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SEE PAGE 860

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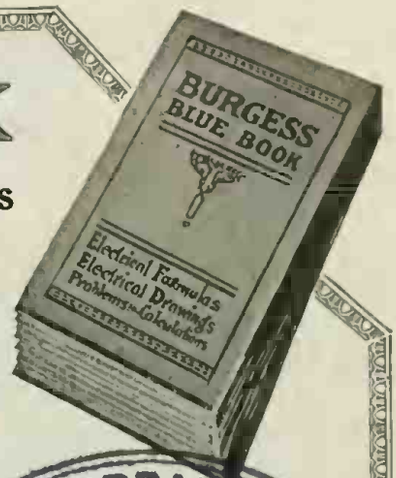
The Burgess BLUE BOOK

for all Practical Men and Electrical Students

(See review of this book by Editor in December issue of your Electrical Experimenter page 568)



I have prepared a pocket-size note book especially for the practical man and those who are taking up the study of electricity. It contains drawings and diagrams of electrical machinery and connections, over two hundred formulas for calculations, and problems worked out showing how the formulas are used. This data is taken from my personal note book, which was made while on different kinds of work, and I am sure it will be found of value to anyone engaged in the electrical business.

The drawings of connections for electrical apparatus include Motor Starters and Starting Boxes, Overload and Underload Release Boxes, Reversible Types, Elevator Controllers, Tank Controllers, Starters for Printing Press Motors, Automatic Controllers, Variable Field Type, Controllers for Mine Locomotives, Street Car Controllers, Connections for Reversing Switches, Motor and Dynamo Rules and Rules for Speed Regulation. Also, Connections for Induction Motors and Starters, Delta and Star Connections and Connections for Auto Transformers, and Transformers for Lighting and Power Purposes. The drawings also show all kinds of lighting circuits, including special controls where Three and Four Way Switches are used.

The work on Calculations consists of Simple Electrical Mathematics, Electrical Units, Electrical Connections, Calculating Unknown Resistance, Calculation of Current in Branches of Parallel Circuits, How to Figure Weight of Wire, Wire Gauge Rules, Ohm's Law, Watt's Law, Information regarding Wire used for Electrical Purposes, Wire Calculations, Wiring Calculations, Illumination Calculations, Shunt Instruments and How to Calculate Resistance of Shunts, Power Calculations, Efficiency Calculations, Measuring Unknown Resistances, Dynamo and Dynamo Troubles, Motors and Motor Troubles, and Calculating Size of Pulleys.

Also Alternating Current Calculations in finding Impedance, Reactance, Inductance, Frequency, Alternations, Speed of Alternators and Motors, Number of Poles in Alternators or Motors, Conductance, Susceptance, Admittance, Angle of Lag and Power Factor, and formulas for use with Line Transformers.

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JOSEPH BRAITH, Electrician.
Madison, Wisconsin.

Your "Blue Book" received and it is just the book I have been looking for. Please mail me three more by return mail for which I am enclosing Money Order. Respectfully.

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R. S. SWANSON.
St. Paul, Minn.

I received the three books I sent for and the next day I sold them. The fellows think they are well worth the price. Please send me three more for which I am enclosing Money Order. Yours very truly,

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EDITORIAL

Interplanetary Messages

A FEW weeks ago Marconi startled the world by stating that he had often received strong wireless signals which seemed to come from beyond the earth. In a recent interview publisht in the *New York Evening Post* Nikola Tesla, too, reminds us that he had made known to the world years ago the fact that extra-planetary signals were recorded in his Colorado Laboratory. That was in 1899, before the world dreamt of wireless.

Even today announcements such as the above are made light of by editorial writers and others of limited scientific perception. For the earth-bound layman still persists that intelligence can only exist on Earth. Such childish reasoning shows what sort of "intelligence" blossoms on this planet. It never occurs to these reviewers to question why Nature in her Wisdom should have singled out the little speck called Earth, on which to plant beings endowed with reason. Why should there be such an exception? Life in some form or other is certain of being found on myriads of worlds thruout the Universe. And if one world dies, all life does not die with it. Svante Arrhenius shows us how life-bearing spores are carried by the pressure of light thru interstellar space, notwithstanding the absolute zero which prevails there.

In our planetary system, conditions for life, such as we know it, probably only exists on two planets: Mars and Venus. Life on the latter being more or less doubtful, due to its heavy water-laden atmosphere, there remains Mars, a body much older in evolution than the earth. Conditions on Mars we know by direct observation as well as deduction are favorable for life, and we may be certain that it exists there. And if we once grant this, we must also grant that it must have existed for hundreds of thousands of years prior to that on Earth; consequently Martian civilization must be thousands of years ahead of ours.

From this we must deduce again that the Martians probably signaled to us ages ago, when prehistoric man still roamed the forests. But why go so far back? Suppose the Martians had sent us radio messages only thirty years ago. We could never have received them, for we then had no means of recording them. Detectors and audions were undreamt of.

In all this warped logic, we presuppose wireless signals. But why should a civilization so far ahead of ours use—to them—obsolete radio waves, which, like as not, can never hope to bridge 35 million miles! If the Martians are signaling to us, you may be certain that they use an entirely different means than Radio. To be sure, it may turn out to be one of the many wave forms of the ether, but we can only make a poor guess at it today. Meanwhile Martian signals probably fly about our heads day and night, as they may have for thousands of years, but we are still deaf and blind to them. The Martian Wave Detector still remains uninvented. At that the Martians probably have used many methods on us. It is not even impossible that they may have used reflected sun rays. Bell and Tainter in 1880 demonstrated a "wireless" telephone—the Photophone—by making use of a vibrating light ray falling upon a selenium cell. Speech was transmitted over many miles this way. With necessary refinements such a system might bridge interplanetarian space.

As to one planet understanding the other, that is of course child's play. Still, many humorous editorial writers have misgivings on that score. They are afraid that on Mars 2 + 2 might equal, perhaps, 5 or 3, so how could we get together, they ask.

A simple example might serve as an illustration. Suppose an American and a Frenchman, neither knowing the other's language, were connected by a long telegraph line. Both are ignorant of the code. But both have enough sense to tap the key. Suppose both have the desire to enter into communication, what will they do? Tap out dots from one to ten, of course. Thus . . . . . etc. It will not take them many months, if they keep at it, to work out a sort of "international" language by means of dots. And the higher their intelligence, the quicker will they understand each other.

That is the basis of interplanetarian communication.

