sensitive jet," and is similar to the well-known "sensitive flame."

Figure 4 shows how a jet may be made to react on itself by placing a wedge in its path. When it strikes the wedge so as to produce a condensation C_1 this effect travels as sound and strikes the base of the jet at "A", which in turn, when it reaches the wedge, causes a condensation C_2 on the other side, and this impinges as a sound wave at B, etc. The pitch of the sound produced will be found to vary with the velocity of the jet and inversely with the distance to the wedge.

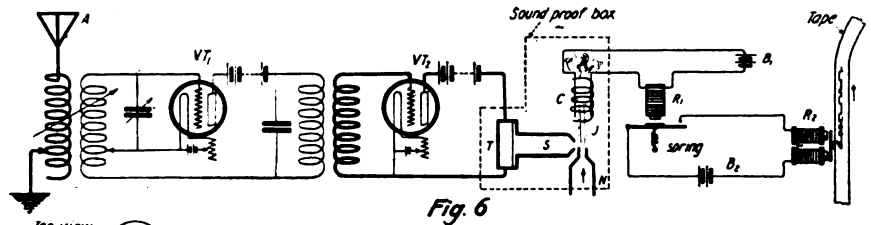
Figure 5 is an organ pipe and differs from the above only in the manner by which the sound is reflected back to the base of the jet, having to travel twice the length of the pipe, WL. It is necessary that the jet have such a velocity that the time taken for sound to travel 2 WL, is the same as for an effect produced on the jet at "N" to reach "W", or at least some simple fraction of that distance, as ½ or 1/3 of NW, thus keeping in step and building up the vibrations. The blowing of a flute is no different in theory, hence no further explanation is needed.

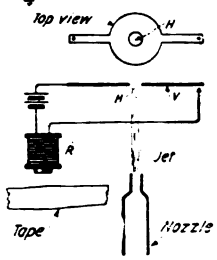
Dr. Hall of Chicago has invented several methods of using this sensitive jet in the recording on tape of wireless signals. The arrangement is shown in Fig. 6. The air jet "J" issues from nozzle "N" and breaks at "A", after passing thru the center of a helical coil "C", composed of fine platinum wire, supported on four posts. The wire is soldered to

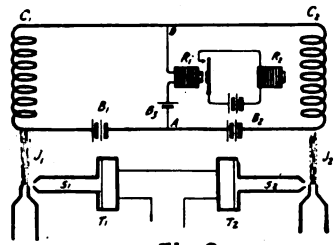
(*Continued on page* 1130)

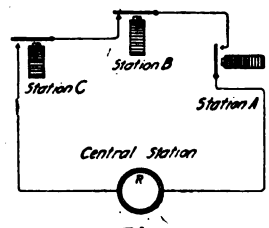


These Diagrams Show Some of the Remarkable Actions Taking Place in a Jet of Air, and Which Phenomena Are Taken Advantage of in the "Hall Relay," Which Instrument Has Been Successfully Used in Recording Signals at High Speed Over Distances as Great as That Existing Between Nauen, Germany, and Chicago, Ill.

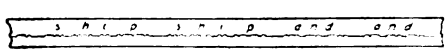




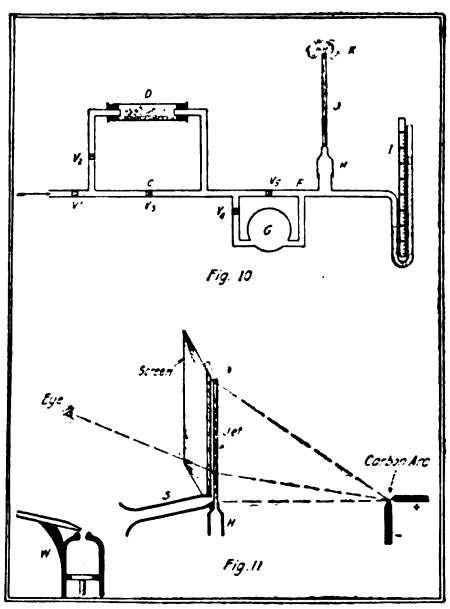




Several Diagrams Showing How the Comprest Air Jet Relay Has Been Successfully Used, With One to Two Stages of Audion Amplification, in Order to Effect a Tape Record of the Received Signals. Whenever a Sound From the Telephone Receiver T Impinges Against the Jet J, the Flare of the Jet Lowers From A to C, Cools the Wollaston Wire Coil C, Changing the Resistance of the Circuit and Causing Relay R-1 to Actuate the Tape Recording Electro-Magnets R-2.



This Sample of Tape Record Was Obtained While in the University of Chicago, in the Spring of 1919, During the Peace Conference. The Station Copied Was Nauen, Using an Eight-Wire, 400-Foot Antenna, About 150 Feet or More High, and an Audibility of About 60.

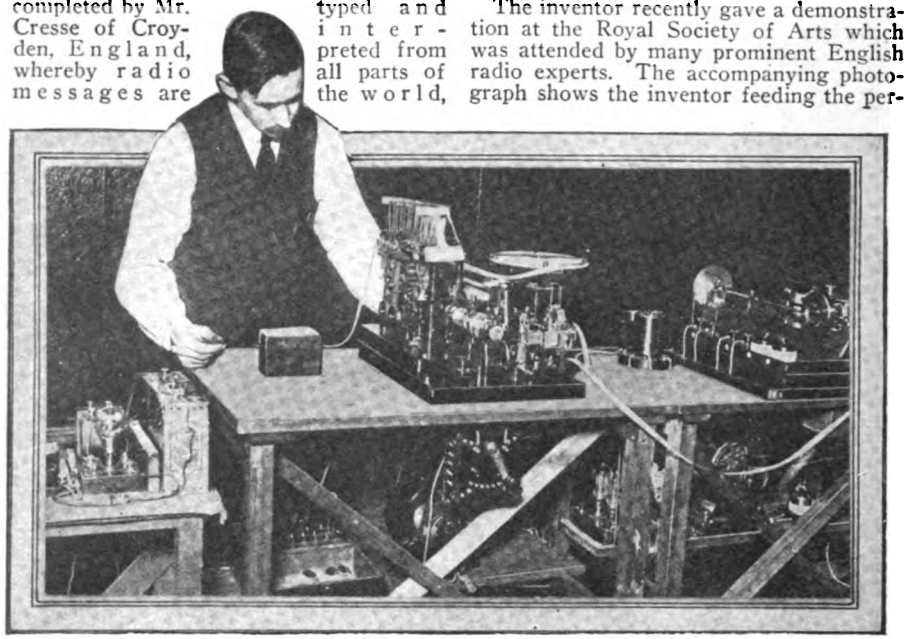


Figs. 10 and 11 Show Some Features of the Special Tests Carried Out by Prof. Doner With the Hall Jet Relay. The Fluctuations of the Jet When Acted Upon by Sound Waves From W Were Made Visible on the Screen by Means of a Powerful Light From the Carbon Arc Shown at the Right.

Messages Typed at 100 Words Per Minute Via Radio

THE accompanying photographs show a very interesting and remarkable invention which has recently been completed by Mr. Cresse of Croyden, England, whereby radio messages are typed and interpreted from all parts of the world, so reports claim. The messages are first transmitted to a perforating machine and then to the automatic typewriter at a rate said to equal a speed of 100 words per minute and more.

The inventor recently gave a demonstration at the Royal Society of Arts which was attended by many prominent English radio experts. The accompanying photograph shows the inventor feeding the perforated paper tape to the automatic typewriter.



New English Radio Typewriter Invention by Means of Which Messages Can be Typed at the Rate of 100 Words per Minute or More. The Typewriter is Operated by a Perforated Tape. This Will Mark a Great Step in Advance in the Radio World, as the Ordinary Operator Cannot Receive at a Rate Exceeding 40 to 50 Words per Minute Aurally.

Many inventors in all parts of the world have taken out patents on automatic typewriter arrangements for use in radio, but none of them have ever been able to give a satisfactory demonstration of their perfected apparatus.

Once such a system as this is perfected, it will mean a great deal to radio, as the present system of dot and dash codes, is of course nothing but a makeshift and what radio and electrical engineers want, and have a right to expect to see very shortly, is the perfection and adaptation of an automatic transmitting and receiving apparatus which will send out and pick up at high speed, pre-arranged series of signals, the successive and ever-varying groups of which, will, when interpreted by the receiving machine, cause the letters of the alphabet to be printed on a paper tape or roll, in the same manner as the telegraphic printers now operate over a single telegraph wire between the larger American cities.

Stock Brokers Find Radio Useful

THE accompanying photograph shows one of the latest wireless telephone sets in use in a stock broker's office in Berlin, Germany. With these wireless 'phones, financial and stock reports are radioed over any desired area, depending upon the power of the transmitting set. It is claimed that with this method, the reports are transmitted and received by customers (who, of course have to install a simple radio receiving set in their offices or homes) much earlier than with the usual ticker service by wire.

The photograph shows the wireless 'phone operator sending out stock reports, while the man at the right is shown in the act of receiving radio reports.

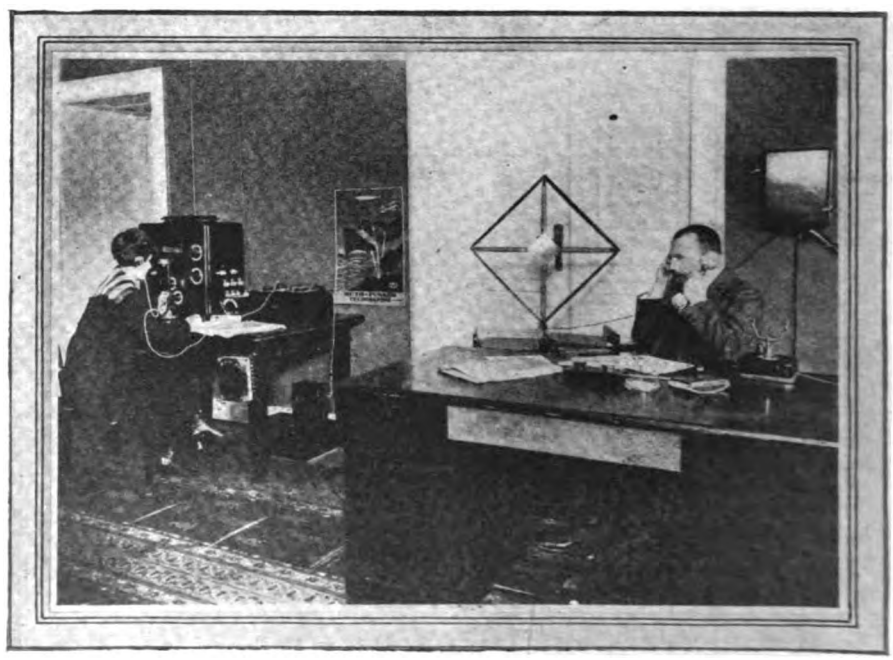
Recently, for the first time in the history of Wall Street, the radio telegraph supplanted the ordinary telegraph lines in the carrying on of stock market operations between New York City and Chicago. The wire lines were disrupted by a heavy storm early one morning, and during the final hour of trading on the New York Stock Exchange, one well-known concern conducted business with a firm in Chicago, by wireless.

The arrangement for the service was made hastily with a radio communication service, which will operate wireless between New York, Cleveland, Detroit and Chicago. This service has not been formally opened; in fact, it was an invitation to the opening of the service quite recently, which gave the president of the New York stock concern, the idea of trying the service at once.

The reply was received three minutes after it left Chicago. Several later messages were answered in from seven to eight minutes. In the case of each brokerage house, however, the message had to be telephoned to the radio station in the respective cities and this caused some little delay that could be eliminated by the use of private wires for this purpose. One of the officials of the New York Stock Exchange said he believed that a half minute would suffice for the transmission of an order, with the telephone part of the arrangement working to better advantage.

After the close of the stock market, the operations by wireless were checked up over the private wire between New York and Chicago, and it was found that not a single mistake had been made.

The Accompanying Photograph Shows a Wireless Telephone Installation in Use by a Berlin Broker. Recently Wall Street Stock Brokers in New York City Employed Radio Telegraphy for the First Time in the History of That Famous Street. Stock Transactions "Via Radio" Were Carried on Between New York City and Chicago When a Heavy Storm Disrupted Traffic by Wire. It is Intended to Make This Feature of Radio-Communication Stock Service a Permanent Asset, as Many Thousands of Dollars Have Often Been Lost Owing to Telephone and Telegraph Lines Being Severed by Severe Storms.

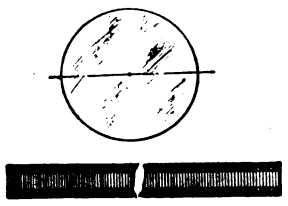


LATEST PATENTS

Acoustic Diafram.

(No. 1,356,399. Issued to Simon David Paddack.)

This invention relates to the making of acoustic diaframs. The in-

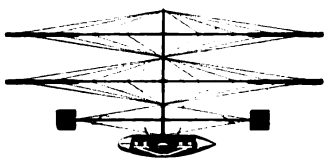


ventor melts together by the use of heat, 40% of shellac, 50% resin and adds to this 10% powdered glass. He then adds enough wax to make a considerable layer of it over the surface of the molten mixture. He then passes blotting paper thru the molten mixture a little wider than the finished diafram and then allows the blotting paper to pass thru heated rollers, which force the powdered glass into the paper making it denser and harder and removes the surplus wax. The resulting diaframs used in phonograph sound-boxes give excellent results.

Helicopter.

(No. 1,350,455. Issued to Peter Cooper Hewitt.)

The helicopter here shown was described in past issues of this magazine. There is a car connected permanently to a shaft thru which pass two driving shafts for the vanes or propellers. These are so arranged that they rotate in opposite directions even when acted upon by only one motor due to the bevel gear arrangement on the motor and

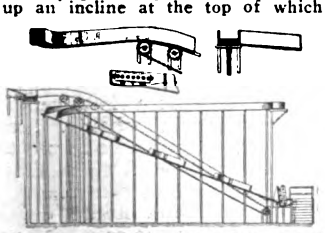


driving shafts. Vanes are connected to incline the car which inclination assists in the forward motion of the machine itself. The propellers are each over 40 feet in diameter and the angle at which they are mounted upon the shaft is variable. Incidentally, these same blades do not start at the axis of the driving shafts but at a considerable distance from them as there is very little thrust obtained near the hub of a propeller.

Pleasure Railway.

(No. 1,356,412. Issued to Frank Aloysius Smith.)

This is a very novel system of providing pleasure by the use of a railway of peculiar design and construction. It consists of a means whereby cars of an elongated shape made to accommodate two persons in a lying down position are hauled up an incline at the top of which

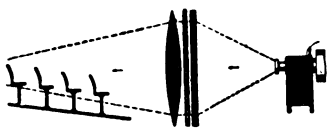


they are released and they travel thru a labyrinth of deflecting vanes. The cars are in full view of the onlookers and amusement is provided for both onlookers and passengers because of the varying positions which the occupants of the car assume. A device is provided whereby the car comes into an upright position at the end of the course, thus assisting in bringing the occupants into an upright position again.

Stereoscopic Movies.

(No. 1,358,685. Issued to William L. Friedman.)

There are several features to this invention which the inventor claims will enable people to view motion pictures and obtain the same sense of relief as is found in stereoscopic pictures. Essentially, the device consists of the regular projector which is placed in back of the screen and projects the picture upon a translucent screen so that those on the opposite side can see it. For this reason the theatre does not have to be darkened to view the picture. In front of the screen is placed a sheet of glass, such as

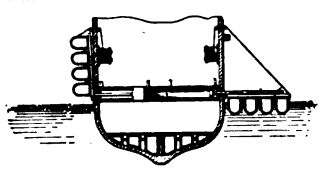


Venetian glass, which has a minutely waved surface but thru which the picture can be seen and in front of the Venetian glass, is a very large lens, the curvature of which is not great enough to create magnification or distortion of the picture and yet sufficient to allow for some slight refraction. The audience can then see the motion pictures in true relief.

Non-Sinkable Boat.

(No. 1,355,937. Issued to John J. Brosnan.)

A method for preventing a boat from sinking and reducing rocking is the subject of this patent. When not in use, frames hinged to the side of the boat are held in an upright position. These frames are provided with casings of sheet steel hermetically sealed and filled with comprest air. The boat in itself is also provided with a false bottom so that any cargo which would be injured or rendered explosive by coming in contact with water can be kept safely because the cargo will continue to float in this false bottom. If the boat has been hit, two

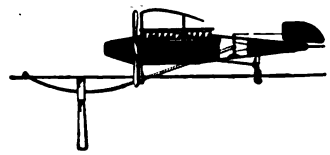


reels play out the rafts or floats and at the same time plungers are forced out by means of air pressure behind respective pistons. This readily holds the frames down near to or on the surface of the water and prevents the boat from sinking; or in case it is used in a storm, prevents excessive rolling and pitching.

Overhead Transportation Apparatus.

(No. 1,355,911. Issued to Rolland C. Riddick.)

This invention aims to provide for an overhead carrier of great simplicity which will allow for quick and economical means of transportation for passenger or freight service. It consists of a conventional airplane construction which will have sustaining qualities and relieve the supporting structure of weight, reduce friction and permit much greater speeds. The idea incorporates many novel automatic controlling mechanisms so as to vary the craft in elevation, and inclinations of the track and also vary the controls for properly rounding curves, the carrier being banked for this purpose, which banking assists

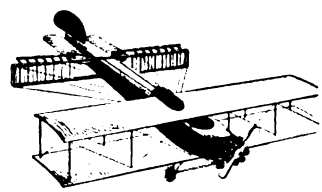


in preventing the tendency of continuing in a straight course. The power for turning the propellers is supplied by means of either electrical or gasoline motors, the latter having their fuel supply within the fuselage-like body of the transportation contrivance; the electric motors could be supplied by power by the usual method, that is, by contact with power rails. Much greater speeds are promised in that friction upon rails is negligibly small, the air friction being the greatest factor which this transportation system has to contend with.

Brake for Airplanes.

(No. 1,356,289. Issued to William Edward Karnes.)

This is a very clever invention the purpose of which is to enable an airplane to stop quickly reducing the landing speed and avoiding collision while in the air. Secured to the tail portion of the fuselage is a frame between the beams of which are a series of vertical shafts provided with cranks at the upper ends, and fitted with blades so designed

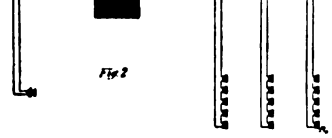


that when closed they slightly overlap each other. Each series of cranks, with their respective crank arms, are connected together by means of a rod and communicate by means of cables to control levers. When the gates are closed, sufficient resistance is offered to bring the machine to a standstill after it has traveled only a short distance.

Amplifiers for Auditoriums.

(No. 1,358,053. Issued to Henry M. Bascom.)

There has always been considerable difficulty experienced due to the fact that when telephonically transmitting sounds, the sounds arrived at the distant amplifier and loud-talker considerably in advance of the sound of the speaker's voice conveyed thru the air. In large auditoriums such a disturbance becomes very disconcerting. The inventor has here produced a means

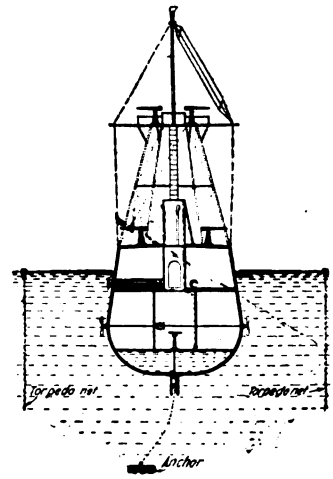


whereby the sound is recorded upon a steel wire or tape and then by properly spacing the take-up coils and regulating the speed of tape travel, and finally amplifying in the usual manner, the speaker's voice and the sound from the amplifiers are heard simultaneously.

Floating Fortress.

(No. 1,350,667. Issued to Julien Ortiz.)

A new form of armored float for use at sea as a means of coast defense is the subject of this patent. Many of these can be anchored at various strategic points along the coast for the purpose of guarding against the approach of enemy seacraft. Each fortress consists of a float which may be submerged if desired and which contains two torpedo tubes and propellers parallel but offset on opposite sides of the diameter of the hull, so that by operating these propellers any torpedo tube may be brought into line

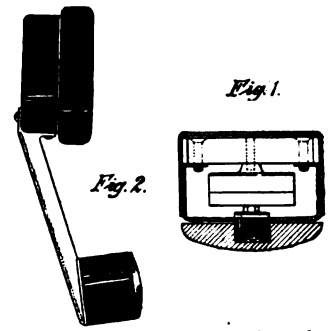


with the enemy craft. Nets are suspended from the outriggers to prevent a counter torpedo attack and two decks are provided with guns. A motor operates ammunition hoists, air and water pumps, etc. The vessel is submerged by introducing water into the lower compartment, or by drawing up the winding chain and thus dragging the entire fortress beneath the level of the sea.

Telephonic Transmitter.

(No. 1,356,190. Issued to Bertram Sydney Cohen.)

This invention is intended to allow for telephonic transmission by

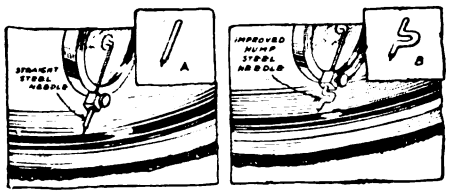


placing the transmitter against the throat of the user and it is operated by the vibrations in the throat instead of by the waves of sound issuing from the mouth. This will be of particular value in places where there are external noises such as those produced by machinery in the neighborhood of the user. It consists of a microphone of the usual carbon granule type. At one end of the transmitter is an insulating disc connected to the microphone via the inserted screw. This when held against the throat of the user permits contact at its center and allows for the compression and release of the carbon granules in the microphone.

What To Invent

By JAY G. HOBSON

THERE are many needed improvements yet to be discovered for the phonograph, because there is much room for improving the tone of the standard talking machine, which is far from being perfect. Considerable profit



Instead of Sticking to a Rigid Type of Phonograph Needle, as Shown at A, Why Hasn't Some Genius Devised a Simple Improved Form of Phonograph Needle Like That Shown, for Example, with a Hump in It? The Steel Needle Seems to Be Too Rigid and Causes Many False Notes and Scratches to Be Transmitted to the Sound Box and Thence to the Amplifying Chamber, Whereas the Hump at B Would Seem to Absorb Some of These False Vibrations.

should result for the inventor succeeding along this line of endeavor.

I have in mind improvements on the sound-box, on the needles, on the records and on the composition from which they are made.

There is not a perfect sound-box on the market today, nor a perfect needle, nor a perfect record. The best sound-box made does not reproduce music as well as it should to give entire satisfaction. A sound-box that will eliminate these faults will be very welcome to the millions of phonograph owners desiring better music from their machines. But to accomplish this great improvement, it will be necessary to keep away from the beaten paths of present sound-box design and originate a construction entirely different from the kind now used.

The best records used are most imperfect. They produce too much surface noise, wear down too soon and are too delicate for general use. An improved record overcoming all these drawbacks certainly will have wonderful success, both musically and commercially.

However, this month's suggestion deals with what I believe to be an improvement on the ordinary steel needle used almost universally today. In my opinion the straight steel needle is too stiff—not flexible enough to eliminate the ever present scratch when playing. To overcome this fault and improve the tonal quality of phonographs in general a distinct departure in needle design should be made. Possibly a steel needle, made with a hump midway between point and end, would do away with the annoying scratch so much in evidence with the straight needles.

This hump, as illustrated, would add greater flexibility to the needle, make it more springy, thereby equalizing the weight of the sound-box against the record grooves, as well as act in the form of a guide when inserting the needle.

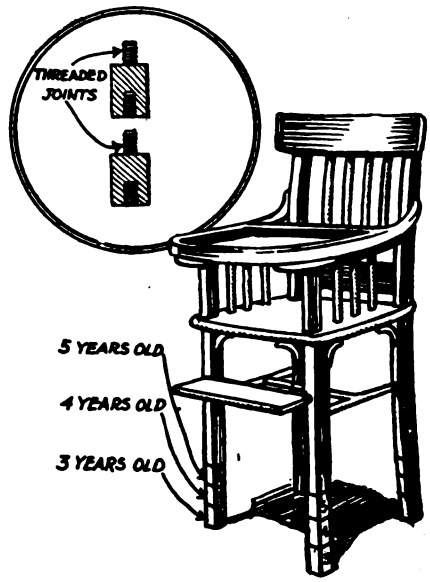
The more flexible the steel needle, the softer will the tone be, and there will be less surface noise from both the needle and record. A design similar to the one described should greatly improve the tone and sell in great quantities.

Improved High Chair

If little babies could talk to their parents and intelligently express themselves on the subject of infantile accessories, I am sure the majority would unanimously vote to banish the present inefficient high chair. With a little explanation, the parent would soon realize the inability of this common design to meet all requirements as desired.

As soon as James Junior is old enough to sit up and say "Da-da," he is placed at the head of the family table in his new high chair, a safe distance from the spillables. A year or two finally passes, when some Sunday morning Daddy finds his mushroom son about grown beyond the confines of his baby chair. His little knees bump against the table and this makes the chair very undesirable to the little rascal, who squirms around peevishly, almost knocking his glass of milk over here, and spilling his gruel over there, until Mama and Papa are so inoculated with the nervous germ that they determine to exile said high chair to yon attic with many other forgotten antiques; or, perhaps, until needed again.

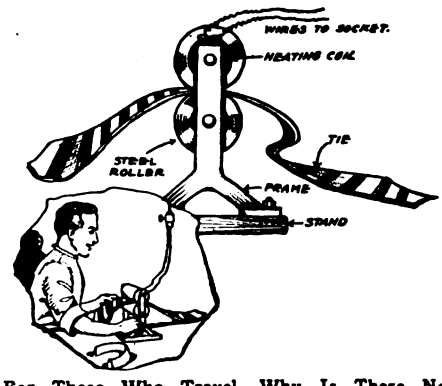
Then, as a makeshift, they employ one of the dining-room chairs, with books and some cushions to provide semi-adult sitting facilities for the young specimen of man. But this arrangement is tricky, under their



For Generations We Have Had with Us Baby's High-Chair with a Single Fixt Height. Now, Why Is It Someone Has Not Given Us a Simple Adjustable High-Chair Like That Shown in the Illustration, So that as Baby Grows, We Can Simply Remove a Section from the Four Legs and Lower the Chair, Each Section Being Marked with the Different Age Year.

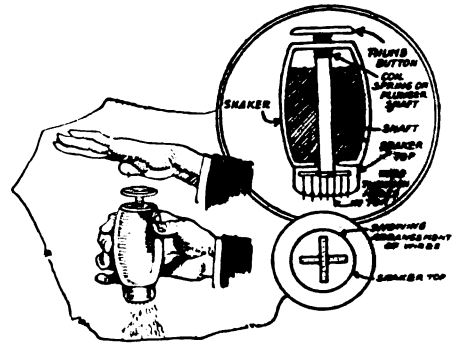
youngster's wiggles, making all sit on pins lest he precipitate himself to the floor. So this condition continues for want of a better improvement.

Here it will be seen an improved high



For Those Who Travel, Why Is There Not Available a Simple Tie Presser, Like This One? Something That We Can Hook Up to the Electric Light Circuit and Operate Like Those Large Steam Mangles We See in Steam Laundries.

chair is needed badly; one that could be adjusted in height to the age and size of the child using it; one with legs made in sections to be removed and shortened as the child grows larger and older. No



And Speaking of Salt Shakers, Here Is a New Wrinkle Which Would Seem Valuable Enough to Warrant Its Being Put on the Market. On Damp Days When the Salt Will Stick, You Simply Push on the Shaker Rod Which Loosens the Salt in the Container, and Also Jiggles Some of the Salt Thru the Top by Means of the Needles Shown.

doubt one similar to the illustration would be just the trick and undoubtedly something of this kind would soon receive hearty approval from thousands of parents with fast-growing children.

Traveler's Tie Presser

Irons may come and irons may go, but wrinkled ties will be with us forever. The traveling public always have, and apparently always will find it almost impossible to keep their ties and scarfs properly prest, living in hotels, on trains and the like, because these homes-for-a-day accommodations do not provide irons nor pressing service of sufficient worth to get small articles ironed neatly. And in view of this condition, it appears to me a small electric tie presser would capture the hearts of all the "away-from-homes", because it could be quickly attached to the ordinary light socket and the ironing of small articles could be done quickly in the hotel room.

Imagine a compact tie presser made of two small rollers connected movably together, something in appearance like the clothes wringer, if you please. Inside one of these highly polished metal rollers would be secured a resistance coil to supply the necessary heat for pressing the ties drawn between the rollers as shown. The men-folks would not feel so sissy toting a device of this design around, but no possible inducement could get them to carry a lady's small iron. Some day our national publications will offer such a contraption for men thru their advertising, and frugal people will welcome it.

New Departure Salt Shaker

Patents galore have been allowed by the United States Patent Office for salt dispensers, but in all these years of advancement none has succeeded in inventing a perfectly satisfactory salt shaker. Strange as it may appear, every device in use today for this purpose is about as efficient as the old ox-team was for transportation. The next time you dine out, notice the kind of salt shakers used in the café, and notice how perfectly they *don't* work, if the day happens to be rainy.

The trade mark slogan of one prominent salt company says: "It Pours When It Rains," but I happen to know that this is

(*Continued on page* 1132)

Scientific Humor

Or Dante's Inferno.—When it comes to listening to a banker's attempt to explain the mysteries of exchange we prefer to read Einstein on Relativity.

—*Geo. Ulrich, Jr.*

He Who Kicks Succeeds.—Two frogs accidentally fell into a large can of milk. They began at once to struggle for freedom, leaping for the top, but always falling back. One of them very soon became discouraged and began saying: "It ain't no use; it ain't no use." But the other one kept on striving and said: "I'll never give up." When several hours later the frogs were discovered in the milk, the one that said "it ain't no use" was dead, and the other one was sitting on a cake of butter singing, "I'll never give up."

—*B. H. Lyon.*

The Face Value of Astronomy.—Dick: "I don't think that the lecture would have interested you. It was all about sun spots."

Daisy: "Oh, was it? Then it certainly would have interested me, for I have been a martyr to freckles all my life."

—*Sydney Hoffman.*

Off Color.—Professor (in science class): "William, name two complementary colors."

William: "Powder and paint."

—*Shannon Jones.*

Our Office Uses Both Systems.—He (addressing a young stenographer): "Do you use the Hunt system or the Touch system?"

She: "The Hunt system is new to me. Explain it, please."

He: "Well, in using the Hunt system you write one word and 'hunt' for the next one, and in using the Touch system you are always 'touching' the boss for more pay."—*Ben H. Lyon.*

He Might Have Bought a Muffler.—Agent: "I have here a little invention to make the voice carry farther."

Mr. Henpeck: "For goodness' sake, don't tell my wife."

—*I. L. Sloter.*

Domestic Geography.—Teacher: "What are the four seasons?"

Johnny: "Pepper, salt, vinegar and mustard."—*Mildred Webb.*

A New "Spring" Song.—First Scientific Bug: "If I were to take a heavy steel clock-spring and wind it up tightly, then place it in a porcelain dish and dissolve it in nitric acid; where would the energy stored up in the spring go to?"

Second Scientific Bug (thoughtfully): "Why, I suppose it would tend to make the acid 'stronger.'"—*I. Hector Graham.*

Disconnected.—Minister (at close of sermon): "We shall now sing hymn number 389."

Operator (rousing from nap): "The line is busy."—*Harry Humberston.*

FIRST PRIZE $3.00

Still More Wonderful.—Scientist: "This pearl comes from an oyster; isn't that wonderful of nature?"

Freddie: That's nuthin', my sister has a whole string of them that she got from a lobster."—*Adolph F. Lonk.*

He's Probably on the "Star"-board Side.

Twinkle, twinkle, little star,
How I wonder where you are;
High above I see you shine;
But, according to Einstein,
You are not where you pretend,
You are just around the bend;
And your sweet seductive ray
Has been leading men astray
All these years—O little star,
Don't you know how bad you are?

—*Donald Newton.*

A Second Einstein.—Teacher (playing a record): "Johnny, what is it called when four people are singing?"

Johnny: "A quartette."

Teacher: "What is it called when two people are singing, William?"

William (after a moment's hesitation): "A pintette!"—*Joseph Humphrey, Jr.*

ALL jokes accepted and published 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.

We Really Can't Print This One.—Professor of Engineering (just after a lecture on the construction of bridge piers): "And now who can describe a *coffer dam?*"

Student: "Well, Professor, the other day I walked in the country and saw a cow swallow an apple, and I thought she would *cough her damn* head off!"

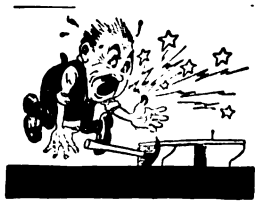
—*Russell F. Daniel.*

Monkey Business.—An auto tourist was travelling thru the great Northwest, when he met with a slight accident to his machine. In some way he had mislaid his monkey-wrench so he stopt at a nearby farmhouse where the following conversation took place between himself and the Swede farmer:

"Have you a monkey-wrench here?"

"Naw; my brother he got a cattle rench over there; my cousin he got a sheep rench further down this road, but too dam cold here for monkey rench."

—*Pierre H. Boucheron.*



Sometimes the Thumb "Strikes" Too.—Mr. H.: "Do you know I can strike nails like lightning?"

Mr. S.: "Is that so?"

Mr. H.: "Yes, lightning never strikes twice in the same place!"—*Frank Holi.*

An Eye-Opener.—Holding her close to him, he gazed into the unfathomable depths of her gazelle-like eyes. Acute anxiety was exprest in every line of her fair face. Ever and anon a sigh seemed to rend her being with its intensity, and she gazed into his face as though she would read his very soul.

For many minutes thus they sat, neither speaking, each gazing into the other's eyes.

"Yes," said the oculist at last; "one eye is seriously affected, and, if not treated immediately, will develop a decided squint."

—*No Name.*

We've Been There.—Cop: "Hey there! you can't stop here, you know."

Motorist: "Can't, eh? You don't know this car."—*P. E. Householder.*

Or to Lick a Spoon.—Fair One on board ship: "Captain, don't you think it is cruel to box a compass?"

Captain: "Not any more than to paddle a canoe."

Joe Radomsky.

O. K. Till Their Fuse Blew Out!—Their meeting was mutual. She being immediately attracted by his magnetic personality, while he was not repelled, for his lips soon made contact with hers, and the sparking grew intense. He proposed with lightning-like precision, then they were united. Their friends were electrified. Wasn't it shocking?

—*K. K. Loafbourrow.*

Or Nitric Acid.—Head Nurse: "Rub him well with glycerine every two hours in the daytime."

Foot Nurse: "What shall I use at night, *nitro*-glycerine?"—*Sterling Gleason.*

A Born Mathematician.—"I saw your sister on the street today."

"Yes? How did she look?"

"I don't know, I didn't see her face."

"Then how did you know it was her?"

"Oh, I'm pretty good at figures."

—*A. F. Lonk.*

Solid Ivory.—Professor (in physics): "Jack, give me a good illustration of density."

Jack: "I don't know."

Professor: "A very good illustration, Jack."—*Shannon Jones.*

How Does Bird-Seed Work.—A teacher was instructing her pupils in the use of the hyphen. Among the examples given by the children was "bird-cage."

"That's right," encouragingly. "Now, Tommy, tell me why we put a hyphen in 'bird-cage'?"

"It's for the bird to sit on," was the startling rejoinder.—*Mary Braverman.*

THE ORACLE

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

1. Only three questions can be submitted to be answered.
2. Only one side of sheet to be written on; matter must be typewritten or else written in ink, no penciled matter considered.
3. Sketches, diagrams, etc., must be on separate sheets. Questions addrest to this department cannot be answered by mail free of charge.
4. If a quick answer is desired by mail, a nominal charge of 25 cents is made for each question. If the questions entail considerable research work or intricate calculations a special rate will be charged. Correspondents will be informed as to the fee before such questions are answered.

Which is Heavier—Wet or Dry Air?

(1074) Guy R. Phillips, Camden, N. J., asks:

Q. 1. I have always thought that moist air is heavier than dry air, as seems evident here, where on foggy days the air or clouds of vapor hang low. Nevertheless, prior to all rains, barometric pressure falls. Can you explain this?

A. 1. In the *January* 1921 issue in the article on "Science and the Weatherman," Dr. Scarr, Director of the New York City Branch of the U. S. Weather Bureau, gives the reasons for the fall in barometric pressure, and you will note from that article, that the effect of moisture in the air has very little effect on barometric readings.