H. GERNSBACK.

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Electrical Experimenter

H. GERNSBACK, EDITOR
H. W. SECOR, ASSOCIATE EDITOR

Vol. VI. Whole No. 72 APRIL, 1919 Number 12

Grand Opera in Your Home

By H. GERNSBACK

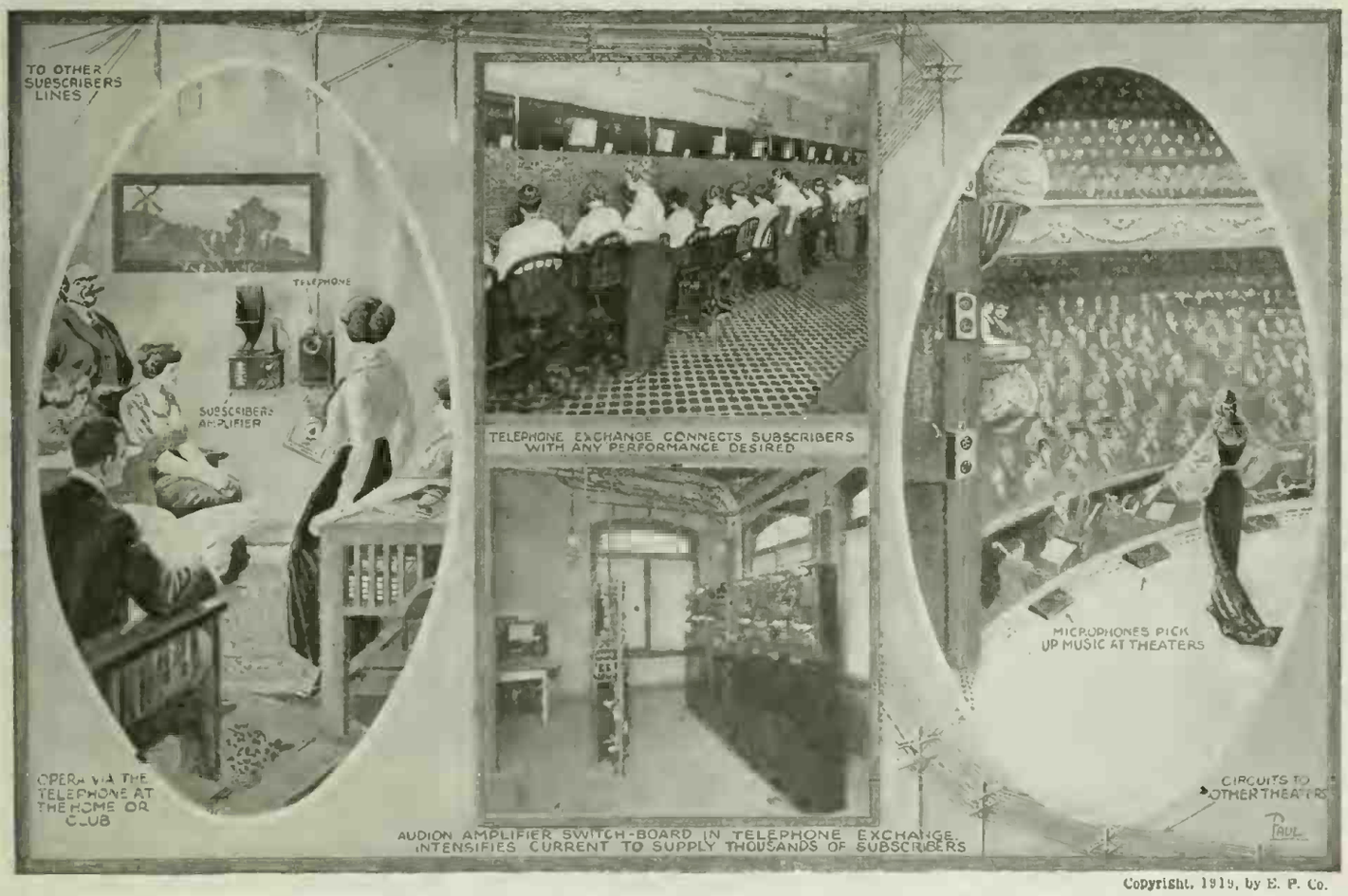
MANY thousands of people musically inclined are deprived of hearing our great operatic stars mainly on account of the high price of admission, also because of the limited seating capacity of even our largest opera houses. Take for instance a "star" performance at the Metropolitan Opera House, New York City. It is necessary to secure tickets weeks ahead if one wishes a good seat in the house, otherwise it is often impossible to make a reservation at all.

While seats may be bought at low prices "up in heaven", only our Italian friends of limited income prefer such seats and, therefore, the gallery is usually made up entirely of really music-loving Italians.

Suppose that all you had to do was to step to the telephone at 8.30 in the evening, no matter if you lived in New York or anywhere else in the country, and immediately had the whole room filled with Caruso's voice. Would this not appeal to you, providing of course that you were musically inclined? All this is now possible, and, we believe, will shortly come about. While of course the idea itself is nothing new—it having been tried thirty years ago to transmit music in this manner,—there was one great technical difficulty at that time which only during the past two years has been overcome.

While it is a comparatively simple thing to place sensitive microphones about the stage and on the other end of the line connect a loud speaking telephone in order to listen to the transmitted music, it is quite a different problem to connect say *twenty or forty thousand* subscribers' lines to these microphones and then reproduce the music at the end of *all* these thousands of circuits. The reason is that heretofore we had no satisfactory instrument whereby the

(*Continued on page* 924)



Due to the Invention of the Audion, It Is Now Feasible From a Technical Standpoint to Connect to One Stage As Many As Fifty Thousand Telephone Subscribers, All of Which Can Listen Simultaneously to Our Great Opera Stars. The Invention of the Loud Talking Telephone Also Has Made It Possible for the Entire Family to Hear the Music As Pictured Above.

New York to Chicago Via the Air in Twelve Hours

"AIRLINE TICKET for Chicago, Please." "Yes, sir; five hundred and twenty dollars. Please. The next 'liner' leaves in half an hour for Chicago and way stations," replied the ticket agent of the *Trans-Continental Airline Company* on a bright June morning in the year 1919. At least that is a fair sample of the conversation we may find quite common in a few months or so, if the plans of one of the largest aërial transportation organizations materialize in any such manner as their originators predict. Complete arrangements for the construction and operation of a line of passenger carrying dirigibles between New York and Chicago at an initial charge of sixty-five cents a mile for each passenger have been made by J. M. McElroy, chief engineer of the Sturtevant Aeroplane Company, of Boston, in collaboration with Noble Foss, one of the officials of the corporation and a son of former Governor Foss, of Massachusetts.

Announcement of the big undertaking was made recently by the Massachusetts Aircraft Association, which held its annual aeronautical exposition at Madison Square Garden and the Sixty-ninth Regiment Armory from March 1 to 15, inclusive, in co-operation with the War and Navy Departments.