In reference to the second part of your query, we cite below the facts indicating the weight of moist or dry air, as given by Prof. F. L. Darrow.

A liter of dry air at a given temperature weighs more than a liter of wet air at the same temperature. This is true for the following reasons:

1—Water vapor is lighter than air. One liter of air at standard conditions weighs 1,293 grams while a liter of water vapor under the same conditions weighs .8043 grams.

2—By Avagadro's hypothesis, "Equal volumes of all gases at the same temperature and pressure contain the same number of molecules."

3—Therefore a liter of saturated air must contain fewer molecules of air, their place being taken by the lighter molecules of water vapor. It is just like mixing oil and water. A liter of the mixture will weigh less than a liter of the water alone.

4—If a liter of dry air is weighed and then allowed to come in contact with water it will become saturated and its volume will increase, thereby making the weight of a liter of the mixture less than it was before.

5—As the air becomes more humid the barometric pressure falls.

If, however, air is saturated with water vapor and its volume is kept constant by artificially increasing the pressure upon it, the weight of a liter will of course be more.

Another fact in this connection is the following: If a gas is confined over water, say when the temperature is 20 degrees Centigrade and the barometer reading is 760 millimeters, then the combined pressures of the gas and the water vapor present will be 760 mm of which 17.4 mm will be due to the water vapor and the balance, or 742.6 mm to the gas. Therefore, only 742.61 760ths of the volume will be gas, while the rest will be water vapor.

Vreeland Oscillator

(1075) A. Walter Ward, Hartford, Conn., writes:

Q. 1. For name of an instrument developing high frequency currents without any moving parts.

A. 1. For obtaining a frequency of 1,000 cycles or more without the use of rotating vibrating or moving parts, results can be obtained by the use of a Vreeland vacuum tube oscillator, or higher frequencies can be readily obtained by the use of an oscillating audion.

Thermo-couple Metals

(1076) I. Cline Boone, Wirtz, Va., asks:

Q. 1. For some general information on thermo-couples.

A. 1. Thermo-electricity is produced by a thermo-couple due to the difference in temperature between the hot and cold junctions of two dissimilar metals. The following substances used in thermo-couples give a thermo-electric power and are capable of increases in temperature to the points specified.

Platinum and platinum-rhubidium compound 90% of the former and 10% of the latter, giving a power of 4.3 microvolts plus .0088, for each degree rises in temperature maximum temperature range zero to 1300° centigrade.

Platinum and 90% platinum 10% iridium—power 11.3 microvolts plus .104 for each degree rise in temperature range zero to 1,000.

Copper and nickel—power 24.4 microvolts plus .106 for each degree rise in temperature range zero to 235°.

Copper and 60% eopper 40% nickel—power 42.3 microvolts plus .058 for each degree rise in temperature range zero to 320.

Telegraph Typewriter Query

(1077) Herman Scott, Kansas, sends description of a telegraph typewriter, which he believes to be new:

A. 1. We have looked over your drawing and description of a telegraphic typewriter, and would advise as follows:

It is difficult in the first place, without knowing in what manner you intend to transmit the requisite number of electric impulses over the line to the typewriter, to form a clear idea as to the real worth and efficiency of your device.

From our experience with the Western Electric Co.'s printing telegraph which works with a regular keyboard and printing system quite similar to those found on the standard typewriter, very high speed is attainable as well as great accuracy, and of course, these instruments are not simple by any means.

We think that unless you have in mind or have already devised an accurate and rapid transmitting method or mechanism for sending the requisite number of impulses over the line to actuate the distributing switch at the printing end of the circuit, that there would be considerable time lost in the method you have outlined in order to print the successive letters, which would mitigate against the commercial worth and utility of your machine.

The best advice we can give is that you make an effort thru your patent attorney or else by consulting your local library, to inspect or obtain copies of the patents issued to the Western Electric Co., and on several other systems such as the Morkrum, on telegraphic typewriters, from which you will learn of all the vast research which has been carried on and the details perfected in operating these machines, today.

High speed, such as 60 to 100 words per minute, is the thing the commercial world wants in any device of this character in most cases. Possibly if you write to the U. S. Patent Office, Washington, D. C., they will inform you whether or not they would be in a position to make the search for you and forward the copies of all the patents that have been issued on telegraphic typewriters and printing telegraphs.

OUR readers will have noticed that since the December issue our cover has changed somewhat in appearance. This is due to the fact that we are now using the so-called Offset Process, which is not printing at all, but which is a sort of lithograph process. By this process, the ink is first transferred from an aluminum plate upon which the design is etched onto a rubber blanket, or mat and this rubber "offsets" the ink onto the paper. By this method very much cleaner work results, showing off much better, and a much softer effect is had. Altogether the result is much more attractive and pleasing than the printed process. By means of this process we are also now enabled instead of printing in three colors to print in four, adding one extra color. We hope our readers will like the improvement.

—*The Publishers.*

New Idea in Phonographs

(1078) Charles D. Miller, Chicago, Ill., sends drawings and description of new phonograph which he believes to be superior in many ways.

A. 1. Would advise you as follows concerning the phonograph idea you have described and shown in your drawings.

This idea is not new at all, and to our knowledge, quite a number of patents have been issued in the past ten or fifteen years concerning inventions connected with the production of "talking movies," and many of these patents have described methods of recording the speech on a moving film in the way you suggest, in connection with selenium cells for reproduction, etc.

Unless a very special form of selenium cell or rather a group of them are used, unsatisfactory results will usually be the order in any such speech-reproducing scheme as this. This is so for the main reason that selenium cells possess considerable inertia or lag, i.e., they do not follow the fluctuations of light and darkness as rapidly as the voice fluctuations, and tend to lag behind.

The best apparatus to use for such a voice reproduction scheme is one employing the photo-electric cell, and if you are interested in studying the action of these cells which are far superior to any selenium cell, send stamped and addrest envelope with your request for the maker's name and address to the Editor of this journal.

Interesting Problem in Physics

(1079) E. Idenwider, Meridian, Miss., asks:

Q. 1. There are 2 ships traveling at cannon ball speed, one ahead of the other by a mile. The back ship shoots a cannon ball at front ship. The question is—will the ball catch the ship ahead; if so, how long before it does?

A. 1. Supposing two ships are pursuing each other and traveling at cannon-ball speed (of course an impossibility) and the rear ship fires a shot at the ship preceding, the ship in front will be hit by the cannon-ball if aimed correctly, the reason for this being that the rear vessel and the front vessel are already traveling at a definite speed. The speed of the cannon-ball must then be added to the speed of the rear vessel or the vessel firing the shot, to determine the resultant speed of the ball.

Suppose that the cannon-ball travels at the rate of one unit per hour and both vessels are proceeding at the same rate of speed, then the speed of the cannon-ball will be two units per hour if fired in the direction in which the vessel is going. Of course, air resistances are not taken into consideration. If the cannon-ball is fired at the rate of one unit per hour from the stern of the vessel and the vessel is proceeding at one unit per hour in the opposite direction to which the shot is being fired, the cannon-ball will drop vertically into the ocean.

Newton's law of motion states that a body tends to remain in a state of rest or uniform motion, unless impelled by some external force to change that state. The cannon-ball is already traveling in a state of uniform motion. If a ball is thrown inside or outside of a moving car, it will travel toward the front or the rear of the car regardless of whether the car is in motion or not and no extra force must be exerted to propel it in either direction, the reason being that the ball is already traveling at a certain definite speed and the thrower of the ball increases or reduces that speed, changing in this way, the state of motion.

BOOK REVIEW

CYCLOPEDIA OF APPLIED ELECTRICITY. Eight large volumes, profusely illustrated. Flexible covers, size 6 x 8½, occupying 10½" shelf space. Publisht by the American Technical Society, Chicago, 1920.

This cyclopedia is a general reference work on the subject of electricity, with over 2,000 engravings contained in its eight volumes. Its authors and collaborators are men well known in the scientific world because of their achievements in the field of electricity; and its authorities, the best.

The subject is entered into in great detail and this slight review merely gives a relatively few topics found in this exhaustive work.

Volume I—In the first volume the "beginnings of electricity" start the reader and student at the correct point by explaining the natural magnet

The subject is entered into a great detail and the places where it is found in greatest abundance, together with its varied uses.

Artificial magnets of the horseshoe and bar type are then discust together with the laws of unit pole strength, induction lines of force, and in fact all the detailed knowledge desired. This, however, is at the same time simple enough for a lay reader to understand. The dipping needle is also given considerable discussion.

A little further in the work, static electricity with its varied functions, discharge effects, screens, together with instruments for measuring, are described and the countless formulas are also added, which make calculation a very simple matter. Wherever possible, water analogues have been used to help simplify the subject. Upon completion of this chapter, electricity and magnetism, and the methods of measuring E. M. F. are considered. Thereupon various resistance circuits and the definition of words referring to magnetic effects and resistances, formulas and tables come in for their attention.

Heaters and electric lamps are also included in this part. Then the varied subjects of the laws of induced currents, chemical effects, radio-activity and radio are considered in order. Direct current dynamos, together with their windings, controlling devices and measuring devices, spot welding and transformers, occupying an important position. A very important and interesting chapter on the principles of direct current dynamos together with the formulas for calculating practically any unknown; each calculation having an example which can readily follow is provided. This includes calculation for the commutation and the time interval required for this commutation and number of poles, etc. Methods of preventing sparking by means of compensation are shown, and motors employing the same principles are described. Questions after each chapter are an added attraction to this elaborate work, making it suitable for even the young student.

The make-up of storage batteries of all sorts are then entered into; the volume ending with review questions on the subjects.

Volume II—The second volume treats mainly upon the subject of alternating current machinery. In this is included alternators, rectifiers, and induction motors. Many formulas and tables allow for calculations in which, of course, a good knowledge of algebra and general mathematics is desirable but not required, as examples of the more important calculations are given.

Most of the types of windings are included and the formulas for quick calculations are added, so that time for performing these is reduced to a minimum.

Volume III—This deals with the design of direct current motors. Every conceivable type of pole design is given and the advantages of each discust. The shaft bearings are also taken into account. Tables for voltage drops, shunt and series types as well as large charts are scattered thruout the book, illustrating clearly armature windings of all types.

Small motor design is then added, including automobile starting motors, and also the design of small transformers, the laws of which can be worked out very readily and the construction developt with practical results.

Volume IV—Electrical measurements are first explained. Then a chapter for everybody who has current in his house; curve drawing instruments and recording instruments are, of course, included. Follows a very exhaustive treatise on electromagnets, the method of calculation for any type, together with the pull under actual working conditions.

The use of electro-magnets is dwelt upon and a short concise review of induction coils, both for radio and X-ray work, and the Tesla transformer filling a much-needed want are given.

Industrial forms of controllers, elevators and railway signaling, each in a chapter of its own, complete this volume.

Volume V—In this book there is given a scientifically correct work on wiring methods, in which numerous minor details such as splicing of wires

(*Continued on page* 1108)

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Book Review

(*Continued from page* 1106)

and cables and all forms of light or power wiring for store or factory, concealed in either wood or metal molding, conduit (flexible or rigid), and steel armored flexible cable are described; numerous charts depict the various methods.

This chapter is completed with the subject of switchboard and panels whose wiring also occupies considerable attention.

A treatise on the planning of wire installations makes this book desirable for electricians engaged in such work. Large blue-print drawings dealing with wiring and electrical signals, cause the study to be greatly simplified. A chapter on Underwriters' requirements giving the exact details of any form of installation completes the volume. Enough cannot be said about this latter chapter in this limited space.

Volume VI—In the sixth volume electric lighting first attracts our attention; method of determining candle-power, and then—incandescent, carbon, Nernst lamps, mercury vapor type and other forms of tube lighting follow in order.

Reflectors of practically all types having basic ideas, are then discust, together with reasons for the choice of certain lights. Store, interior lighting, industrial plant lighting, flood lighting, home lighting and street lighting—all occupy respective positions. Railway car lighting and the method of control is then added, demonstrating many features not generally known to individuals and to a great extent unfamiliar to electricians.

A radical and novel addition is a chapter for the chemist, on Electro-chemistry, which is bound to attract favorable notice and undoubtedly wide use will be made of the simple diagrams given therein to conduct experiments in miniature.

Volume VII—This brings us to the seventh volume which is considerably more technical and intended more or less for the Electrical Engineer. After a profuse discussion on power stations and switchboards, together with dynamos and other electric machinery, electric welding is entered into, showing the advantages of this method, the time and cost involved and the process for producing the results desired.

Cutting by the arc and also gas torches, such as oxy-acetylene, are included, and last but not least *thermit*, and its uses. The types of welds and tools employed are, of course, necessary adjuncts found in this work.

Volume VIII—In the eighth and last volume of the Cyclopedia of Applied Electricity, electrical transmission and methods of installation, together with distribution, pole guying, conduit arrangements, and in fact every form of electrical transmission detail that would ever be required is given in this exhaustive study. The forms of electrical railway control, methods of testing and power-house arrangements, together with the electrification of steam railways naturally occupy many pages.

The work ends with a glossary in which the definitions of words used in the text are given in simple language and reference is made to the volumes in which information desired may be found. The cyclopedia is scientifically correct, and is as free as possible from unnecessary mathematical formulas; also technical phrasing is omitted wherever possible.

Diagrams and curves, together with practical examples, are greatly helpful in explaining the subject. Inasmuch as the work is modern, written by undoubted authorities in their respective fields, its reliability can be vouched for. One regretful omission is the lack of a discourse on the subject of Telephony, but even in view of this the Cyclopedia remains almost priceless to its owner.

THE YEAR BOOK OF WIRELESS TELEGRAPHY AND TELEPHONY FOR 1920. Cloth cover, 1,148 pages, 33 illustrations, size 8¼ inches by 5¼ inches. Publisht by the Wireless Press, Ltd., London.

This excellent work covers in detail practically every branch of wireless telegraphy and telephony, describing fully the latest accomplishments in these interesting fields of human endeavor.

In the first half of the book are contained the record of the development of wireless telegraphy, radio laws and regulations of all countries of the world and the names of land and ship stations, giving their geographical positions, their call signals, wave lengths, and the nature and hours of service, etc.

The latter half of this book is devoted mainly to the call letters allotted to land and ship stations, radio-communication and meteorology, wireless with relation to time, and arrangements current in various countries. Useful radio data, nautical measures, companies engaged in the commercial development of radio-telegraphy and radio-telephony are also given.

A biographical section of leading men in the wireless world, including obituary notices, followed by a review of the latest radio publications, constitute the concluding portion of the work. This valuable reference book should be found in the library of every radio operator, both amateur and commercial.

(*Continued on page* 1110)

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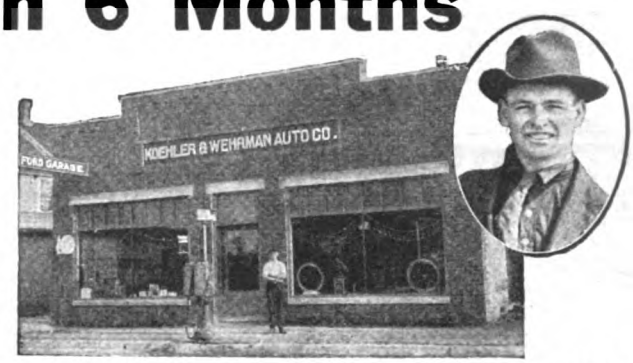

This is Ben W. Koehler and some of his men leaving with a string of cars enroute from Detroit, Mich., to Pulaski, Wis. Mr. Koehler is at the head of the line—look him over—just a fine, ordinary young fellow only 20 years old, but with lots of pep and an M. S. A. S. training.

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Mr. L. B. Fisher,
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Dear Sir:

This will acknowledge your letter of May 1, addressed to the attention of Mr. Vincent.

I would advise you to enter an auto school, as I believe you would get an all-around experience quicker than working either in a Factory or Garage. I understand that the Michigan State Auto School have turned out some very good men, and I do not believe you would make any mistake in attending this school if you wish to become thoroughly experienced in the automobile business. In this school you would get an opportunity to work on all different kinds of cars, and you would also have instructors who could explain the different parts, etc.

Yours very truly,
PACKARD MOTOR CAR COMPANY.
J. D. Wilson,
Ass't to Vice-President
of Engineering.

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Book Review

(*Continued from page* 1108)

AIDS TO ELECTRICIANS' EXAMINATIONS—QUESTIONS AND ANSWERS. By Samuel J. Thackaberry. Paper covers, 79 pages, size 4¼" by 6¾". Publisht by Aaron Shapiro, 222 E. 64th St., New York City, N. Y.

This book covers every question that could possibly be given in an electrician's examination, together with its answer, all in a clear and concise manner. A few of the many practical questions and answers contained in this book are as follows:

Q. If you had to install 250-watt gas-filled lamps with shades over them what kind of sockets would you use?

A. Mogul sockets, which have no fiber lining.

Q. Is it necessary to ground the base frames of 250-volt motors?

A. No. The base frame must be insulated from the floor or from their supporting surface.

Q. What kind of insulation on the wire in metal moulding?

A. Rubber covered, single braid.

This book, as its name implies, is truly an aid for electricians in their examinations, and the wealth of information contained therein, will not fail to convince the reader of its real value.

MR. TOUCH-BUTTON, OR THE HOME OF BEAUTIFUL IDEALS. By Nancy Berry. Paper covers, 48 pages, 40 illustrations, size 7½" by 10". Publisht by Country Life, Ltd., 20 Tavistock, St., Covent Garden, W. C. 2, England.

This book, written by a child authoress, is a tale for children, describing an all-electric house, in which electricity is applied to every conceivable labor-saving device and comfort-increasing contrivance in the home.

The story itself, is written in an interesting and fascinating manner, and we are wafted upon the wings of electricity, to a wondrous house wherein every demand of our adventure is promptly fulfilled.

This book can truly be enjoyed by children of all ages, and it describes to the youthful readers, the many and varied advantages of an electrically equipt home, wherein every modern electric contrivance is found; such as vacuum cleaners, indirect lighting and loud-speaking telephones.

WHO'S WHO IN AMERICA—1920-1921. Vol. 11. Cloth covers, size 5½ by 7¾ inches, 3,302 pages. Publisht by A. N. Marquis & Co., Chicago.

We have received Volume 11 of "Who's Who in America," a work which has had a long and honorable career, and which really sets the pace for all similar books of contemporaneous biography.