It is proposed to form a company with four dirigibles and two main terminals, one at New York, the other at Chicago. The dirigibles are to be of the Zeppelin type, with rigid housing and multiple compartment structure. The U. S. War Department's wonderful new discovery, Helium gas, will be used, thus removing the danger of fire. The airship will be 425 feet in length and forty-five feet in diameter. Its engines will have a horsepower of 1,200. The bag will have a capacity of 650,000 cubic feet of gas, providing a gross lifting power of twenty tons at sea level. This would mean a practical net lift of ten tons.

It is estimated by Mr. McElroy that a speed of seventy miles an hour can be maintained and that the trip from New York to Chicago could be made in comfort in less than twelve hours.

"The cost per mile, roughly speaking," says Mr. McElroy, "would approach sixty-five cents per passenger, or $520 for the entire trip in either direction. There is no doubt but that after the line is run for some time, it will be possible to cut down the rate considerably."

Each dirigible will have accommodations for twenty-five passengers. The power plant will consist of two engines, side by side, driving thru gears a central stub shaft mounting a variable pitch air screw. Balance and altitude will be adjusted by expansion or compression of the gas.

The crew will consist of the captain, navigator, chief and two assistant engineers, wireless operators, steward, cook, waiter and maid.

In regard to the landing places, which with dirigibles is a great problem, Mr. McElroy says:

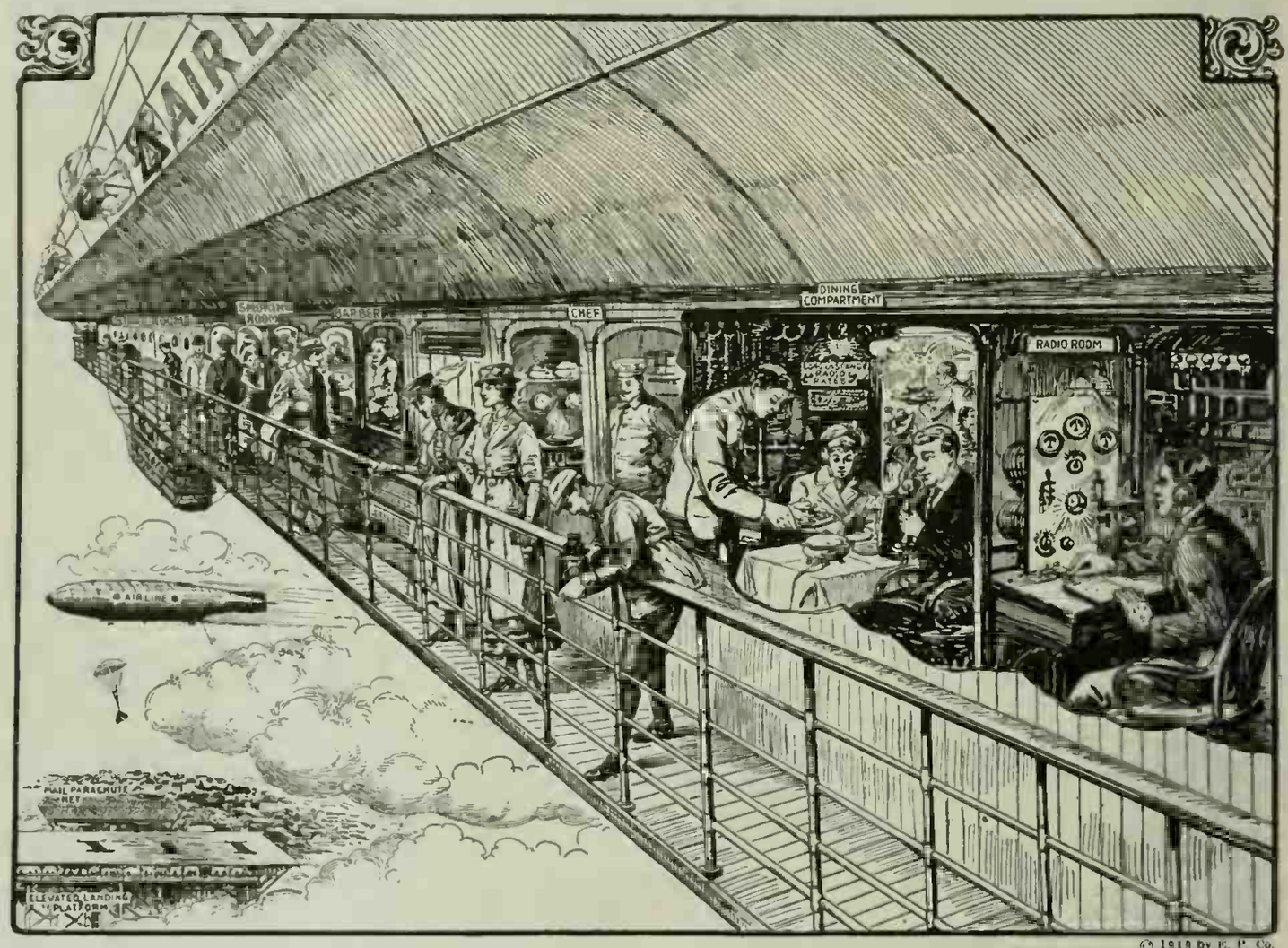
"It is reasonable to believe that hill walled landing zones could be located, or natural depressions in the earth could be enlarged to offer breakairs to permit the air liner to come down safely. The terminals at either end of the New York-Chicago route could be floating piers secured at one end, so as to swing with the wind to permit easy housing of the ship."

With regard to the possibility of trans-Atlantic flight, Mr. McElroy says:

"When we have put the New York-Chicago route into successful operation then it is time to throw a line across the pond and do a real job."

Apropos of transcontinental aërial transportation we find much food for thought in a speech recently made by Allan R. Hawley, president of the Aero Club of America, before the National Rivers and Harbors Congress, at Washington, D. C., on

(*Continued on page* 915)



Regular Air Line Passenger and Freight Transportation Between the Larger Cities, Particularly New York and Chicago, Promises to Become an Accomplisht Fact This Spring. A Company Has Already Been Formed to Develop and Promote This Project. All the Usual Conveniences Will Be Available to Passengers, Besides Wireless Communication, Mail Service, Sleeping Quarters and Aerial Promenade, Not to Mention the Most Wonderful Scenery ever Presented to Alpine Tourists, for These Giant Airships Will Fly Right over the Mountains.

Guiding Airships With the "Radio Barrage"

Invisible Walls of the Ether

By DR. LEE de FOREST

JUST at this time, when our army and navy officials, and many airplane builders, are taking steps for the commercial development of the airplane and dirigible, along industrial and governmental lines, is it not practicable, as well as advisable for radio inventors and engineers, as well as others concerned, to give thought to those essential safety devices which come within the scope of radio-communication and control?