The first volume was for the year 1899-1900 and contained 827 pages with 8,602 biographies. Since then it has grown, the proportional growth being most marked in the early editions. And now, in Volume 11, there are 3,302 pages with 23,453 biographies, of which biographies 2,514 appear in no previous issue. Increasing at this rate, it would seem as if it would surely reach a prohibitive size, but the subjects of its text keep dying, and that is what saves it; because it is a dictionary of only living people. Back references are given to former volumes for those who have died. It therefore is a complete modern American biographical dictionary in its full set of 11 volumes, and any library possessing such a set, should preserve it carefully.

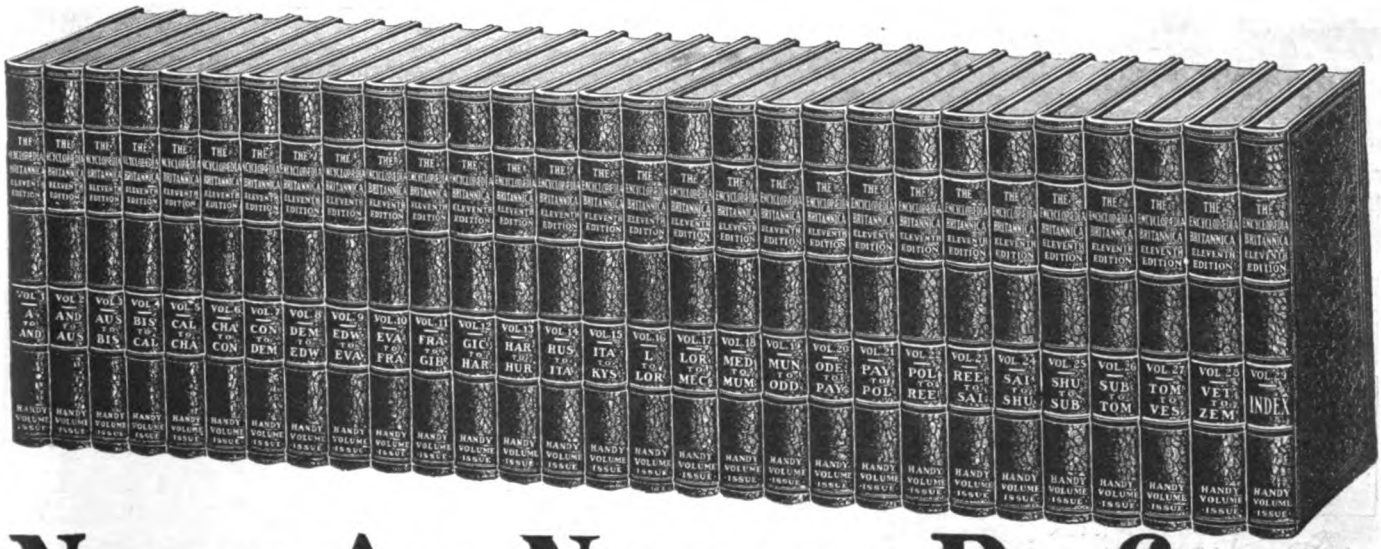
The work has become an absolute standard and is based on the following rule which we quote from the foot of its tenth page, "Not a single sketch in 'Who's Who in America' has been paid for—and none can be paid for."

SELENIUM CELLS AND HOW THEY ARE MADE——By Samuel Wein. Fully illustrated. Paper covers, size 6 by 8½ inches. Publisht by The Progress Publishing Co., New York.

This little pamphlet contains a quantity of information about the element selenium. This subject is acquiring increased importance, and is exciting more interest day by day; therefore, we believe the book, which is a very thorough compendium of different processes and terms of the subjects with numerous illustrations of the cells, will be favorably received by our readers.

Selenium is a conductor of rather high electrical resistance, but whose resistance is reduced by exposure to light, to which it is very sensitive, and this sensitiveness opens a possibility for the construction of very interesting electrical apparatus.

(*Continued on page* 1112)



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Book Review

(*Continued from page* 1110)

"THE HOW AND WHY OF RADIO APPARATUS." By H. Winfield Secor. Cloth bound, size 6¼ x 9¼ inches, profusely illustrated. Publisht by EXPERIMENTER PUBLISHING CO., New York City, N. Y., 1920.

This book undoubtedly, presents the radio subject as it should be given; clearly, concisely, and with the least mathematics possible in a work so thoroly covering the principles of nearly every conceivable radio apparatus.

It will be remembered that there are comparatively few "radically different" pieces of radio apparatus and the instruments which are coming into the market at the present day are only revivals of some of the older types. The author of this work explains and illustrates both the older and newer types of instruments, and presents them in the same pleasing manner which characterizes his numerous magazine articles.

Among the subjects covered are induction coils, the transformer and method of operation, explained by water analogies and numerous diagrams for the hookup; condensers for transmitting, a table of inductivity factors accompanying them, which enable anyone to readily compute the size of condenser required for any definite purpose.

The description of spark gaps and other radio transmitting devices such as helices, etc., and of their method of operation, brand this book as the only one for the amateur radio man and the best one for the professional, where an all-around knowledge of the field is desired. On the subject of radio transmitting inductances alone, there are no less than nine distinct types given, each so remarkably simple, that the student can readily construct any himself.

The author has attempted and succeeded in rendering the subject of radio in as few well-chosen words as possible, omitting technical phrasing except where impossible, in which case, a thoro explanation of the words used is given.

Eleven different types of variable condensers are shown and nine different detectors and hookups for each type. All the various types of telephone receivers; 13 drawings of radio amplifiers, crystal, vacuum tube, and relay types are given.

The method of making and calculating wave meters is treated upon at length. Antenna construction details together with the Fire Underwriters' requirements and in the last three chapters, the calculation and measurement of inductance is made simple enough for any reader to understand, if he will but put a little conscientious effort forward in that direction.

All of the devices mentioned herewith are given in simplified diagrams suitable for constructive purposes and an appendix containing tables for and formulas of spark coil dimensions, closed and open core transformer data, glass plate condenser data, high potential condenser data, and various wire and harmonic tables and tabulated voltages according to sparking distances of coils are included.

The work is very well written; with clear, understandable type on good quality paper, and is ideal for all radio men whether beginners or adepts.

We quote from the notice of this book given in the columns of the *London Electrical Review:*

"The writer of this little volume points out an important fact to his readers and also to other authors. A volume on wireless telegraphy cannot be complete. A student must read all books on wireless telegraphy which he can possibly obtain in order that his knowledge shall be complete.

"The author is an experimentalist himself—an enthusiast. One sees it in every line, and it is that which gives the volume a certain appeal which somehow rarely is found in this country. In America the amateur is catered for as he is in no other country. The literature at his disposal stimulates his interest."

ORGANIC PHOTOGRAPHIC DEVELOPERS—By Samuel Wein. Cloth covers, size 6 by 9 inches, 128 pages, two indexes. Publisht by Forty-Second Street Commercial Studio, New York.

This is a very convenient manual, giving the names and formulas of a very large number of photographic developers. In many cases, the manipulations and processes required to manufacture them are given in some detail, and the field seems to very fully cover many of the compounds described. Sometimes the patent is called upon, and sometimes scientific publications, for the description.

The book shows a great amount of research and painstaking on the part of the author. When the compounds involving the benzol series are reached, graphic formulas are given as required.

The second section of the book is devoted to the use of the different developments and other photographic processes such as developing, factorial development, bleaching and intensifying, and toning. A considerable section is devoted to the diazotype process, and the much debated subject of direct positives has a chapter.

One interesting chapter describes the making of plaster plaques, by the aid of photographs.

(*Continued on page* 1114)

Book Review

(*Continued from page* 1112)

SIR WILLIAM HERSCHEL — By the Rev. Hector Macpherson. One illustration. Cloth covers, 5 by 7½ inches, 78 pages. Publisht by the Macmillan Co., New York.

This is a most convenient biography of the great astronomer, German by birth and English in his career. It is publisht by the same concern to whom the Life of Faraday, just reviewed, is due; and by giving his personal characteristics, the book is made excellent reading. A portrait of William Herschel forms the frontispiece.

INDUCTION COILS IN THEORY AND PRACTISE — By Prof. F. E. Austin. 40 illustrations. Cloth covers, 5 by 8½ inches, 64 pages. Publisht by the author at Hanover, N. H.

This seems a very practical book. The mathematics used and the formulas given are all quite elementary, so that it is well adapted for those who have not had the advantage of a full course in higher mathematics. The illustrations are exceedingly clear and to the point. It is arranged as a text book, being divided into sections, called lessons.

THE PRINCIPLES OF WAR—By General Foch, Commander-in-Chief of the Allied Armies. Two illustrations, with maps in pocket cover. Cloth covers, 5½ by 8¼ inches, 372 pages. Publisht by the H. K. Fly Co., New York.

This is a very good presentation of the great French general's famous classic. While it seems as if such a book must be technical, it is so admirably written that it makes excellent reading. It would be presumption in us to even review a book by the "Wonder of the World War," a man whose ability was equaled by his modesty and elevated character. Some interesting illustrations are given.

ELECTRIC WELDING—By Douglas T. Hamilton and Erik Oberg. Fully illustrated. Cloth covers, size 6 by 9¼ inches, 294 pages. Publisht by the Industrial Press, New York.

Electric welding is only beginning to take its proper place in industry, and we anticipate that every year it will be more and more developt in its widening field. This book gives some wonderful examples of what is done today, in which work the different kinds of welding, spot, arc and other types, are very fully treated, with numerous illustrations. It is one of those books which, while on its face it looks technical, really makes interesting reading in these days, when all are supposed to know something of technology.

INDUSTRIAL CO-OPERATION — By Dr. Charles P. Steinmetz. Paper covers, 5 by 7½ inches, 28 pages. Publisht by the Industrial Extension Institute, Inc., New York.

Dr. Steinmetz, who is one of the leading physicists and mathematicians among the electricians of America, is well known also as a student of sociology, and in this little pamphlet he treats a subject that is very well put. He makes a plea for personal interest on the part of technical workers and for improved working conditions. He includes different forms of profit-sharing and of participation in management.

ROMANCE OF A GREAT FACTORY —By Charles M. Ripley. About 100 illustrations. Cloth covers, 6 by 9¼ inches, 204 pages. Publisht by the Gazette Press, Schenectady, N. Y.

We have just reviewed Dr. Steinmetz's pamphlet. He has been identified for many years with the great Schenectady Works of the General Electric Co., and in this book we have a vivid account of the personnel and of the striking features of the great factory, all presented in the most interesting way.

Numerous illustrations are given and the book is written in a most picturesque and interesting way.

The introduction is by Dr. Steinmetz and in the end of the book is given an example of the shorthand which Dr. Steinmetz uses, and which system was invented by himself. The book is partly for the benefit of the Insurance Association of the Great Works.

ELECTRICAL PHENOMENA IN PARALLEL CONDUCTORS — Elements of Transmission. Volume 1. By Frederick Eugene Pernot. Clearly illustrated. Cloth covers, 6 by 9¼ inches,

(*Continued on page* 1116)

Book Review

(*Continued from page* 1114)

332 pages. Publisht by John Wiley & Sons, Inc., New York.

This book is devoted to the mathematical treatment of its topic, using the higher mathematics. It is a very exhaustive book, and will be of great value to those devoted to the higher mathematical development of the electrical theory.

It is the first volume, we notice, and we hope that the second volume will contain an adequate index to which so elaborate a book is entitled.

GEORGE WESTINGHOUSE—His Life and Achievements. By Francis E. Leupp. 12 illustrations. Cloth covers, 6¼ by 9¼ inches, 304 pages. Publisht by Little, Brown and Company, Boston.

This is a vivid presentation of the life of the great inventor—George Westinghouse. It makes excellent reading, going back to the days of his boyhood. It is to be remembered that no one person has so revolutionized railroad work as he has done by his air brake. The personal characteristics of the great engineer are brought out in a number of stories of his relations with his subordinates, showing that while on the surface impetuous and determined, on second thought he was always ready to make amends for apparent hastiness. This book is very interesting, especially to those who have lived thru the days of the development of electricity and the old fight between the alternating and direct current described therein.

CLASSROOM LECTURE NOTES—Automotive Starting, Lighting and Ignition. By R. C. Fryer. Illustrated. Cloth covers, size 5 by 7 inches, 210 pages. Publisht by John Wiley & Sons, Inc., New York.

This book is devoted to the electrical systems on motor cars, including the ignition and starting systems as well as the special circuits for the horn, spotlight and the like. A very interesting series of data gives the firing order and timing of the leading makes of cars; towards the end we are given lessons, each one being largely in the form of questions and suggestions, and at the close of the book a large quantity of useful notes and very clear and excellent diagrams of the electric systems appear.

TRAINING FOR THE ELECTRIC RAILWAY BUSINESS — By C. B. Fairchild, Jr. Illustrated. Cloth covers, size 5 by 7¾ inches, 156 pages. Publisht by J. B. Lippincott Co., Philadelphia.

This book covers the organization, the executive and transportation functions, the engineering department, the administration work and miscellaneous departments of the electric railway organization.

It is largely written from a personal standpoint, and we are sure it will prove quite interesting reading for the large body of men now engaged in the transportation end of the public service corporations.

ESSENTIALS OF ALTERNATING CURRENTS—By W. H. Timbie and H. H. Higbie. Illustrated with photos and diagrams. Cloth covers, 5 by 7½ inches, 374 pages. Publisht by John Wiley & Sons, Inc., New York.

The name of this book indicates the somewhat ambitious spirit on the part of the authors, but on inspection they really seem to have carried out their wishes very well. They have produced an exceptionally interesting, well illustrated treatise on alternating currents; 200 illustrations are included, and at the end of each chapter is given a summary of its contents and a number of problems. The answers to the problems are not given.

AIRPLANE CONSTRUCTION AND OPERATION — Including Notes on Airplane Design and Aerodynamic Calculation, Materials, Etc. By John B. Rathbun. Profusely illustrated. Cloth covers, 5¼ by 7¾ inches, 432 pages. Publisht by Stanton and Van Vilet Co., Chicago.

This book with glossary, but unfortunately lacking an index, impresses one as entirely practical. A very considerable space is devoted to the all important subjects of wing section and aerofoils; head resistance, power and the practical details of training and operating are gone into.

Some of the illustrations of the different maneuvers, such as the famous "Immelmann Turn," are decidedly interesting. One illustration shows a machine flying upside down, so close to the ground that it is impossible to rectify it, the illustration therefore showing the beginning of what proved to be a fatal accident.

(*Continued on page* 1118)

Book Review

(*Continued from page* 1116)

ARMATURE WINDING AND MOTOR REPAIR—By Daniel H. Braymer. Fully illustrated. Cloth covers, 5½ by 8¼ inches, 516 pages. Publisht by McGraw Hill Book Company, New York.

The title of this book is so comprehensive and clearly put that it makes a review hardly necessary. It is enough to say that its numerous illustrations with data and appendix, with its index supplementing the very practical and full treatment of the subject in the text, justify us in recommending it to those of our readers who have to deal with dynamo and motor repair work and construction on the practical side.

GENERAL SCIENCE—By Otis William Caldwell and William Lewis Eikenberry. Clearly illustrated. Cloth covers, 5½ by 7¾ inches, 404 pages. Publisht by Ginn & Co., New York.

The title of this book indicates an ambition on the part of the authors to cover the entire field of natural science; for of course, when the word "science" alone is used, natural science seems to be, perforce, understood. The book reminds one a little of the famous old "Chemistry of Common Life" which had such an extensive circulation two or three generations ago. The authors seem to have made a very successful effort at producing a readable book and also in covering a wide range of subjects.

SCIENCE FOR BEGINNERS—A First Book in General Science for Intermediate Schools and Junior High Schools. By Delos Fall. Well illustrated. Cloth covers, size 5½ by 7½ inches, 382 pages. Publisht by the World Book Co., New York.

This book is designed for school use and seems to be well adapted for such purpose. The illustrations are quite numerous.

The book has an aspect of practicality, and is intended to be used on the basis of experiment and of field work. The chapters devoted to field work are very nicely put and the work may be called a treatise on the introductory training in natural science.

ELECTRIC RANGE HANDBOOK — Prepared by the Society for Electrical Development. Fully illustrated. Flexible cloth covers, 5 by 6¾ inches, 216 pages. Publisht by the society that prepared the book.

It is a curious fact that while there is no more wasteful method of producing heat than by the electric station operated by coal, the convenience of electric heating and the facilities for turning it on and off as required, so as to eliminate at least one element of waste, have made it a practical thing, whose use is daily extending. A very valuable sheet of electric range data from 100 central stations is annexed to the book, and from that one can learn exactly what can be done with different types of these cooking stoves. The work is written largely from the standpoint of the electric supply station.

UNITED STATES ARMY X-RAY MANUAL—Authorized by the Surgeon-General of the Army. Profusely illustrated. Flexible cloth covers, 5¼ by 7½ inches, 506 pages. Publisht by Paul B. Hoeber, New York.

This volume was prepared under the direction of the Surgeon-General of the U. S. Army, as a text book for instruction in military X-ray work. During the war there was a small manual prepared for use by army surgeons, but this very complete book is now to supersede it. A large introductory section is devoted to X-ray physics; laboratory experiments and new apparatus follow. The dangers incident to X-ray work are given less consideration, perhaps, than might be wished by those who have seen the dreadful effects produced by it on incautious operators. Very complete illustrations are given and a very adequate synoptical table of contents, followed by an index, closes the book.

MICHAEL FARADAY — By J. A. Crowther. One illustration. Cloth covers, 5 by 7½ inches, 72 pages. Publisht by the Macmillan Co., New York.

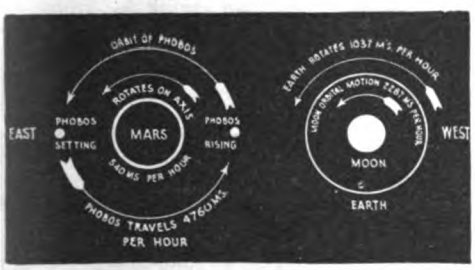
There is no more lovable character in the modern scientific world than Michael Faraday. A man of pre-eminent fame, he was characterized by the greatest modesty and gentleness of character. In this book, of course, the religious views of the great scientist receive consideration. The great sincerity and the general charm of the man are well brought out. The text is preceded by his portrait.