I venture to say that if there was any one device used in the European war which contributed to the success of the Allies in their supremacy of the air, it was radio-communication, both telephone and telegraph. By means of it the fighters in the air were at all times able to talk and signal with their commanding officers at headquarters, and after a personal examination of the various kinds of apparatus used by the different countries, all of which pay high tribute to American genius, I feel I am fully justified in predicting an even greater use of radio control and communication for peace purposes.

One of the first questions to be taken up, it seems to me, when we have reached the point of regular passenger and freight traffic by air, is that of proper warning to pilots in case of fog, cloud or other interferences. Will it not be necessary, for example, to establish a regular "traffic squad of the air," for those cities in the principal lines of communication? The use of the human voice in sounding a warning, without wires, is already an accomplished fact; at Point Judith Light, where the *Radiophore*, at regular intervals, calls out to the ship operator: "Point Judith Light," and then in a weaker voice: "You are getting closer—Keep off."

By means of a number of wireless stations placed around any given city, why cannot we do likewise in the matter of our radio traffic squad of the air? So that when a pilot comes within range, he would receive a message such as the following:

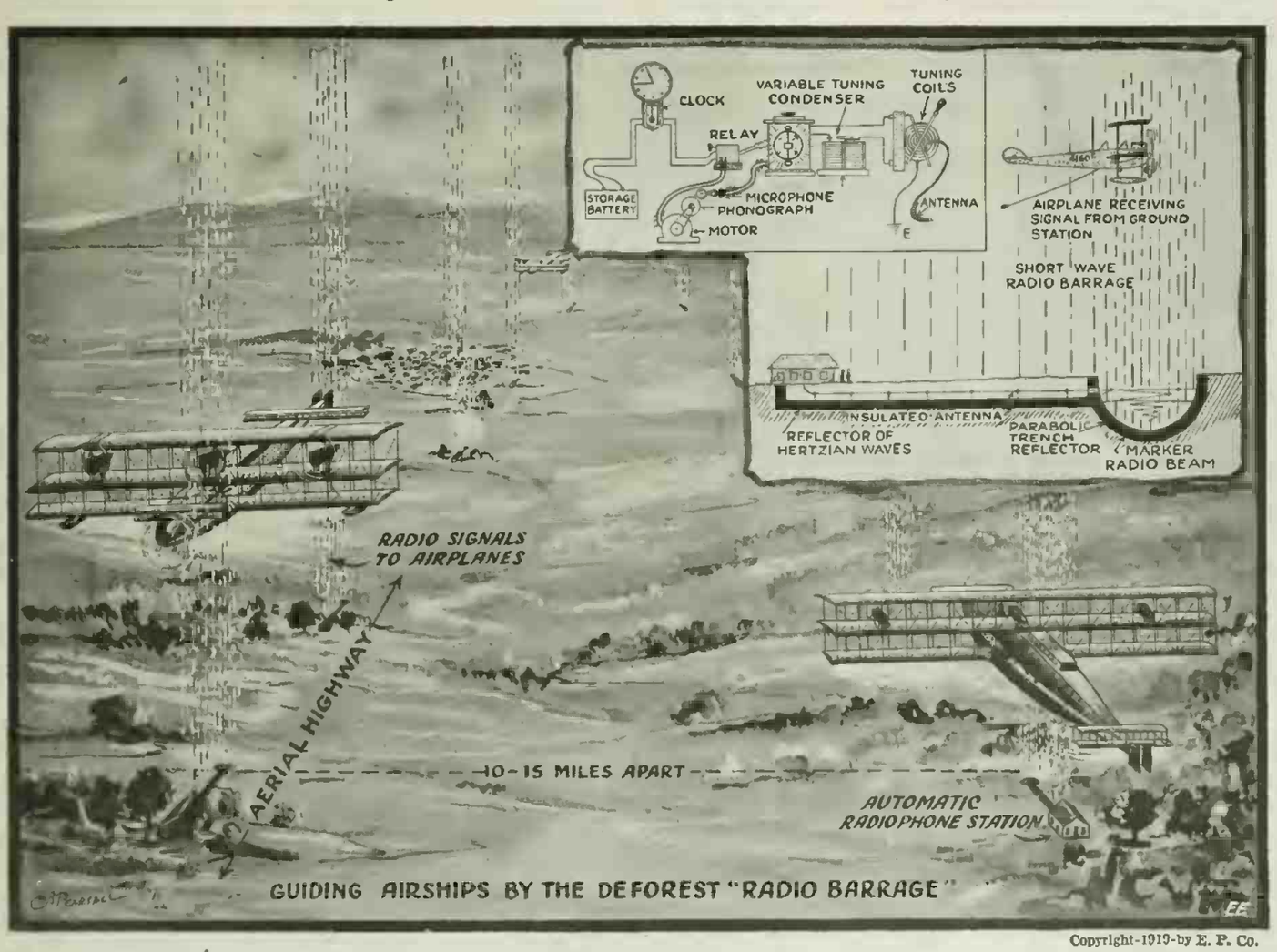
"Buffalo Office—Turn West by South, and Pick up Cleveland," or again such warnings as, for example, it will be necessary to inform the pilot of weather changes: "Weather Warning—Your are nearing a storm area—Cyclone Ahead," etc., etc.

There should be, no doubt, a continual "radio barrage," or zone of automatic warnings thru which airplanes must pass in approaching regions where air traffic is dense; namely, around landing stations, and especially so near steep mountain ranges and peaks, or cities like New York, with extraordinarily tall buildings with consequent air pockets.

By arrangement of antenna or reflectors not unlike those used behind large searchlights, a beam, or narrow zone of wireless waves, invisible to the eye of course, could be set up. This would necessitate the use of very short wave lengths, of only a few meters, far shorter than the wave lengths used today in radio-communication. This feature would also have the advantage that these short wave lengths would not interfere at all with existing radio-communication. All this short wave vertical radiation would be controlled by the automatically repeating phonograph, similar to the *Radiophore* arrangement at Point Judith Light.

The pilot of the airplane, his 'phone clamped to his head in the helmet, would hear these safety signals as he flies thru these invisible walls of etheric warning, in ample time to govern his course accordingly.

With the mastery of the air for governmental, and for commercial purposes, already at hand, certainly the question of radio control, and of traffic regulation, is of prime importance, worthy of the immediate interest, and of the best thought in the radio world.



The Airships of Tomorrow Will be Guided by Wireless Telephone Signals, Possibly Arranged in "Barrages" or Walls, as Here Illustrated. This is the Only Feasible Way of Signaling Location and Weather Data to Aërial Craft in Stormy and Especially Foggy Weather. Prof. Walter I. Schlichter, of Columbia University, Has Also Recently Advocated the Use of Powerful Wireless Signaling Stations for Guiding Trans-Atlantic Seaplanes in Their Proposed Trips Across the Ocean.

How Electricity Serves World's Largest Hotels

Do you know that the two largest hotels in the world have just opened in New York City, each one with over 2,000 guest rooms and a bath in every room? One of these hotels has, among other startling new features, an electric automobile elevator, which carries the guests' motor cars up to the grand ball room floor, so that milady and her escort do not have to pass thru any chilling winds when arriving at the hotel. These hotels are veritable cities in themselves, and either of them has more telephones than the entire nation of Greece. One hotel has the largest electric laundry in the world, not to mention the gigantic dining rooms, ball rooms, kitchens, swimming pools, children's open-air playgrounds, and a whole regiment of employees.

By H. WINFIELD SECOR

THE two largest hotels in the world recently opened in New York City, one, the "Hotel Pennsylvania," opposite the Pennsylvania Railroad Terminal at 33rd Street and 7th Avenue, and the other, the "Hotel Commodore," located adjacent to the Grand Central Terminal, and built directly over both the Queensboro and Lexington Avenue subways. There are so many hundreds of innovations and conveniences which have been developed and applied to these—the last word in Hoteldom—that one can hardly judge of the undoubted value of all of these important and elaborate appointments without having actually visited such an establishment in person. Take, for example, the gigantic proportions of the Hotel Pennsylvania with its 2,200 rooms and bath. This hotel can accommodate 3,500 registered guests with rooms, not to mention several dozen additional small-town populations, which it can easily entertain in the grand ball room and its six well appointed restaurants, also numerous private banquet rooms and private dining rooms, not forgetting the roof garden, which is one of the most beautiful and perhaps the largest in the world, Besides a capacity of 3,500 guests with rooms, 3,000 additional guests may be entertained in the several restaurants including the roof garden, or the total capacity of 6,500 guests, which is a respectable little city all by itself.

If you haven't already visited one of these magnificent and beautifully appointed 20th century hotels, you will probably wish to know what conveniences are provided for the guest, and with that very object in mind, the writer paid a special visit to these establishments and enjoyed an afternoon off from the editorial rub-dub, amid the flowering palms and the aroma of one dollar Havana perfectos arising from the "loungees" reclining luxuriously on the thousand dollar leather settees, which grace the main lobby. This wonderful lobby is furnished in handsome imported marble and is lighted by reflected beams passing thru a richly designed leaded glass ceiling. Both the Hotel Pennsylvania as well as the Hotel Commodore have the same transit facilities, i.e., both have subway as well as railroad service, the one the Pennsylvania Railroad, and the other New York Central Lines. There are underground passageways in either case leading from the railroad terminals directly into the hotels, and special elevators for this service to carry the guests to the floor of the main lobby or vestibule. If one arrives by subway from up or downtown New York, he finds the same conveniences awaiting him, and is whisked from the subterranean passageway to the splendor of the main lobby by elevator, which is operated by young women nattily attired in spic and span uniforms. There is even a woman "elevator starter"—and speaking of elevators, the Hotel Pennsylvania boasts of a total of 27. In the following description of the hotel features, as the writer found them, the Hotel Pennsylvania is inferred, except where otherwise mentioned.

On arriving on the floor of the main lobby, which is certainly a magnificent piece of architecture, one finds that the principal and most important conveniences of the hotel are at once available. Among other appointments immediately accessible and available from the lobby are the main Dining Room, the Palm Room, used for afternoon teas, etc., the men's café, the men's bar, the grill room, and in the basement the most attractive barber shop imaginable, resplendent in handsome tile and marble with leather lounges, and adjacent to these the handsomest array of lady manicurists ever seen this side of Paris. While dining in the grill room, you may, if you wish, have a one-step or *two* with your guest on the highly polished dancing floor in the center of the room, while the Original Dixy Jazz Band turns loose the jazziest jazz you ever shook a foot to. Considering for the moment that some rainy afternoon you might happen to pop in at the "Pennsylvania" from the water-proof subway, and that you might find at arriving in the royally appointed lobby that your capital was limited to the large sum of 15c, due perhaps to the efficient activities of an unknown pickpocket on your ride up to the hotel, you can still enjoy yourself ostentatiously by repairing to the basement floor, where there is a "Quick Lunch Restaurant," which will accommodate several hundred guests, who may for one reason or another wish to enjoy a 15c or 25c meal. That is what you call real service, and both of these hotels are out for service with a capital "S," first, last and always. Later, when you are assigned to the guests' floors and see the layout of the rooms, you will find that these hotels undoubtedly count on a heavy, transient traffic, the suites in most cases consisting of from one to three rooms and a bath.