There Is a Moon That Sets In the East

By CHARLES NEVERS HOLMES

THE only moon with which most of us are entirely familiar belongs to our Earth. We are very well satisfied with it, with its splendor, particularly when it is a "full Moon." Indeed, most of us would not become used to *two* large moons in our darkened firmament, until we had observed them many, many times. And even if we still possessed only one moon, and not ten moons like the planet Saturn, it would take us some time to become accustomed to that one moon, were that satellite to *rise* in the *west* and then *set* in the *east*. As we all are well aware, our own Moon rises in the east and sets in the west, and should it suddenly change its habits—rising in the west and setting in the east—some of us might believe that we were losing our minds.

However, if we could be transported to the surface of the planet Mars, we should behold a moon that rises in the west and sets in the east. This peculiar moon is a very small one, estimated to be not more than 50 miles in diameter, and probably not more than 35 miles. It is called "Phobos," and was discovered by Professor Hall, at Washington, in the year 1877. Now, even if Phobos were 50 miles in diameter, it would possess only about 1/43d of our own Moon's diameter, but,



Since Phobos Revolves Around Mars About 9 Times Faster than Mars Rotates on Its Axis, Phobos Travels Faster than the Rotating Surface of Mars, and, Therefore, Sets in the East. Above There Are Comparisons of the Respective Velocities of the Orbit of Phobos, the Rotation of Mars, the Orbit of Our Moon, and Our Earth's Rotation.

since it is very close to the surface of Mars, not quite 6000 miles from that planet's center, whereas our Moon is distant from us 239,000 miles, it would appear larger than our own satellite, although not nearly as bright. In addition to Phobos, Mars has another small moon by the name of "Deimos," but Deimos is a rational moon, rising in the east and setting in the west.

However, it is easy to explain and understand the irrational behavior of Phobos. Phobos is really a very rational moon, but it is situated so close to the martian surface and revolves around Mars so much faster than the planet rotates on its axis, that, inasmuch as the satellite is revolving eastward, Phobos presently disappears from sight or sets in the east. In the case of our own Moon, the terrestrial satellite is so far from the Earth that our Moon falls behind in their movements towards the east, and, accordingly, sets in the west. In other words, there is a sort of race between Mars and Phobos, both revolving in the same eastward direction, and, were we able to watch Phobos from the martian surface, we should behold him traveling much faster than the surface upon which we stood. Then, he would disappear from sight below the eastern horizon of Mars, having set.

The Transparascope

By H. GERNSBACK

(*Continued from page* 1074)

issue that theoretically, given a sufficiently strong light, it will be possible for light to shine even thru the densest bodies. Of course, there is a limit to this, but it seems possible that if we could concentrate a strong enough light upon the back of a person it would be possible to see every organ inside of such a person. In this case it would be necessary to interpose a heat-filter between the source of light and the patient, otherwise serious burns might result.

To those who are skeptical that we will ever be able to make ourselves entirely or partially invisible, the reader is referred to an article appearing in another part of this magazine, entitled, "The X-Ray Fluid." It will be seen that Dr. Jules Stean has already accomplisht the very thing with animals, altho these at present necessarily are not alive any longer. But it is a step in the right direction, because Dr. Stean has actually made bodies transparent, and *he also is able to control the degree of transparency at will.*

If we had told you thirty years ago that it would be possible to actually see the bones in a live body we would have been laughed at derisively. The X-ray, however, has proven many things that were considered preposterous before. X-rays in contradistinction to light rays are streams of matter shot out at tremendous velocity, at extremely high frequency (rate of vibration. See table). Due to this, X-rays pass thru most solids as easily as light passes thru glass. The X-ray particles may be likened to tiny bullets, for they are just as real as bullets, and they move at speeds as high as 40,000 miles a second. X-rays do not experience the usual refraction, diffraction, interference or polarization as do light rays. X-rays pass in absolutely straight lines thru any medium that does not absorb them. This proves that they cannot be due to trains of waves as light rays, otherwise they could be made to interfere and to experience diffraction. X-rays are totally unlike light rays, and objects that are opaque to light rays are transparent to X-rays and *vice versa.* Thus, for instance, pine wood to X-rays is two and one-fourth times as transparent as water!

Of course, the human eye cannot see X-rays themselves. If it could all we would have to do would be to turn on the rays on a human body and we could look right thru it. But the human eye is not so constituted, and in order to get some of the X-ray effect we find it necessary to view the body thru a platinum-barium-cyanide screen. We interpose this screen between our eye and the body to be viewed, and then we only see a shadow-picture. It is as if we were looking thru a pane of glass at night; we can see nothing or very little. In order to see thru the pane the light must shine on or thru it. The limitation of the human eye, as far as X-rays are concerned, is similar. When X-rays fall upon the screen, the latter becomes luminous, due to fluorescence, and in proportion to the strength of the X-rays falling on them. We then see the bones of the hand as shadows, *but if we had "X-ray eyes" we would be able to see right thru them.*

The limitations of the human eye are not confined to X-rays alone. The human eye cannot see certain rays that may properly be termed light rays. For instance, the human eye cannot distinguish all colors of the spectrum. Rays below red

the so-called infra-red, and above violet, the so-called ultra-violet rays, are invisible to us, altho some birds and animals can see them quite well.

How then will we solve the problem of making bodies transparent to our eyes? We must find some agency or some ray capable of piercing bodies similar to the X-ray or even better. Then by using another "carrier ray" at the same time we shall be able to look right thru the body we wish to view. Not only that; as our front-cover illustration and the illustration herewith show, we shall be able at will to control the rays in such a way that we will be able not only to make a body, whether it be a human being or a typewriter, invisible in its entirety, *but we will also be able to make it translucent to any degree desired*, as does Dr. Stean with his X-ray fluid today.

By referring to the table which we print herewith it will be seen that there are some regions which are as yet unknown. The new rays of which we speak probably lie between the 35th and 46th octave, or possibly between the 50th and 58th octave. They may also lie beyond the 61st octave. Perhaps a combination of ordinary X-rays used as a penetrator in connection with the as yet undiscovered rays can be used successfully to solve the problem. It is quite possible that there may be other rays in regions lying far beyond the 61st octave of which we are as yet totally ignorant.

What will be the practical use of the future machine which the writer has termed "Transparascope" (transparent—shining thru; scope—to see)? As our illustration shows, it will be of inestimable value to medicine. It will make it possible for us to see our internal organs in their true colors and in their true shape. For instance, it will be possible for us to watch the heart beat, and the physician instead of listening to the heart beat will be able to see just what is wrong with it. He will be able to examine the lungs, and he need no longer tap the chest to locate the disease. Physicians will be enabled *before* performing an operation to see for themselves just exactly what is wrong with an organ and no chance operation need be resorted to; no patient need be cut open to find out the real trouble. It should be noted that it will be possible to obtain any degree of transparency of the human body; thus the rays will be made to shine right thru the bones, making them entirely invisible, if it is desired. For instance, to view the heart right thru the ribs.

All this may seem far-fetched, but it is not only a prophesy but a prediction of the very near future.

As far as the criminal aspect is concerned, we doubt very much that it will ever be possible for a human being to make himself invisible at will, because we think it will take some cumbersome apparatus to accomplish the invisibility, and it would be difficult to carry this about on the body. It does not seem likely that there will ever be discovered a substance, even of the radium variety, that would have the power to render humans invisibile, altho this is not entirely impossible.

TELEPHONE COMMUNICATION BETWEEN LONDON AND GENEVA

Wireless telephone messages from England were plainly heard in Geneva recently when William Marconi gave a demonstration.

The newspaper correspondents attending the Assembly of the League of Nations were especially invited to the demonstration, and understood quite clearly messages spoken by Lord Burnham and Lord Riddell from Chelmsford, County Essex, England, 500 miles away.

Popular Astronomy

By ISABEL M. LEWIS, M.A.

(*Continued from page* 1091)

an inclination of 60° with the lines of forces, but in such intermediate positions the central component is present tho fainter than for an inclination of 90° and the two outer components are *elliptically* polarized in opposite directions and one component cannot be completely extinguished for a given position of the Nicol. It is evident then that the polarity and the direction of the lines of force in any portion of the solar surface can be found by estimating the relative intensities of the lines of a Zeeman triplet.

Let us consider how these principles are applied in observations of the magnetic polarity and inclination of the lines of force in a sun-spot region. The slit of the spectroscope is moved across the spot and for each successive position a record is obtained of the relative intensities of the lines of a Zeeman triplet. The polarity will depend upon which component, the red or the violet, is transmitted for a given position of the Nicol. The intensity of the field is a function of the amount of separation of the lines. The more intense the field the greater the separation.

Magnetic intensities of solar fields are expressed in terms of gausses. A separation of the components corresponding to one thousand gausses can be easily detected for certain spectral lines and estimates of the field strength are made from observations of the widening of the line for lower values. One hundred gausses is the unit used in recording field intensity in sun-spots and the letters R and V to indicate the polarity. R30 would indicate that the polarity corresponded to that of the south magnetic pole and that the intensity was about thirty hundred gausses. The maximum magnetic intensity recorded in sun-spots is about forty-five hundred gausses.

By observing at what portion of the sun-spot the two outer components are transmitted with equal intensity it is possible to locate the neutral line in a sun-spot which connects points moving along the lines of force of the field.

The magnetic axis of sun-spots it has been found are directed radially outward from the center of the sun. That is, they lie in the direction of the solar radii.

A long continued and detailed study of the intense magnetic fields in sun-spots made at the Mt. Wilson Solar Observatory during the past twelve years or so has brought to light many interesting and valuable facts and in conjunction with careful examination of the forms of sun-spots revealed in photographs taken in the light of a single ray—spectroheliograms—has made it possible to formulate a theory of the nature of sun-spots and of a possible cause of their magnetic properties.

It appears certain now that sun-spots are solar storms analogous to whirling storms in the earth's atmosphere such as tornadoes and cyclones. It is well-known that such storms in the earth's atmosphere have a left-handed direction of whirl in the northern hemisphere and a right-handed whirl in the southern hemisphere due to an increase in linear velocity of the air from pole to equator arising from the earth's rotation.

Since the sun is also rotating on its axis it seemed reasonable to assume that solar storms—sun-spots—might also be cyclonic in nature and follow the same law of direction of whirl for the two solar hemispheres as for cyclones and

tornadoes in the two hemispheres of the earth. Observations in great numbers showed a vortical structure of the hydrogen flocculi (intensely luminous hydrogen gases) in sun-spot regions as if the superimposed hydrogen gases were being sucked inward and downward into a vortex centering in the sun-spot umbra.

An examination of the photographs suggested the theory that a sun-spot is a vortex wherein electrified particles produced by ionization of gases in the solar atmosphere are whirled at high velocities. Now it can be shown experimentally that such a whirling of electrified particles gives rise to a magnetic field and moreover sets up in overlying gases secondary vortices corresponding to the hydrogen whirls above sun-spots.

The Zeeman effect was accordingly searched for and detected in sun-spots and has since been found to exist in every sun-spot observed. Photographs taken in the light of the high-level hydrogen line show that hydrogen vortices centering in sun-spots cover vast areas of the solar surface. There is abundant evidence to show that the hydrogen gas is sucked inward and downward spirally and at lower levels moves spirally outward in the chromosphere above sun-spots, and that the sun-spots beneath consist of electric vortices whirling spirally upward along solar radii to the photosphere and spreading outward along its surface.

Magnetic observations of sun-spots have revealed, moreover, that there is a strong tendency to the bi-polar form. That is, in each group of sun-spots there usually exists two principal members of opposite polarity. About sixty per cent of all sun-spots form such bi-polar groups and in most instances the western member, or the one that precedes as the spot-group is carried across the disk by the solar rotations, is the most extensive in area and has the most intense magnetic field.

Even uni-polar spots show some of the characteristics of bi-polar groups—a magnetic disturbance in the photosphere of opposite polarity frequently preceding or following such spots.

Both the uni-polar and bi-polar sun-spot groups are often attended by minor spots of small area that may be either of the same or opposite polarity but the sharp division of polarity between the two principal members of a group is very marked and is evidently a characteristic feature of sun-spot activity.

In a few instances a sun-spot group is so complicated in form that it cannot be separated into two distinct members of opposite polarity. Such formations are very rare, however.

Observations made before the last sun-spot minimum showed that the polarity of the *preceding* member of a sun-spot group in the northern solar hemisphere was *negative* in almost every instance and that it was also opposite in polarity to the corresponding member of a group in the southern hemisphere. This appeared to be analogous to the law governing direction of whirl of cyclones in the earth's atmosphere except that the bi-polar character of each group introduced a new feature. Strange to say, however, after the date of the sun-spot minimum had past it was noted that the law was *reversed* and that the polarity of the preceding member in each hemisphere had changed. The cause for this remarkable reversal of polarity in each hemisphere at the sun-spot minimum is a puzzle and astronomers interested in solving the puzzle are awaiting with interest the approach of the next sun-spot minimum, which is due to appear shortly, to see whether a reversal will again take place with the sun-spot minimum. If so, there is evidently some connection between the sun-spot cycle and the polarity of a sun-spot group.

Turning from a consideration of the restricted magnetic fields of great intensity that exist in sun-spots to that of the general magnetic field of the sun we find the same method of observation is used, that of an estimate of the separation and relative intensity of the components of a Zeeman triplet. The time chosen for the observations is that of the sun-spot minimum when few sun-spots are present and consequently the strength of the general field is undisturbed by special magnetic fields of great intensity in sun-spot regions.

It is reasonable to expect from many considerations that a general magnetic field should be found for the sun. If we accept Schuster's theory that all rapidly rotating spheres are magnets simply as a result of their motion then we should certainly expect to find a general magnetic field in the solar atmospheres analogous somewhat to that existing in the earth's atmosphere tho of course the physical conditions of the two rotating bodies are far different.

As a matter of fact the existence of a general magnetic field for the sun has been detected and its vertical intensity at the poles has been found, from the lines observed, to be approximately of the order of fifty gausses or only about one hundredth of the maximum intensity of the magnetic field in sun-spots. It is therefore very difficult to detect and measure.

It has been found from a long series of observations that the inclination of the magnetic axis of the sun to its axis of rotation is six degrees approximately and that it makes a revolution about the axis of rotation of the sun in a period of about thirty-one and a half days. The polarity of the general field of the sun, it has been found, corresponds to that of the earth; that is, the north magnetic pole lies near the north pole of the axis of rotation.

Observations of the intensity of the sun's general magnetic field made at Mt. Wilson have revealed the fact that the magnetic intensity *decreases with elevation* in the solar atmosphere. Owing to the smallness of even the maximum displacements in Zeeman triplets arising from the general magnetic field of the sun it has been found that nearly all lines observed for this effect lie within a very narrow shell of the solar atmosphere scarcely 100 miles in thickness just above the photosphere, and that the intensity of the field falls off so rapidly with elevation that the displacements of the lines due to the field are too small to be measured at much higher altitudes. The value of the intensity of the general field given, about 50 gausses, is therefore the value for this shell of the solar atmosphere.

Tho the only *direct* evidence of the presence of a general magnetic field in the solar atmosphere and of the far more intense local fields in sun-spot regions is that obtainable from observations of the Zeeman effect, yet the conclusions formed from the results of these observations are what we would be led to expect from the form of the solar corona, which is apparently chiefly of electro-magnetic origin and follows approximately the lines of force of a uniformly magnetized sphere with the magnetic poles near the poles of rotation. Sun-spots produce periodic variations in the form of this corona during the period of the sun-spot cycle and, as we have seen, there is evidence that there is also a change in the polarity of sun-spot fields with the sun-spot cycle. It is believed that continuation of the magnetic observations of sun-spot regions thru several sun-spot cycles will reveal the law that governs these changes in the magnetic fields. The time that has elapsed since the first systematic observations of the Zeeman effect in the lines of the solar spectrum were begun is very short, cov-

ering not much more than a single sun-spot cycle, so there is as yet insufficient data from which to derive a general law governing these magnetic phenomena tho there is the strongest indication that such a law does exist.

Even within the few short years that have elapsed since a regular program of observation of solar magnetic phenomena was first adopted at the Mt. Wilson Observatory, the results have been so decisive that the great value of such an undertaking is indisputable.

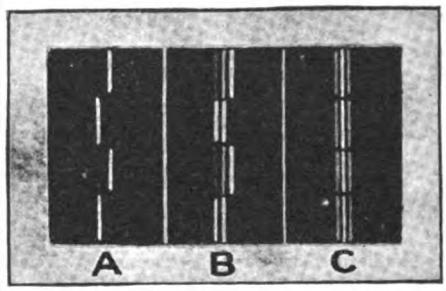
Solar magnetic phenomena are closely associated with and have a marked effect upon terrestrial magnetism. The appearance of unusually large and extensive spots upon the sun, which we now know possess magnetic fields of great intensity, set up magnetic disturbances in the earth's atmosphere such as magnetic storms and auroral displays. Streams of electrons or of Alpha rays—or both—for we are still in doubt as to the exact composition of these streams of ejected particles that are shot off from the sun in the vicinity of eruptive prominences and sun-spots, bombard the earth's atmosphere and set up magnetic disturbances here. The time of passage of such particles from sun to earth depends upon the nature of the particle and its velocity.

Certain lighter Alpha particles attain a velocity as high as seven-tenths of the velocity of light. Others have only one-hundredth of the velocity of the lighter particles or approximately a speed of thirteen hundred miles per second. Such particles would pass from the sun to the earth in about twenty hours.

Electrons travel more rapidly and in pecial instances attain a velocity approaching within two-hundredths of the velocity of light itself, which requires eight minutes to pass from the sun to the earth.

It is well-known that terrestrial magnetic storms follow the appearance of large sun-spots of extensive prominences *after an interval of a number of hours.*

Any discovery that is made concerning the laws that govern the appearance of sun-spots or prominences or other forms of exceptional solar activity may therefore have a distinct bearing upon problems of meteorology or terrestrial magnetism.



Showing the Lines of a Zeeman Triplet as Produced in the Laboratory With a Nicol Prism and Quarter-Wave Plate.

(a) For Inclination of Zero Degrees With Lines of Force. The Central Component Is Absent and the Two Outer Components Are Circularly Polarized in Opposite Directions, So Successive Strips, Which Correspond to a Rotation of the Nicol Thru an Angle of 90°, Show the Two Components Alternately Extinguished. To Determine the Polarity of the Field, It Is Necessary to Note Which Component Is Extinguished for Any Given Strip.