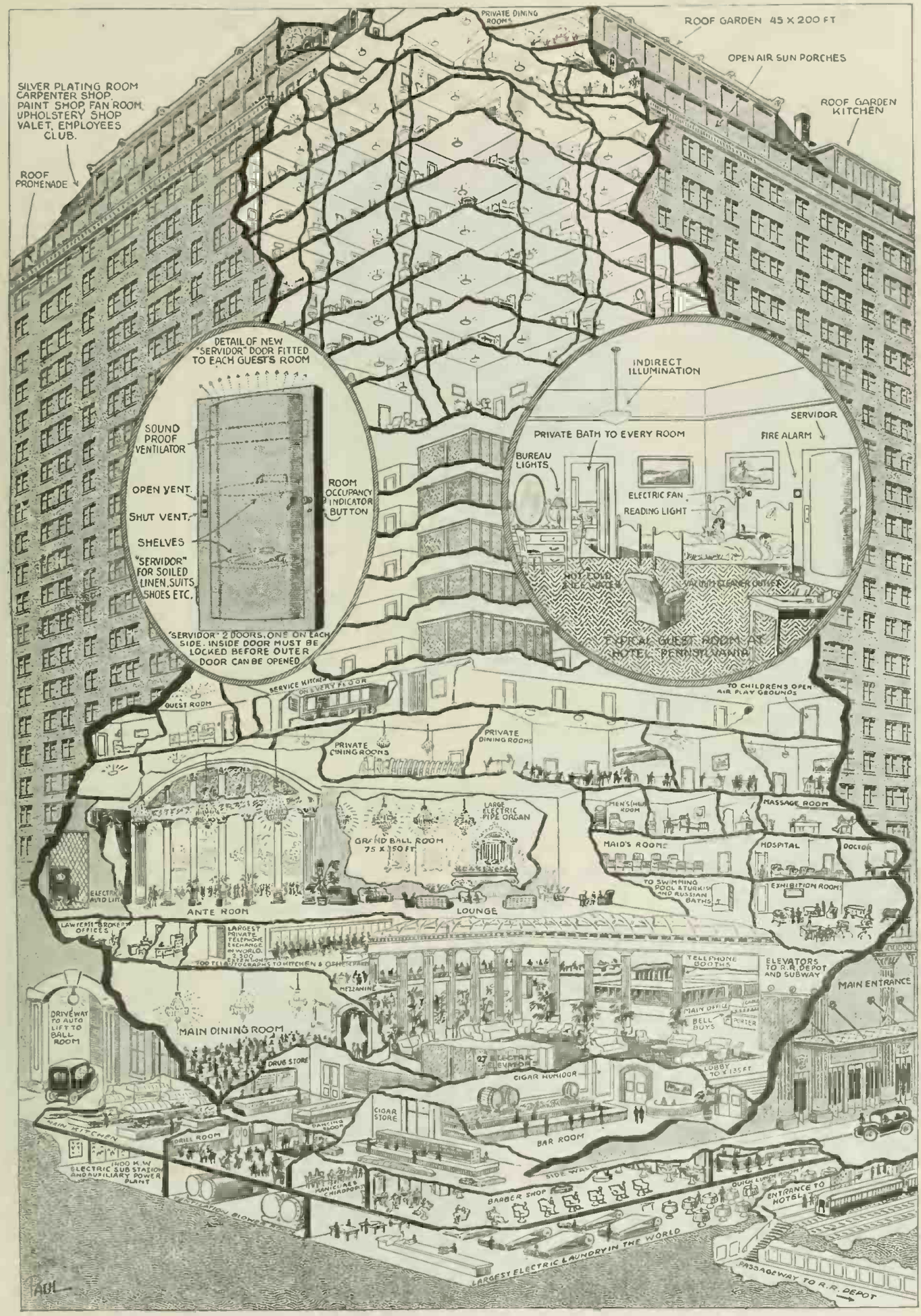
The lower part of the hotel is well shown in the accompanying illustration, and of course there are many rooms and conveniences not shown for obvious reasons, owing to their location on other parts of the mezzanine floors, et cetera, which cannot be brought out in the limited size of our illustration. The mezzanine floors, just above the main or street floors, contain the private offices, and also there are sleeping and living quarters on these floors for the employees. On the first mezzanine floor there are exhibition rooms for business purposes, and on the second and third mezzanines dining rooms for the employees. On the third mezzanine we find the "Grand Ball Room," which is most beautifully decorated in pleasing colors which do not jar or irritate the eye as do some of these large public rooms in similar establishments. The general decorative scheme thruout the hotel, it may be said, is one of good taste and extremely homelike. The service is carefully worked out to give this feeling at every turn.

The largest private telephone exchange extant, with capacity for 3,340 extensions, 260 trunk lines and 23 operators is connected to the various rooms and other parts of the hotel, and this is located on the second mezzanine floor.

In the telephone exchange are also located a large battery of "Telautographs"—the electric machines that write—and both of these recently opened hotels have been very lavish in their telautograph equipment. The Hotel Pennsylvania has at present some 200 telautographs, and more will undoubtedly be added later as demands require them. The telautograph equipment at this hostelry has been very carefully worked out by skilled engineers, and it undoubtedly is one of the best that the writer has ever seen put into operation. More will be said with reference to the telautograph system anon, and for the present it will be of interest to the reader to note what happens when a guest is to be paged. In most hotels, at least in the smaller hotels, a guest is not paged except in the main lobby and dining room, but at the "Pennsylvania", when an outside party or a guest calls up the telephone exchange, and the operator writes down the name of the person who is wanted, the following operations ensue: the telephone operator,—(and they are all good looking, take it from your Uncle Dudley, for he had the good luck to actually visit this "holy of holies", past the door of which no man may enter, excepting that he has a pass signed by the powers that be in the telephone world),—proceeds to write the name on the *transmitting* platen of her telautograph, there being a telautograph for each of the 23 telephone operators, and simultaneously the written name appears in the main dining room, grill, bar, roof garden and the office, as well as at the bell captain's office in the main lobby, so that when the name is called out by one of the bellhops in your vicinity, you can rest assured that the same name is being called simultaneously in about ten other parts of the building. This of course, serves two purposes; it promotes speed in locating the guest, which is sometimes a very important factor, and also owing to the multiplicity of the system, it renders trebly certain the locating of the desired party, which would not be the case under ordinary conditions.

The total amount of electric power, not to mention the steam used for heating, is truly enormous in a building of this size, which covers a whole city block, and while talking to the chief engineer of the building, it was ascertained that the total light and power load for the hotel would require as much as 1400 K.W. or about 1900 horsepower. Electricity is used in a general way for many purposes and important operations conducive to the efficient operation of the hotel, which the average guest never sees or even dreams of. For instance, how do you suppose the ventilation of such a large hotel as this is taken care of? The chief engineer answers this question by taking you down to the sub-basement two stories underground, where you see one of the largest electric motor-driven blower rooms in the world, covering a quarter of a square city block. Here dozen of powerful electric motors rated at anywhere from 25 to 50 horse-power each, drive gigantic blowers or fans, each of which is connected up with certain air ducts leading to various parts of the building. Thru these ducts, air is pumped which promotes the proper circulation thru the hallways, and the rooms of the building. Neither of these monster hotels has a large power plant of its

(*Continued on page* 915)



FULL STORY OF THIS LATEST NEW YORK HOTEL—A VERITABLE CITY IN ITSELF—ON OPPOSITE PAGE.

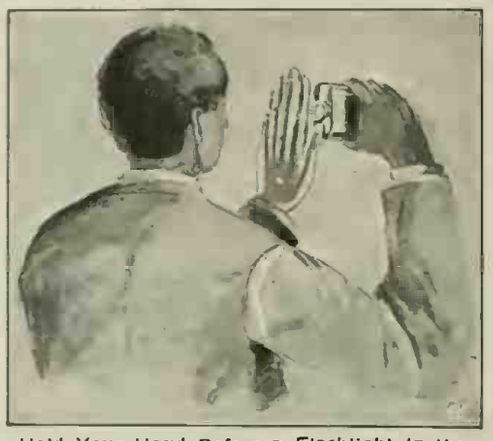
Seeing Thru You Without X-Rays

The New Shadow Photography

By BATTELL LOOMIS

WHAT of the infra-red ray in photography? Is its penetrative power the equivalent of the ultra-violet, or actuating principle of the X-ray? Has Dr. Paull S. Hunter, former State Secretary of Health for Colorado, and hailing from the city of Denver, stumbled on something he didn't know and doesn't know yet, in looking for something he had guest? That is a question it may take time and development to answer, but which the writer is content only to raise by way of introduction to a story which has its element of humor because tho it relates a serious discovery, worth thousands of dollars to society at large, the discovery will not realize its discoverer one penny. In which it is not unlike many other important scientific discoveries.

One night Dr. Hunter was waiting for a car. He held a flashlight in his hand, and covering the ray, was attracted by the marked red glow of his flesh. He noted the dim shadows of the bones in his fingers. "Hm," said he, "the red rays come thru. If the rays were more vivid, the shadow of the bones would be sharper. I can intensify them and I'll bet I can photograph that."



Hold Your Hand Before a Flashlight In the Dark—You Can See the Bone Outlines Dimly. This Is the Basis of the New X-Ray-ess Bone Photography Here Described.

The idea took hold. The doctor was a user of the X-ray, but he found it easier in ordinary practise to bring a patient to the ray than to take the weighty apparatus with its cells and coils to the patient. What a boon to the country doctor it would be if he could make a fracture diagnosis with an ordinary camera! The X-ray is of value only to the rich and the very poor who receive free treatment. The middle class must pay more than it can afford or go without.

So Dr. Hunter seized the first opportunity to lay his hand on a naked *panchromatic* photo plate and expose it to the electric light for a moment. He secured a picture of his bones with his first try. It was not very sharp, but it was a good beginning. He reasoned it out: "It wants only a concentrated *light from a point* to cast a clearer shadow. This ray must go thru a camera which protects the plate from random rays and I have a good bone picture," he argued.

Accordingly he employed his mechanical knack to construct a black box with an opening at one end large enough to receive his hand or foot. See illustration of the apparatus used by Dr. Hunter, herewith. He made it collapsible so it would fit in a physician's grip. He fitted an iris diafram in the top of his box and fastened a plate-holder on the bottom with a developing box beneath that, into which the plate might fall the instant of its exposure, for speedy developing. He then secured a Wratten F or extreme red ray filter and placed it above his lenseless shutter and diafram. He placed his hand over the plate, tied a black cloth at the open end about his elbow, turned on the electric light, removed the slide from the plate-holder, and squeezed his bulb for a half second exposure. The result was the excellent bone picture shown herewith.

This picture was *taken entirely with a filtered light*—the light that passes most easily of all visible light, thru blood. The discoverer has made nothing new except his camera, which is not essential to success He has merely combined a stock Eastman panchromatic photo plate brushed with eosin solution to intensify its sensitiveness, with an F ray filter and a fine point of light to do simply what Röntgen earned his fame for doing in a more roundabout and costly way. He has made a discovery which he prophesies every schoolboy will at once begin to play with, and every doctor to use in his business.

And he has given his discovery freely to the world. He does not intend to secure patents either on his combination of materials or on his novel folding camera, which may be made in any size and open at both ends to fit different portions of the limbs. Whether the rays will penetrate the trunk for abdominal and intercostal examinations he does not know from practise, altho from theory he contends they might be made to do so by improved technique, such as a more intense ray of light and a more sensitive plate.

Further Dr. Hunter has to say:

"My claim is apt with a box fitted out in this manner and a box of panchromatic plates a physician can tell whether a broken arm is set right before leaving the house, and that it will undoubtedly be used all over the country for that purpose.

"The machine can be improved by using a roll of film if the manufacturers would make it, and so do away with glass plates; the developing tank at the bottom would be adapted to films. The whole outfit is, moreover, made to fold up flat and occupy very little space.

"These pictures could also be made with a camera using a powerful arc lamp to throw the rays thru the human body, and if plates could be made sensitive enough, pictures of the heart's action could be made on celluloid rolls, giving moving pictures of the heart action and other organs of the body. So far I have only used it for extremity work and it has proved very satisfactory; in fact, the first pictures are as good if not better than the first ones made by the X-ray.

"I give the idea to the world with the hope that someone will further develop its usefulness and by improved design and more sensitive plates be able to make pictures as well with this $2.00 outfit as with a $1.000 X-ray machine."

IF you are old enough, you will probably remember the time when the X-ray was first announced. We all thought it one of the most marvelous inventions ever conceived by the human mind, and so it was indeed. But now Dr. Paull S. Hunter announces a strikingly simple way to perform the same experiment which Dr. Röntgen performed in a very difficult, roundabout way. Where Prof. Röntgen used a complicated electrical apparatus in order to take shadowgraphs of the human body, Dr. Hunter uses nothing but plain light rays. There is no doubt in our minds that if sufficiently powerful light rays are used in connection with a heat filter in order that the patient does not sustain burns, it should become possible in the near future for physicians to actually see every bone in the human body. Not only this, but we predict that by using certain color rays, it should be possible to bring out every organ in the human body as well, such as heart, liver, blood vessels, etc., which are now very difficult of observation by the X-ray.

Our front cover shows what is already possible today if you will drape the human body in such a way as to cut off all the direct glare, and then by exposing strong electric arc-lights from behind, it becomes possible to see the bones of the body clearly. Dr. Hunter, who is an American physician, deserves great credit for bringing about this extraordinary result, as simple as it is efficient. The accompanying article explains the system and methods fully.

EDITOR.

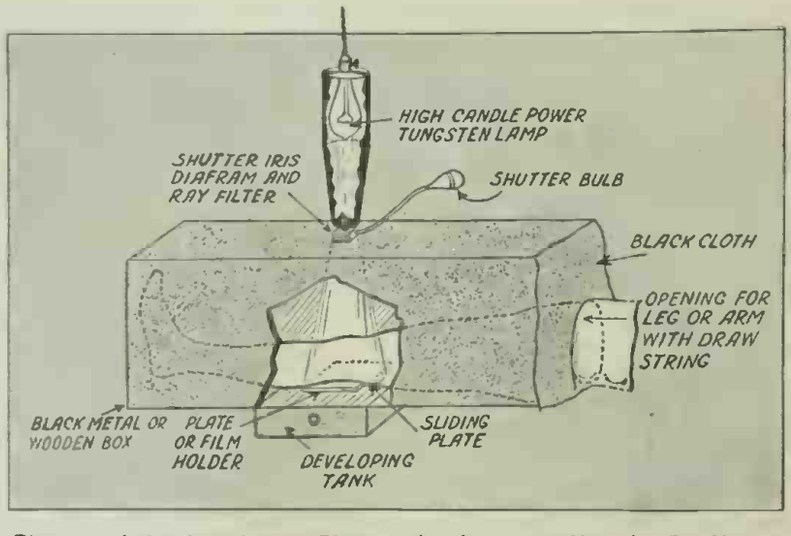


Diagram of the Actual Bone-Photography Apparatus Used by Dr. Hunter in Successfully Photographing the Bones of the Limbs.

The front cover picture, showing the bone structure of a woman, gives us a clear idea of how the full figure would appear, using of course, a sufficiently strong light source, such as an arc lamp. A frisket or template would be cut out to just fit the outer contour of the body, thus giving the maximum X-raying power available in any case. The fleshy portions of the body would appear red just as our artist has shown them, in contradistinction to the usual X-ray image observed in a fluoroscope, where the outline of the flesh is just discernible. It would seem that this new direct light system of bone photography would be much less harmful to the patient, as the X-rays exert a detrimental effect when applied in reasonably large dosages, and in some cases cause growths and burns which are incurable.