(b) For Inclination of Sixty Degrees With the Lines of Force. The Plane-Polarized Central Component Is Present, but the Elliptically Polarizd Outer or n-Components Cannot Be Completely Extinguished by the Nicol and Quarter-Wave Plate. The Polarity of the Field Is Indicated by the Relative Intensities of the Lines for a Given Position of the Strip.

(c) For Inclination of Ninety Degrees With Lines of Force. The Central or p-Component Is Present and Has Twice the Intensity of the Two Outer Components. All Three Lines Are Plane-Polarized, but the Plane of Polarization of the Central Component Is at Right Angles to the Plane of Polarization of the Outer Components.

PEAT BLOCKS FOR FUEL

So serious is the fuel situation in the Baltic States that the Government of Latvia is considering the issuing of wood and peat cards in much the same manner as the other Governments of Europe issued, during the war, bread, sugar and milk cards.

As a result of this threatened fuel shortage the Latvian Government has turned its attention to the harvesting of the vast peat deposits which are to be found about Riga, in the country around Kovno, and in other sections. Already the peat market in Riga is one of the interesting spots in the city, while the gathering and preparing of it is furnishing employment for scores of men and women.

Peat is merely decaying vegetable matter found about stagnant water. When harvested, it is cut into bricks and stacked to dry. The completed product as it appears in the market resembles in shape somewhat the blocks of comprest coal briquettes used on European railroads. To prevent profiteering, the Government will place a fixed price upon peat bricks.

In this attempt to educate the people in the use of peat, the various stations of the American Red Cross are setting an example by using it for cooking purposes. At the same time Red Cross officers are conducting experiments with a combination of peat and other materials in an endeavor to find a fuel which may be used in the manufacturing plants about Riga and thereby reduce the drain on the wood supply of the country.

STATEMENT OF THE OWNERSHIP, MANAGEMENT, CIRCULATION, etc., required by the Act of Congress of August 24, 1912; of SCIENCE & INVENTION, published monthly, at New York, N. Y., for October 1, 1920.

State of New York, County of New York, ss.

Before me, a notary public in and for the State and county aforesaid, personally appeared Hugo Gernsback, who, having been duly sworn according to law, deposes and says that he is the Editor of the SCIENCE & INVENTION and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management (and if a daily paper, the circulation), etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, embodied in section 443, Postal Laws and Regulations, printed on the reverse of this form, to wit:

1. That the names and addresses of the publisher, editor, managing editor, and business managers are: Publisher, Experimenter Publishing Co., 233 Fulton St., New York City; Editor, Hugo Gernsback, 233 Fulton St., New York City; Managing Editor, Harry Winfield Secor, 233 Fulton St., New York City; Business Manager, R. W. DeMott, 233 Fulton St., New York City.

2. That the owners are: (Give names and addresses of individual owners, or, if a corporation, give its name and the names and addresses of stockholders owning or holding 1 per cent or more of the total amount of stock.) Experimenter Publishing Co., 233 Fulton St., New York City; Hugo Gernsback, 233 Fulton St., New York City; Sidney Gernsback, 233 Fulton St., New York City; Harry Winfield Secor, 233 Fulton St., New York City.

3. That the known bondholders, mortgagees, and other security holders owning or holding 1 per cent or more of total amount of bonds, mortgages, or other securities are: (If there are none, so state.) None.

4. That the two paragraphs next above, give the names of the owners, stockholders, and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him.

H. GERNSBACK.

Sworn to and subscribed before me this 13th day of October, 1920.

Beatrice K. Owen, Notary Public, New York County, New York; New York County No. 57; New York Register No. 1129. (My commission expires March 30, 1921.) (Seal.)

New York Subways a Century Hence

By H. WINFIELD SECOR

(*Continued from page* 1071)

much congestion, or focusing as we may call it, of the subway lines from Brooklyn and New York City proper in the lower business district of the city. But the subway engineers are slowly beginning to see a great light, and future tunnels under the East River to Brooklyn have already been planned—at least in blue-print form.

As Mr. Bolton asked, why is it that the builders of a city of this magnitude have so poor a vision that they can only conceive of a Greater New York composed of Brooklyn, Queens, Richmond and Manhattan? "Truly fallacious," this engineer intimated, "for what is to prevent the Greater New York City from extending and taking in a part of New Jersey, including Newark, Hoboken and Jersey City?" We do not mean to say that these highly developed territories need necessarily be taken into the legal jurisdiction of Greater New York, but they should be linked up just as closely by subways and other modes of transportation as are Brooklyn and Manhattan, for example.

Jerseymen had a good taste of the practically complete isolation of Jersey City and Hoboken due to strikes and tie-ups of the ferries and Hudson Tunnels, during the past few winters. When the two Hudson Tubes stop and the ferries discontinue service, transportation is at a standstill.

Even tho the Pennsylvania Railroad does have two tunnels under the Hudson to Manhattan, there should be several subways connecting New Jersey with New York, and there should also be one or more bridges such as suggested by the famous bridge builder, Gustave Lindenthal.

We see much better treatment of all such matters as this in foreign cities, where parts of great social centers are divided by rivers or other bodies of water.

The Greater New York of tomorrow, said Mr. Bolton, will be bounded by a great circle, probably 50 miles in diameter, which will include territory far out in Long Island, will extend far northward of Manhattan Island, and will include a large portion of New Jersey.

In 1970, or fifty years hence, Greater New York, judging by its recent growth, will have, instead of 6,000,000 people, a vast population of possibly 15,000,000 to 20,000,000 people. The problem to be solved is obvious and the solution with the present rapid growth of the city is that the subways must be extended and multiplied, but in a logical and farsighted manner.

As Mr. Bolton mentioned, in the days to come we will not have simply a few subway arteries of transportation running along just under the surface of the ground, but there will be high-speed subterranean expresses, 200 feet underground, which will hurl one from Brooklyn directly over into New Jersey, a distance of 12, 15, perhaps 20 miles, in as many minutes.

Thanks to the constant improvement of electrical apparatus, and systems of distributing the current, the subway trains of tomorrow, especially the expresses running along the high-speed routes, will make much faster schedule time than we can even imagine now. These high-speed express tubes will of course have stations at intervals of 5 or 10 miles undoubtedly, where the passengers will be raised and lowered to and from the street level by means of electric elevators.

And let us hope that the subway designers of tomorrow will relieve us of the terrific noise which is almost maddening on some of the present routes.

The Hall Jet Relay for Recording Radio Signals

By PROF. RALPH D. DONER

(*Continued from page* 1099)

two of these posts and insulated from the other two, thus making half turns in parallel as conductors between the two metal posts. "T" is a telephone receiver from which the sound is led to the base of the jet by a resonator "S". Coil "C" is heated to a dull red heat by a current from the battery "B". When a signal comes in at "T" the sound strikes the base of the air jet; causes the break to occur nearer the orifice, and thus envelopes "C" in a cooling blast, reduces the resistance of the fine wires, increases the current thru C, B, and R, and closes the armature of the balanced relay "R". This controls the recording circuit B_2R_2 and produces an ink record on a moving paper tape.

The platinum wire must be very fine, 2 to 4 mil. in diameter, so that its rate of cooling may be rapid. The whole jet, telephone and nozzle should be enclosed in a sound-proof box to shield the jet from room noises, and the air supply must be quite steady and free from noises and hisses.

A less efficient means of translating the changes in the jet is to replace coil "C" by a vane "V", Fig. 7. The undisturbed jet passes thru a small hole in the center of the vane, but when the break occurs below the vane, either opens or closes a circuit as desired, and controls the recording circuit "R."

The writer, while assisting Dr. Hall, has experimented with the method first described, quite extensively, and some of the best results are: speed of 90 words per minute; continued service without readjustment for several hours; recorded signals of such low audibility that oral reception was difficult, have been recorded; tone selectivity (by use of resonator S) to within 1/6 octave, has enabled several messages to be recorded from one receiving set; and Nauen, Germany, etc., had been recorded in March and April, 1918, at Chicago with circuit in Fig. 6.

Fig. 8 shows a "bridge" circuit that has been used for the reduction of static. Two telephones are used, one attached to a resonator S, tuned to one tone of a two-tone arc, and the other to a resonator S_2, tuned to the other tone. In this way J and J_2 are acted on alternately but not simultaneously by the signals, and similarly C and C_2 change their resistances oppositely every time the tone changes. Thus the potential between A and D adds to that of B_2 for one tone, and subtracts for the other. Most crashes of static will affect both sides of the bridge about equally and in the same direction, hence producing little effect on the bridge. If C_1 and C_2 are long coils, it will take a loud crash of static indeed to cause both sides of the bridge to reach such a low point that a signal cannot influence one side more than the other.

The combinations possible with several such "jet relays" are almost unlimited. For instance, several receiving stations, miles apart, could be tuned to the same signal, Fig. 9, thus closing their relays simultaneously (in a series circuit) for the signal, but not all would close for static that was not perfectly general in character, and a clean record could be obtained at a central station R.

Recently the writer has made an investigation of the sensitive air jet and its

(*Continued on page* 1138)

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 addre t 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.

How to Protect an Invention*

By JAY G. HOBSON

THE inventor who obtains the greatest remuneration from his improvement is possessed with sufficient knowledge of patent procedure, from the conception of his idea, to enable him to cover all points of possible attack upon his rights.

Hundreds of people have lost the fruit of their labors at the eleventh hour of success because some seemingly insignificant loophole in the beginning ultimately proved the undoing of their carefully laid plans for protection.

Every ounce of witnessed evidence is highly important as facts in proving priority of inventive conception. Even a small piece of scrap paper showing a drawing or specification of some added part, or change for practicability in the finished device, if properly dated, signed and witnessed by some trusted friend (not a relative) will often turn the tables in favor of the deserving party.

Photographs, models, designs, blueprints and all forms of descriptive matter concerning the invention in question are very valuable as proof of originality and ownership. So it behooves each person having ideas of worth to record steps of improvement as they are made in perfecting the article under consideration.

The first inventors of the adding machines and typewriters serve as shining examples of lack of attention to details of the progress made in perfecting their original ideas. Burroughs, the bank clerk, could have obtained basic patent protection on his embryo adder had he been farsighted enough to preserve each drawing and each model of his improvements. With basic patents he could have prevented numerous other concerns imitating the original conception and thereby secured greater monetary gain for himself.

On the other hand recall the case of Hoffman, who invented the modern steam pressing machine used in ninety-five per cent of all tailor shops today. Records of improvements from the beginning showing a very novel method of pressing clothes then in use, enabled the inventor and his associates to secure practically basic patents which at this writing exclude almost every attempt at infringement and competition. As a result the owners of this unique improvement are obtaining the rewards made possible by diligent attention to details of protection at the start.

There is as much difference between patents as between night and day. Because some unscrupulous patent attorney offers to get a patent, or no fee, is little assurance that the patent will be worth the paper it is printed on when it is allowed.

A patent without broad protective claims is really no patent at all. The claims embraced within the patent grant are the foundation of patent protection. If the claims are weak and too general you really have no protection.

I would rather have a patent with one broad claim than one with ten claims so thin that any person could get around them. Financiers, investors, manufacturers and stockholders are interested in any good improvement with broad, protective patent rights; but never in the kind that can be infringed upon by others.

Therefore, aspiring inventors should remember to preserve every important drawing for possible future proof in case it becomes necessary to fight some patent pirate who would claim priority and probably get away with it if the real inventor could not produce sufficient evidence to convince the judge, who in this case might be the United States Patent Office.

In the eye of the Patent Office, the word of the pirate is as good as that of the inventor unless one or the other can present the witnessed facts to prove who is the one entitled to Government protection.

While possession is conceded to be nine points of the law, yet the contestant may prove the possession to be stolen property if neither party can produce other evidence than oral testimony.

Save all evidence of development, employ an honest patent attorney and secure the patent before marketing the invention, which will result in the best protection against infringement and absolute loss.

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

Some Inventions to Invent

By SIENS N. ENVENSHN, Jr.

HAVING seen in 3 or 4 previous editions of this paper some suggestions by Uncle Jay Hobbyhorse on what ought to have been invented but hain't, I thot I would try to shove off some of my ingenious ideas on you, unsuspecting readers, for you to invent and get rich from.

Well, in the 1st place, the other day I chanct accidentally to want to go to the city to show off some of my patents, patent leathers, I mean, as I never wear 'em unless when I go there, and as usual I was obliged to set in the deepo till our train come; we have one each way, everyday, unless on Sunday, and I noticed what a burden it was for the agent to wake from his nap to sell the tickets (they was two of us going that day), and so I says why not sell tickets by slot machines, like chewing gum. Thar you are, then, invention No. 1.

The works would be as follos: Put a five cents piece in the slot to pay the cost of printing, this unlocks the works; then hit the typewriter keys on top of the machine and spell out where you are and where you want to go, such as for instants, *Crokers Corners to Brown Junction.* Then look at the table which shows the cost to go from anywhere to anywhere else, and then put the am't in a slot and you get a ticket. The only thing left for my readers to invent is to dope out a way of providing a way to see that the patron puts in enuff, which ought to be very simple.

When I had got this invented, along come the train and the two of us clumb aboard and was about to set down, but the seats was 2 dirty and we had 2 call a porter, and he was asleep; finally he come and I set down to think how to do away with the porters and decided that all they did was brush seats and people and open windows and collect tips, and that machinery could do all, except the last, witch I will accommodatingly do for the railroad.

A vacuum cleaner run by the car wheels with pipes running to the insides of the plush padding of the seats, would suck all the dust out of said padding and the occupant. Furthermore motors started and stopt by thermostats and *rain switches* could open and shut the windows, and all "you" haf to invent is a *smoke switch,* to start the motor when the smoke comes in.

To call the deepo's a electric phoney-graft, started by contacks made thru holes in a strip of paper run by a set of gears from the car's wheels, would do the work.

The holes is punched at distants so that for instants, when you have gone from Jonestown to Hooker's Crossing, or in other words, 10 miles,—the tape will have gone from one hole to another and the phoney-graft will holler—"Hooker's Crossing"!

Well, this is all the ideas I got that day, but it is enuff to make you rich, and when you get that way, don't forget your Uncle that put you where you are.—Contributed by Hilbert R. Moore.

What to Invent

By JAY G. HOBSON

(*Continued from page* 1102)

not always so with even their salt in the best of shakers made.

Therefore, in view of the very troublesome salt shaker used today, an improvement is much desired. One that I believe practical could be easily constructed to provide a simple means to force the salt thru the shaker top by a plunger arrangement operated by the thumb pressing rapidly upon the bottom of the shaker proper.

A Radiogenes

By CHARLES S. WOLFE

(*Continued from page* 1070)

world until next morning, when the down train brought the morning papers and the operator.

Crafty Fred Ashton proposed to get the results of the fight by listening in with his unsuspected radio station to press accounts of the battle, and then hasten over to the store and put his money on a sure winner! The stage was all set for a "killing."

Then William's laughter became more difficult to control, for into his quick brain had flashed the rough outline of the counterplot.

The next day he hunted up two of his old and trusted pals. To them he entrusted the carrying out of certain details of his scheme, the substance of his instructions running something like this:

"Fellows, our compatriot, Mr. Fred Ashton, seeketh our scalps. I will not tell you how I know this fact, but be assured that I do. Unfortunately for Fred, he has reckoned without William Jones. I have been around the Horn, and across the Equator, and Frederick will have to get up earlier in the morning to slip one over on me. Fred proposes to do all his betting on the evening of the fight. Now how much money can we raise to cover his bets?"

Hasty inventory disclosed the fact that by pooling their capital, quite a goodly sum would be available.

"Fine!" cried William, when the statistics had been compiled. "Now I simply dare not be present to take Fred's offers, for he might possibly smell a rat. But you two take every cent he puts up. If you have to borrow cover him, no matter what your own private opinion of the fight may be."

One of the conspirators hesitated, demurring on the ground that a terrific sum might be involved, but William brushed his scruples aside.

"My only fear is that he may not have enough to satisfy us," he cried. "Take all he'll put up, and get it into the stakeholder's hands in cold cash."

And so it came to pass that on the night the fight was pulled off, Fred Ashton dropped into his chair before his instruments and donned the headset with shaking hands.

All unknown to Fred, in his carefully darkened room a hundred feet or so away, there sat also William Jones, who chuckled as he watched Fred's every move.

Ashton closed his aerial switch and lighted the filaments of his amplifier. As the set came to tune, a coarse, low-pitched station greeted his ears, batting away at a terrible clip. Beneath that fog-horn roar Fred could distinguish the faint, shrill, pipings of other stations, but profane experiments demonstrated that he could not tune out that bellowing monster.

As the minutes sped by and the coarse one showed no inclination to desist, Fred grew desperate. He tried to copy the speeding demon, but the rate was too much for him. He gave it over, and hung on on the off chance that the fellow might stop long enough for him to pick up something pertinent on the fight.

Finally, when it seemed to his tortured nerves that he simply must scream, comparative silence fell. The loud one had stopped. And there came to his ears the welcome, high-pitched piping of one of New York's press stations. His flying pencil followed the rhythmic Continental:

"Twenty-first Round. Molinsky rushed from his corner and tore after the fast weakening O'Brien. He launched a terrible fusilade of lefts and rights. O'Brien clinched and hung on. Referee parted them. Molinsky dropped O'Brien with a—"

Fred shrieked a terrible imprecation, as, with a deafening roar, the old nuisance broke forth again. For five minutes Fred listened impotently to the ether-blasting bellowing, and just as he was going to quit in despair and go over to the store and risk his money on the strength of what he had heard, silence fell once more.

With a glad cry, he gripped his pencil. Joy! The press station was going!

"Twenty-second Round. O'Brien staggers from his corner as Molinsky rushes to meet him. Molinsky sends left to head. O'Brien counters feebly. Molinsky drops O'Brien for the count with a terrific right to the jaw, winning the championship."

With a gurgle of joy Ashton flung the head-set from him, seized his cap, put out his light, and rushed from the house.

Outside the store, he paused to gather his breath and his composure. Then, assuming a most casual attitude, he sauntered into the meeting.

All talk ceased as he crossed the threshold, for his avowed intention of placing his bets on the night of the fight was fresh in the minds of all. Enjoying the small sensation that his entrance had caused, he stood in the center of the floor, hands in his pockets, a sneer on his lips.

"Now then, you birds," he began, in his characteristically pleasant fashion, "I've been called a piker and a braggart around this place a good many times in the past few weeks. Let's see if we can pick out the pikers now. I have six hundred dollars here that says Molinsky wins the fight."

There was a startled gasp as Ashton fished a fat roll of greenbacks from his pocket. For an instant, stunned by the display of wealth, no one spoke. Then one of the conspirators came forward. It must be confest that he walked in a sort of trance. His highest previous wager had been five dollars, and on that occasion he had sat up all night awaiting the outcome. In a voice that he strove desperately to make cool, he croaked: "I'll take that bet, Ashton."

Somewhat startled, Ashton's cowardly soul faltered before this ready acceptance. But the knowledge he possessed reassured him. "You, Smith?" he nodded, carelessly dropping his money into the hands of the now important and excited stake-holder. "All right. Here's six hundred more. Any other sports in our midst?"

The crowd gaped and stared as Cole, the second of the conspiring trio, staggered forward to what he most certainly now regarded as the slaughter. He dropped his money soundlessly into the stake-holder's hands, as Ashton, his face betraying his surprise, followed suit.

Then Ashton played his trump card. Pausing to allow the moment to attain all its dramatic value, he said, slowly: "And now, pikers, I have one thousand more that says Molinsky wins. Any gentleman of the O'Brien persuasion present?"

There was a silence as the awed crowd huddled awaiting developments. Followed a ten minute delay while Smith and Cole, shaking but game, borrowed five hundred dollars. Then the bet was completed, and the crowd broke up in silence. It was an eventful night in the village.

The next morning the populace was out in force to greet the down train. And as it thundered to a stop, there was a rush for the open-doored baggage coach. The baggage master grinned as he hurled the bundle of morning papers out to the storekeeper. "Hooray for O'Brien!" he yelled, as he slammed the car door shut.

Fred Ashton started forward, amazement and incredulity mingling with dismay

on his features. He raced for the crowd gathered about the opened papers. The head-lines confirmed his growing fears.

O'Brien Sends Molinsky Bye-Byes in the Fifteenth Round—A New Champion Crowned.

Then a second crowd gathered. Fred Ashton had fainted.

Later in the morning, Jones, the modern Ali Baba, sat with two of his confederates. Beyond doubt the other thirty-eight were there in the spirit. In the cool of his room he unfolded to his admiring audience the complete story of Fred Ashton's grievous downfall.

"You see, fellow citizens," he said, "when I saw Fred in his room with his set and realized that he was using his metal roof instead of a legitimate aerial, it dawned on me that here was the reason for his delayed betting. He intended to know the result before he put up his coin.

"I simply couldn't let him get away with it. I rummaged thru my old junk box and brought out two buzzers. The one I tinkered with until I got a high note that would pass very readily for any one of the commercial press stations. The other I adjusted to give a coarse, low tone, resembling an ordinary amateur, or old ship installation."

"Why two buzzers?" queried the interested Cole.

"Very necessary, my boy," responded William. "Vital, I might say. The high-noted outfit was designed to deliver to Frederick his hand picked news. The other was, to use an analogy, my "smoke screen." For while I was myself gathering some very badly needed information, I had to keep Frederick off the air. It wouldn't have done to have allowed him to listen to the chatter about the fight that must have been going on all evening. At the same time it would have spoiled it all to let him suspect that he was being prevented from hearing it intentionally. The coarse-pitched buzzer turned the trick nicely, disguised as an interfering station.

"So the other morning about two o'clock I hied me over into Ashton's yard and did things to the ground lead. Last night when he sat down to the set, I was waiting for him. I had the low-pitched outfit hooked up to my omnigraph and I just let it rave at somewhere around thirty-two per, which I felt confident he could never copy. Then when I knew myself how the scrap had gone, I switched off the omnigraph and gave him a round of the fight on the high-toned. I was watching him, and I saw that he had bit hard. Then, for art's sake, I gave him a little more of the omnigraph, and finished off with the 'Molinsky wins' stuff. Then he beat it to trim the gang."

"You had a set of your own rigged up and got the straight story first?" asked Smith.

"I did not!" retorted William, emphatically. "I realized the—er—frailties of the radio system, as instanced, for example, in what I was about to do to poor Frederick. So to make sure of things, the night that I embellished Ashton's ground lead I made an evening of it while I was at it. I shinnied up the pole in front of my house here. The commercial telegraph cable goes right by our door—past Fred's, too, for that matter, and if the boob had been half as smart as he thought he was he'd have done what I did—tapped that line and had a private wire in for the occasion. While I listened to the siren song of the sounder the omnigraph was demonstrating Continental as she should be shot to Freddy. All clear?"

The two conspirators nodded a wondering assent, and a silence fell—a busy silence. They were dividing Freddy's substance.

Grand Opera by Radio

By NELLY E. GARDNER

(*Continued from page* 1097)

tives of the press. And in the long halls of the Hotel McAlpin, had gathered a host of guests and employees to enjoy the rare musical treat. After the wireless concert, some of the enchanted listeners were invited into the apartment where they found Tetrazzini as gracious a hostess as she is a great musician. Much to the visitors' delight, the musicians began to play Titl's "Serenade," and Madame Luisa, as she likes to be called, began to hum softly. Gradually louder and fuller became her voice, until finally it rang out with all the triumphant glory of the opera. This extemporaneous concert seemed best of all to the men and women who sat there, listening in enchantment.

Madame Tetrazzini also heard a wireless telephone concert, that night. About 9 o'clock, the U. S. S. Texas, which was steaming 450 miles at sea, called New York and was connected with the apartment in the McAlpin. The Captain wanted to know if everything on shore was in readiness for the concert, saying that the men at sea were anxious that nothing should happen to spoil the evening that they were anticipating so eagerly. So Madame Tetrazzini talked to him, assured him that she was ready, and then to prove it, sang him a song all for himself.

In gratitude for this unexpected treat, the Captain replied, "Now I shall have one of my sailors sing for you."

Describing this incident, Tetrazzini put her hand to her heart, and said (partly in Italian, French and English), "Ah, I am so emotion tonight! I heard that lovely boy's voice sing to me, just as plain as if in this room. And such a voice it was! So sympathetic!"

As she spoke of her love for the soldiers and sailors her face lighted with the look that all kind-hearted and motherly women feel for the boys who risk their lives in the defense of their country. During the war, Madame Tetrazzini was renowned for her work among the Allied troops. In recognition of her extraordinary services, she wears the Victory bar of Italy; the first class medal of the Italian Red Cross; the Academic medal of Public Instruction in Paris; and an Italian decoration which is such a high honor that it has been bestowed upon only four Italian patriots—the Queen Mother, Margherita, Queen Helena, the Duchess of Aosta and Mme. Tetrazzini.

FARMERS WILL GET PRICES BY RADIO

Market quotations are to be furnished daily by wireless to New Jersey farmers so as to keep growers supplied with up-to-the-minute information regarding the selling prices of their products, under an arrangement between the N. J. State Bureau of Markets and the Federal Bureau. Director Clark of the State Bureau invites boys' clubs to study wireless in order that their parents may avail themselves of the service.

"The quotations," he says, "and other valuable information of special interest to New Jersey farmers will be flashed from the Government wireless station at Washington at 5 o'clock each evening. Amateur stations to tune in for the market messages will require an instrument with sensitive detector and a 400 metre wave length. The message will be twice repeated and will be sent slowly enough for an amateur to jot it down if necessary, in dots and dashes for later interpretation.

The Hall Jet Relay for Recording Radio Signals

(*Continued from page* 1130)

acoustical properties, employing an arrangement as shown in Figs 10 and 11. Air from a constant pressure tank entered at V_1, Fig. 10. Part of the air went thru valve V_2 and part thru a smoke producing chamber D, where punk was heated just sufficiently to cause partial combustion. The flow of air then passed thru V_3 and F direct to H, or thru V_4 and G a gas meter, by means of which the volume—and therefore the velocity—of the jet might be determined. A water manometer I measured the pressure.

Fig. 11 shows how the jet was ocularily examined. It is a well-known fact that the dust particles in a room are made visible by a strong beam of sunlight if the background is dark. The same principle is used here. A carbon arc illuminates the jet, and a screen shades the eye from the arc. A whistle W, or any suitable source of sound for the great range of pitches was used, either near the jet or sometimes at a distance and the sound conducted to the jet by a tube S.

First, curves were plotted for different jets, giving the relationship between pressures and velocity, so that in subsequent tests the velocity could be found from the pressure. Then a study was made of the jet, undisturbed by sound, to find the relation between the height of the jet and the velocity.

It would appear from some of the graphs, the lowest velocity, 44.5 feet per second, and a pitch of 3,000 gives the greatest response, but the fact is that this action is too slow to be very efficient and too unstable and sensitive. About the best working characteristics are: a diameter between .035 inch and .078 inch, velocity between 40 and 70 feet per second, and pitches any where from 500 up to 10,000 depending on the telephone receivers used, and the rest of the circuit.

For very high pitches a special receiver was constructed of low inductance and with a diafram about the size of a quarter of a dollar. This seemed to be less sensitive to static than lower pitch receivers. As high a frequency as 30,000 cycles has been tried with some success, with the idea in mind of building a system to work on a 10,000 meter wave without a detector, but this has never been thoroly tested.

The writer has put the sensitive jet to other uses, such as that of controlling an electrical toy by sounds with success.

It is possible to adjust the jet, the position of the platinum coil, and the pitch and construction of the resonator in such a way that the system will respond to but one tone, even tho other loud noises are present. On the other hand it may be adjusted so as to respond to the buzz of a fly!

"POPULAR ASTRONOMY" CORRECTION

In the "Popular Astronomy" article, page 892 of the December issue, the next to the last paragraph contained the word in the final line, possibility instead of impossibility. This paragraph should have read: "The theory that the moon was once an integral part of the earth has had many adherents and has been put forward by many of the world's greatest scientists, and from the foregoing facts and considerations it would seem that this is indeed a physical *impossibility*."

The Divining Rod—Is It a Fake?

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

(Continued from page 1080)

is the tool of numberless fraudulent practitioners, the motion of the hand is so slight in its operation that there is room for a possibility of honesty on the part of a self-deceived practitioner or believer.

In all scientific work, the object is to remove experiments from extraneous effects. But here, to detect distant objects, the crudest imaginable appliance is used—one absolutely subject to human control and which it is practically impossible for anyone to abstract from such control, no matter how carefully or steadily he may attempt to hold it. It is absolutely unworthy of all scientific consideration. It is of purely psychical interest as a study in deception—both that of the observers, and in some cases of the operator himself.

There is any quantity of literature on the subject. In going back 500 years to Agricola's *"De Re Metallica,"* a book published in Latin in the 16th Century, we find several pages dedicated to the divining rod in which the author, whose German name was Georg Bauer, and who is known as Agricola, takes a very moderate view, being apparently afraid to say it is absurd and worthless, but advises people to use the regular methods of detecting ores, rather than attempt to exploit this instrument.

We reproduce the interesting wood cut from the old book showing the use of the rod in those days. One critic suggests that "there may be an element of sarcasm in the illustration," where some of the miners are extracting ore without waiting for the "dowser" to direct them.

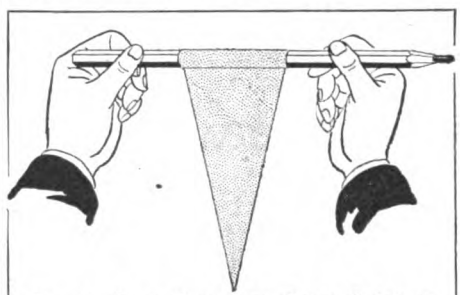


Fig. 3. Lead Pencil and Paper Index to Illustrate the Principle of the Divining Rod.

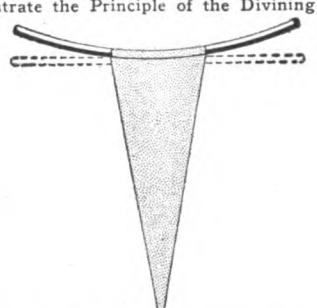


Fig. 4. The Experiment of Fig. 3, Using a Wire or Steel Knitting Needle, Instead of a Pencil.

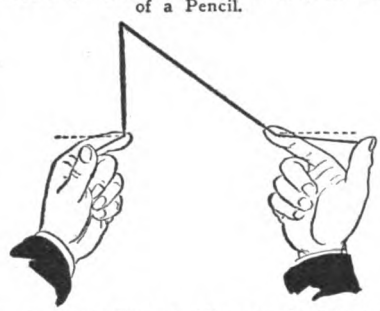


Fig. 5. Bent Wire to Illustrate the Principle of the Divining Rod.

A Floating City

(*Continued from page* 1063)

motion, and this will be greatly reduced in its effects by the distance intervening between the bearings. If one ship is rising on the sea and the other descending, the 1,500 foot length of chord of the truss will make the inclination imparted to the platform very slight.

A great central crane is provided for handling goods, and of course special docks for giving access to the great structure will be provided.

Electricity is supposed to be applied in the most advanced way. A very powerful electric power station is to supply electric light for the *city* and to drive the motors of the four ships, as well as to take care of the steering. The ships, it is specified, are to have twin screws. Nothing is said about the effect of the wind on such a structure, but it is evident that it will be very great, and how far it may affect the operation is a matter of surmise.

New Draft Device Saves Fuel

By HAROLD A. MOORE

(*Continued from page* 1078)

tank, the action being perfectly comparable to that of the ordinary ball cock used on tanks in the houses.

The cock regulated by the float is stationed on a by-pass and the thru-line of pipe parallel to the by-pass, contains a supply cock which can be opened or shut by hand, so as to permit of hand regulation.

That is all that is to be said about the apparatus, which is simplicity in itself. It is claimed that by its accurate regulation, extraordinary results in the way of efficiency, are obtained; that evolution of obnoxious gases is prevented; and that metal laden vapors of great value are saved in the condensing chambers, presumably by the prevention of too strong a draft.

Recently, Mr. J. O. Anderson, the inventor of the new draft regulating device, has, according to reliable authority, successfully demonstrated the adaptability of his device for use in plants that generate steam for power purposes. On a cannery in Puyallup, Washington, he has erected one of his regulators and has produced results that are said to be radical improvements in combustion methods. The firm which allowed him to demonstrate was installing three new boilers and fireboxes to take care of increased demands made upon their power plant. One of these boilers had been installed under Mr. Anderson's direction, with combustion chambers and stack built according to his specifications, and upon its completion he prevailed upon them to allow him to proceed with his demonstrations from that point. He installed his draft regulator and fired up the boilers.

The first day he produced the full capacity of the boiler in steam with but 40 per cent of the fuel that the firm had expected to use. Experiments were made with crude oil, wood and coal as fuels, and with all the same satisfactory results were obtained. After five days, with minor adjustments, *he was able to effect a saving in fuel of over 80 per cent*, and was producing almost as much steam as the three boilers would have generated under ordinary circumstances.

The X-Ray Fluid

By JULES H. STEAN, Ph. D.

(*Continued from page* 1076)

membranes, thru the action of x-ray fluid. Also the auricle of the ear is, due to its tissue structure, transparent, but visible in detail.

Another cut, half body part of fœtus, shows the ribs partly developed and partly composed of cartilage. It also shows the tissue, the thickness of which may be seen above the spinal column.

The second cut, arm and hand of a fœtus, is characteristic of the power of the fluid. Here we have the developed bones, as well as the undeveloped ones. The picture shows the ossification of the bones remarkably well. The ulna and radius not developed to the full degree are plainly visible.

The photographs of the specimen have lost very much in detail and appearance, as the specimens were preserved in ordinary glass vessels which caused a distortion of light in photographing, but the pictures may give a good idea as to the value of the fluid in the study of anatomy.

The reproduction demonstrates that *the transparent specimen shows all parts of the inside body,* which parts may differ in the index of refraction materially from the tissues.

In order to produce specimens which show inside parts, as bones, or the more plastic arteries, the bones may be stained *or the blood vessels filled with colored substance.* For instance, instructive preparations may be obtained by injecting into the blood vessels colored fluid for the demonstrating of the vascular system and the specimen may then be immersed and preserved in the x-ray fluid.

The study of the structure of the vegetable texture shows some remarkable and interesting details when penetrated by the x-ray fluid. *Wood one-half inch in thickness acquires such a transparency that print can be read thru the board.* But the wood has not lost the detail of its structure at all, and is preserved unharmed.

Leaves and flowers are very easily prepared and give a unique picture entirely clear to look thru, except that the veins stand out very prominently.

Taking into consideration the work accomplished with the x-ray fluid, it can be said that it will be a valuable help for the student and layman for the study of anatomy, as well as for the botanist.

Rare specimens can be preserved in the natural state indefinitely, eliminating wax preparations to a large extent.

Here a student may handle the glass vessel containing the prepared specimen, may observe the interesting features of the object without being handicapt in his imagination, as he would be in the case of a wax preparation. Every part of the specimen is visible in the glass vessel and tissue and underlying parts may be seen clearly in their original form. No parts need to be touched or dissected and knowledge may be obtained in a more sanitary form and more thoroly than by the old method.

BUYING RECORDS BY TELEPHONE

Numbers of people have already written the manager of this new department telling him how much pleasure it has given them to hear new records over the telephone so that they might order them without further trouble. Needless to say, the sales in this department have greatly increased since the plan is in use.

Is Electrocution Humane?

By JOSEPH H. KRAUS

(*Continued from page* 1081)

will be stimulated as near to the muscle as possible, and secondly, when the nerve is stimulated as far away from the muscle as possible.

The distance between the two bare wire electrodes is now carefully measured. A record is then made with a tuning fork giving exactly 250 vibrations per second and which has mounted on one prong a fine wire. It will be seen therefore, that between each two adjacent points of the tuning fork record one-250th of a second has elapsed and from the graph we also see that there is a certain latent period between experiment one and experiment two, the muscle having contracted more rapidly in experiment one than in number two.

The difference in time is then carefully measured, and when compared with the difference in lengths of the nerve, a definite ratio will have been established. The rate of impulses can then be computed and the following speeds observed. In the sciatic nerve of a frog the speed of nerve impulse transmission has been calculated as 27 meters per second. In man this speed has been found to be from 110 to 140 meters per second. Just compare this speed with that of light or compare this with the speed of electricity—three hundred million meters per second.

It is obviously impossible for a nerve to transmit a sense of pain to the brain at the terrific speed at which electricity travels, contracting as it does, every muscle in the body including the involuntary muscles of the heart and causing this contraction to be maintained, at the same time rendering the individual unconscious.

Dr. Spitzka has definitely stated that were he to die in any way whatsoever, he would prefer the electric chair, except for the stigma attached to such an execution. "Were capital punishment," he says, "properly handled in this and other states in the Union, there would not be half as many murders as are occurring daily."

A murderer now, however, has many chances to get away without paying the penalty. At first he can plead insanity, sometimes a very ridiculous plea, wherein the fact that he swallowed a pin when an infant, has even been brought up as evidence. If adjudged insane, he goes to an asylum where there is a reasonable chance of getting out. If he is indicted for murder in the first degree and found guilty, he may receive one of two sentences, either life imprisonment or be sentenced to die.

With life imprisonment he may fight for and obtain a pardon. Again, he may have the death sentence appealed to a higher court. After the appeal is granted he has another chance; if again adjudged guilty and the order of the lower court is comfirmed he may appeal to a still higher court. At all times he may apply to the Governor for a commutation of sentence.

Obviously, therefore, it would seem that in order to make capital punishment what it should be, it is necessary that it be carried out drastically. This does not mean to infer that the editors are in favor of capital punishment in any form, but the rapidly increasing number of murders tend to show that something is radically wrong somewhere.

The Sun's Unknown Rays

By ROGERS D. RUSK, M. A.

(*Continued from page* 1086)

low pressure are due in part to air rising from portions of the earth which have become unequally heated. Why storms are commoner certain years than others and why they seem to vary with the activity of the Sun are puzzling problems. Huntington has found that in addition to the direct action of the Sun's heat, there may be another and swifter agency at work which we have not yet detected. In his work he made a careful study by days of the years from 1904 to 1918, in which he compares the spottedness of the Sun with the barometric pressure on the earth and with changes in the weather. He also compares other solar disturbances and the amount of heat radiated at any time with the barometric pressure.

In studying the sunspots he divided the Sun's disk into three equal divisions, as shown in Fig. 3, with the result that he found the two marginal areas to be more effective in producing weather changes on the earth than the central area. This is a somewhat surprising conclusion as disturbances at the edge of the Sun are projected away from the earth, while those nearer the center of the Sun's disk are projected more directly toward the earth. This may be the result of some electric or magnetic disturbances, or it may be due to some unknown agency. If it is the former, the storminess can be explained by the fact that the earth, air and clouds are charged bodies, and that a disturbance of these charges would lead to increased motion of the atmosphere and clouds, and hence increased variability in the weather. Huntington himself says: "In view of all these facts we seem to be led to the conclusion not only that variations in solar activity are among the prime causes of disturbances in the earth's atmosphere, but that these variations are of two kinds. One is clearly thermal. The other kind may be electrical or of some type not yet understood."

"Home Electrics"

By G. L. HOADLEY, M. E.

(*Continued from page* 1089)

as in Fig. 4, the lower right-hand one usually reading in tenths of a kilowatt-hour. Read such dials as usual, and add two ciphers to obtain the reading in watt-hours. The latest practise is to leave off all markings above the dials, as shown in Fig. 5.

Sometimes a dial hand by wearing of its aperture or of the spindle becomes misplaced, is behind its proper place as it turns. This is the case in Fig. 6, with the hand of the second dial from the right. It is evident that as the right-hand index has past 0, the next hand should have past the 8.

The above sources of error cover those met with in practise.

The highest value obtainable from any standard four-dial register is 9,999. Heavy consumers of electricity may use more than that amount of energy per month and a register constant or multiplier is required to extend the range of the meter. In such cases, the makers' stamps on the face of the meter register, "Multiply by 10" as in Fig. 5. They will hardly ever be met with in household use.

To determine the amount of energy consumed over a month, for instance, subtract the reading of the meter at the beginning of the month from the reading at the end of the month. This will give the net consumption. Figs. 7 and 8 illustrate typical registers and will assist in learning to make correct readings.

Swiftest Things on Earth

(*Continued from page* 1064)

Airplanes the Fastest Carriers

Altho the United States sent one of the fastest and highest powered airplanes ever designed, to compete in the recent James Gordon Bennett Trophy aerial meet, the American entrees broke down and never finished the race owing to engine and other troubles, and Sadi Lecointe, the French aviator won the International Airplane Race by covering the course of 300 kilometers (equivalent to 186.45 miles) in one hour, 6 minutes, 17 1/5 seconds. This is equivalent to a rate of 2.81 miles per minute, or 168.6 miles per hour. This is a little faster than the high speed limit attained by Tommy Milton in his automobile, but Lecointe's speed is the average for an ultra long run, and not the greatest airplane speed attained.

The highest official speed attained by an airplane, is that reached by de Romanet, the French aviator, who attained 193 miles an hour on November 4. It has been reported several times that airplanes both in this country and abroad have reached a speed as high as 230 to 235 miles an hour.

The velocity of sound is 10.88 feet per second, at zero degrees Centigrade, at a pressure of 1 atmosphere. A cyclone rushes at the rate of 585 yards a second and about the fastest material thing on earth is the projectile from a gun, the velocity of which is, as shown in the accompanying illustration, 975 yards per second or at an equivalent velocity of 2,000 miles per hour. The next succeeding fastest thing we know of is the velocity of the earth itself, as it speeds around its orbit about the sun at the rate of 65,533 miles per hour. Finally, we come to the highest speed thing we know of, which is credited with having the ultimate speed attainable in the universe by any object or agency,—that of Light and Electricity, which travel at the marvelous speed of 186,000 miles per second. This is also the speed of the Hertzian waves used in radio-telegraphy and telephony, so that a high powered radio wave sent out from the station at a point on the earth's surface, will theoretically pass around the earth seven times in one second.

MICROPHONE DETECTOR OF FIRE DAMP

The microphone is applied to the detection of fire damp in mines. This is its principle: If sound waves from two pipes of equal pitch impinge on microphones connected in series with a telephone, a clear note is heard, but if one of the pipes emits a slightly different note, beats will be heard in the telephone.

Here is the application: One pipe is placed in the mine, the other above the ground and they are blown simultaneously. If the air in the mine is charged with fire damp, it will produce a different note from that produced by clear air, owing to the difference of density, and in consequence, a series of beats in the telephone gives warning of the presence of fire damp.

The same apparatus is very sensitive to the presence of coal gas.

—always remember

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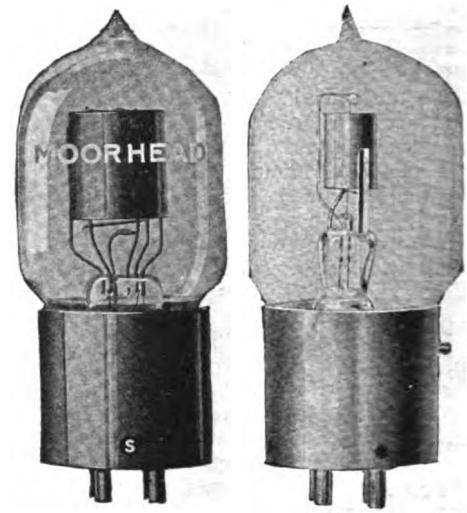

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Consolidated Radio Call Book Co., Inc., 41 Park Row, New York City

Talking on a Thread

(*Continued from page* 1077)

The thread must be made very uniform in diameter, and should also possess an extremely smooth surface, as otherwise there would be heard, of course, noises and other disturbances in the machine when it came to reproducing the voice.

The inventor points out another very interesting fact with regard to this "talking thread" phonograph, namely, that the chisel edged stylus or recording member does not cut into the thread or moving portions thereof, but records the speech or musical vibrations simply by its varying pressure on the thread as it travels along below it, which produce in the surface of the thread, certain irregularities corresponding to the vibrations of the recording member.

The Editors of this publication have had the pleasure of hearing this "talking thread" phonograph in operation, and it is really one of the most wonderful devices of its kind that one can possibly imagine, especially when it is realized that it is possible to "talk" on several hundred feet of the thread and after this is all reeled up, the reel can be removed from the machine and mailed to any point on the globe, placed in a similar machine by the recipient and have its message transcribed whenever and wherever desired.

It is the inventor's idea to commercialize this machine for use in business offices as a *dictaphone*, and one supreme idea fathered by the inventor lies in the fact that, instead of wasting time in dictating a letter on a phonograph of the present type, which is then to be transcribed by a typewriter, the business man of tomorrow may be able to talk into the machine, to remove the length of thread containing the letter or statement, and mail it directly to the party for whom it is intended, no matter whether he is 100 miles or 1,000 miles distant. Undoubtedly such a scheme as this will be considered a commonplace in a shorter time than we are perhaps inclined to believe possible.

The machine is very finely built and reflects the wonderful model-building ingenuity of the Swiss. Among some of the interesting features of the machine are these: it can be either manually operated or else can be driven by a spring or electric motor; when a reel is wound to a certain depth with the thread, a bell automatically rings, informing the operator of the fact that a fresh empty spool is required; a clever needle and dial on the front of the machine indicate how much thread has been "talked on" so that if the operator wishes to repeat a section or the whole of a sentence or paragraph, he can simply throw over the reverse lever on the top of the machine which winds the thread on the stock spool, and then by throwing the reverse lever to the take-up position—proceed to run the thread under the reproducing edge of the stylus and listen to the repetition of his own voice, the same as is now possible with the standard *dictaphone* used for business correspondence.

WOMAN FINDS NEW STAR

Another new star has been discovered at the Harvard Astronomical Observatory. The Nova is in the constellation Sagittarius, and was at its maximum brightness on Aug. 11 and 12, 1914, being then of the eighth magnitude, and since then has declined in brilliancy.

Miss Woods of the observatory staff detected the star, the position of which is given as right ascension 17 hours 59 minutes 44 seconds, declination minus 31 degrees 44.9 minutes (190). The discovery is the fortieth of its kind in the history of astronomy and the twenty-second in the records of the Harvard Observatory.

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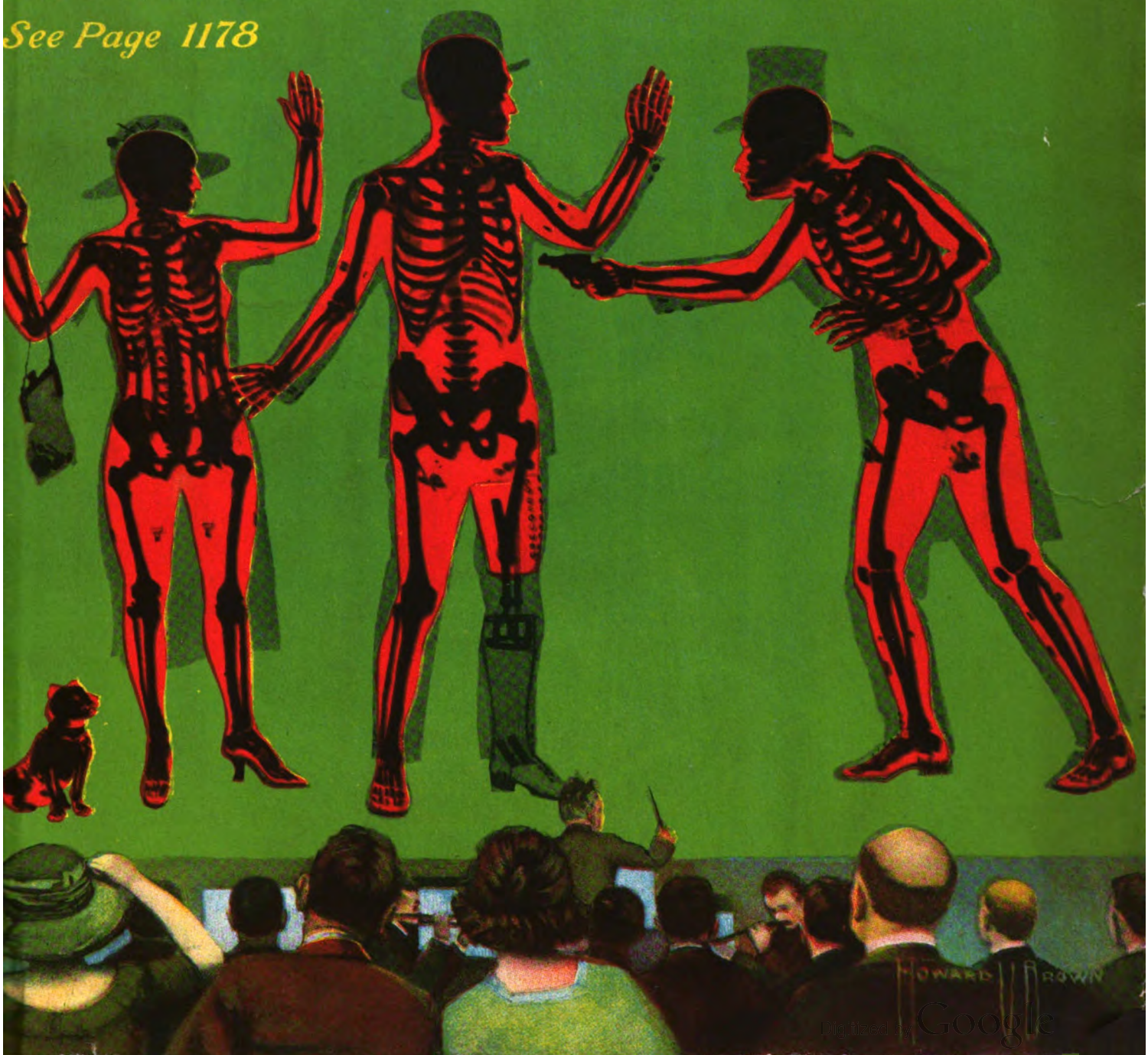

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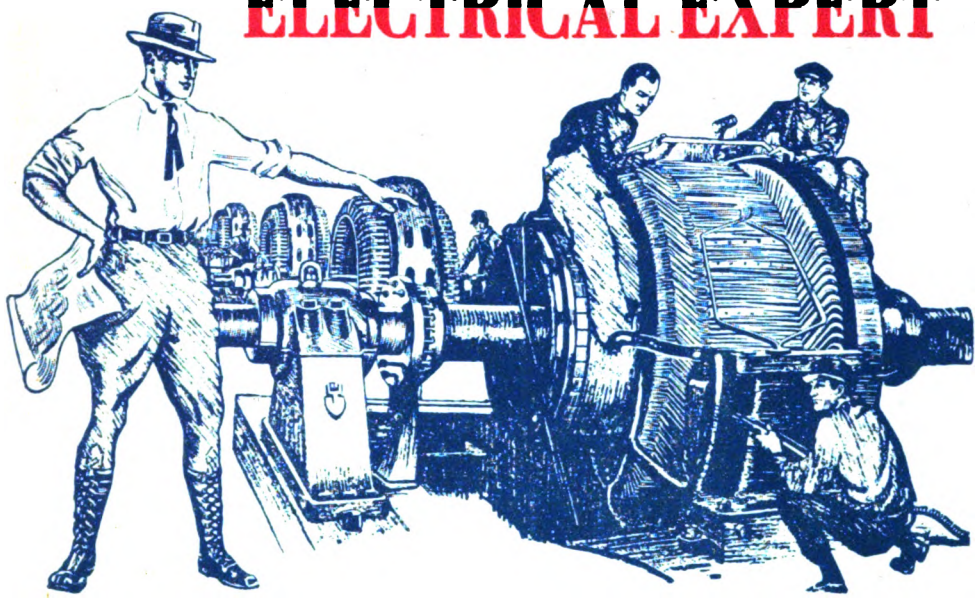

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Complete Letters Sent When You Write Me

YOU CAN DO IT

Vol. VIII
Whole No. 95

Science and Invention

FORMERLY
ELECTRICAL EXPERIMENTER
233 FULTON STREET-NEW YORK

March, 1921
No. 11.

Publisht by Experimenter Publishing Company, Inc. (H. Gernsback, Pres.; S. Gernsback, Treas.; R. W. DeMott, Sec'y), 233 and 236 Fulton Street, New York

The Mysterious Rays

WHEN Röntgen first discovered the X-rays, the discovery provided a sensation not only in scientific circles, but it caught the popular fancy as well. When these mysterious rays were first discovered, the outstanding facts about them were of course their penetration thru the human tissue, and it gave us the means to view the bones in the human body, a thing which before that time had appeared fantastic of accomplishment.

Altho it is now twenty-five years since X-rays have been discovered, we still know very little about them. In some quarters it is maintained that X-rays are not a wave motion of the ether similar to light, but that on the contrary, the rays are really streams of matter shot off at the speed of light. This view, however, does not seem to be upheld lately, mainly for the reason that it has been discovered that X-rays can be refracted in certain crystals similar to light rays, which latter can be refracted by means of prisms and lenses. As time wore on many new wonders became possible by means of the X-ray. It was early found that these rays have the property to ionize, *i.e.*, making electrically conductive the air thru which the rays pass. This quality is shared by radium in a similar manner.

Every day we behold new wonders which are accomplisht by the X-ray in one way or another. Certain diseases for many years have been treated by means of X-rays and cures have been effected on cancerous tissues by these rays as well. Metal castings which have invisible flaws need no longer endanger human life; for instance, our automobile axle may look perfect from the outside, but it may have invisible fissures hidden inside. The X-ray reveals these faults today. Certain insects which infect tobacco are now killed by X-rays. The crates containing the tobacco are subjected to the rays and the insects are killed off in short order. One of the greatest scourges of humanity, insanity, is now indirectly cured by the X-ray. Teeth containing pus were hitherto unsuspected of creating insanity, but they do just that. The X-rays show at once such defective teeth. There are now thousands of recoveries if the teeth are either treated or extracted properly.

By rubbing the finger over metallic powder and taking an X-ray picture, the French police recently found this to be a valuable adjunct to ordinary finger printing. Not only do we thus get the true picture of the skin's lines and whorls, the same as if ink were used, but we get the structure of the bones as well, and these were found to vary just as much as the finger prints themselves.

Oil paintings by old masters are now readily proven genuine or spurious by means of X-rays giving us immediately the true condition of the painting.

Recently X-ray moving pictures have been proposed whereby audiences may witness the most fantastic spectacles ever seen. Instead of seeing the human beings or animals in the flesh, we see only the bones as well as the outlines of the body.

We may safely say that we have only scratched the surface with the X-ray. Every day brings forth new wonders—new applications. It is impossible to draw a line limiting what can be accomplisht by these mysterious rays in their own field, and much is to be hoped for from them during the next few years.

H. GERNSBACK.

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