Actual Bone Picture of the Hand Taken by the Inventor of the New System of X-Ray-less Bone Photography—Dr. Paull S. Hunter, with a Strong Electric Light, a Red Ray Filter and a Photographic Plate.

WAR ACHIEVEMENTS OF U. S. SIGNAL CORPS.

When the American forces came to France "communication" was one of the first efforts to which American ingenuity and invention was directed and the Signal Corps, under which communications fall, met it as have the organizations of the American Expeditionary Force. Existing French telegraph and telephone systems were overburdened. There was little left for Uncle Sam and Brig. Gen. E. Russell, chief signal officer, and his staff of experts tackled the job.

What they have done in construction is shown in the following statistics: The Signal Corps has built approximately 1,750 miles of poles on which it has strung 4,175 miles of wire. In addition about 2,000 miles of American wire has been strung on existing systems for our use, and it has leased and operates more than 3,000 miles of French wire. Exchange lines to the extent of 12,750 miles have been built, and to operate these lines it has 244 stations, and 102 telegraph offices.

The long-distance telegraph and telephone system constructed by the Signal Corps is entirely maintained by its own personnel, and in addition some 3,000 miles of leased wires are maintained by it.

All this construction has been made by Signal Corps battalions with implements and material from the United States, with the single exception of poles, most of which were obtained in France.

THE JOHN FRITZ MEDAL FOR GENERAL GOETHALS.

The John Fritz Medal Board of Award, composed of representatives of the National Societies of Civil, Mining, Mechanical and Electrical Engineers, held their annual meeting for 1919 at the Engineers' Club, January 17, and awarded their gold medal to George W. Goethals, the builder of the Panama Canal.

The medal has previously been awarded to Lord Kelvin, George Westinghouse, Alexander Graham Bell, Thomas A. Edison, Charles T. Porter, Alfred Noble, Sir William Henry White, Robert W. Hunt, John Edson Sweet, James Douglas, Elihu Thomson, Henry M. Howe and J. Waldo Smith.

Col. John J. Carty, now in France, has been Chairman of the Board, but in his absence Ambrose Swasey, of Cleveland, presided.

George H. Pegram has been elected Chairman for 1919 and W. F. M. Goss, Treasurer, in place of Prof. F. R. Hutton, who died during the year.

NEW MARCONI INVENTION EXPLAINED.

A joint meeting of the Institute of Radio Engineers and the New York Electrical Society was held on Wednesday evening, March 5, at the Engineering Societies Building, at which Roy A. Weagant, chief engineer of the Marconi Wireless Telegraph Company of America, read a paper on "Reception thru Strays and Interference."

The recent announcement of Mr. Weagant's discoveries and inventions in connection with wireless telegraphy created wide sensation.

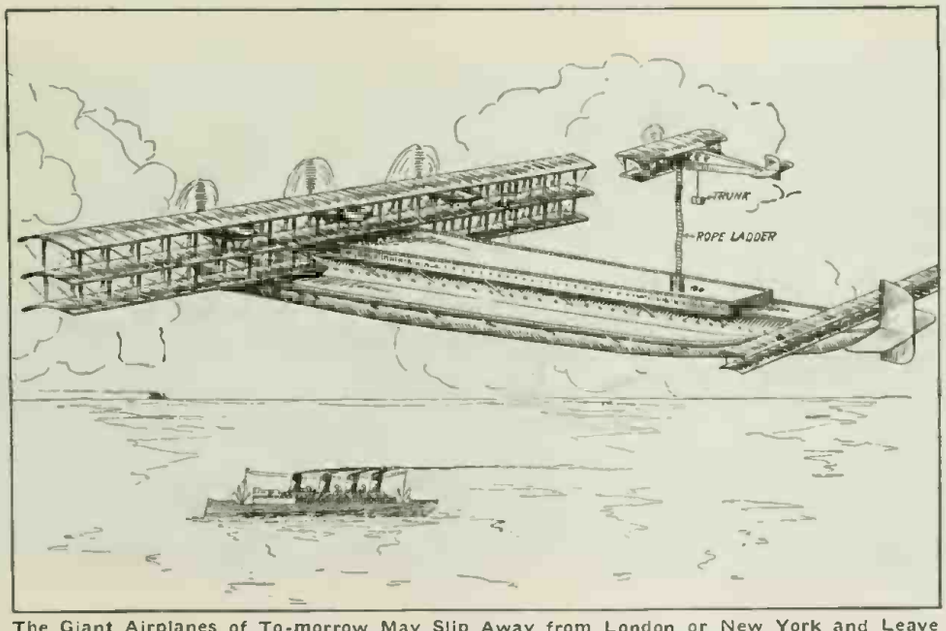
THE AERIAL PASSENGER LEFT BEHIND.

WE all know of the taxicab clattering down the street at breakneck speed with the belated passenger making a bee-line for the dock and just arriving in time to see the gang plank pulled in and missing the Liverpool steamer. But the American business man, nothing daunted, by such a trivial occurrence promptly charters a fast harbor boat and races the steamer down the bay, overtakes it and is hoisted up to the deck in time for lunch.

A few years from now humanity probably will not have changed much, and we will still have with us the late passenger, only this time he will not race down to the dock but up a 30-or 40-story elevator trying to catch the Trans-Atlantic Flier, but just in time to see the big bird "take the air."

Will the American business man of 1925 bewail his lot and return dejectedly to his home? Not if he can help it! He will signal a passing *taxiplane* which will come down on the huge platform which a few minutes ago harbored the great Trans-Atlantic flier. Twenty minutes later, the fast little *airliner* will have overtaken the big air monster and after depositing the belated passenger on the upper deck of the European bound flier,—not to forget the violent language of our businessman who thinks he has been overcharged by the modern bandit of the air,—he will go to his deck chair and begin perusing the latest edition of the ELECTRICAL EXPERIMENTER.

While the taxiplane might land directly on the big European-bound flyer, such a method might be more or less fraught with danger. Mr. H. Gernsback suggests that the transfer of the passenger might be accomplished much easier, as shown in our illustration. The taxiplane would fly about twenty feet above the deck of the big flyer, in the same direction of course, *and also at the same speed* as that of the large machine. The passenger could then descend from a rope ladder and drop to the deck with ease, as well as without danger.



The Giant Airplanes of To-morrow May Slip Away from London or New York and Leave You Behind. Then What Would You do? Easy—Board a "Taxiplane" and Chase the "Skyhound" Down the Bay.

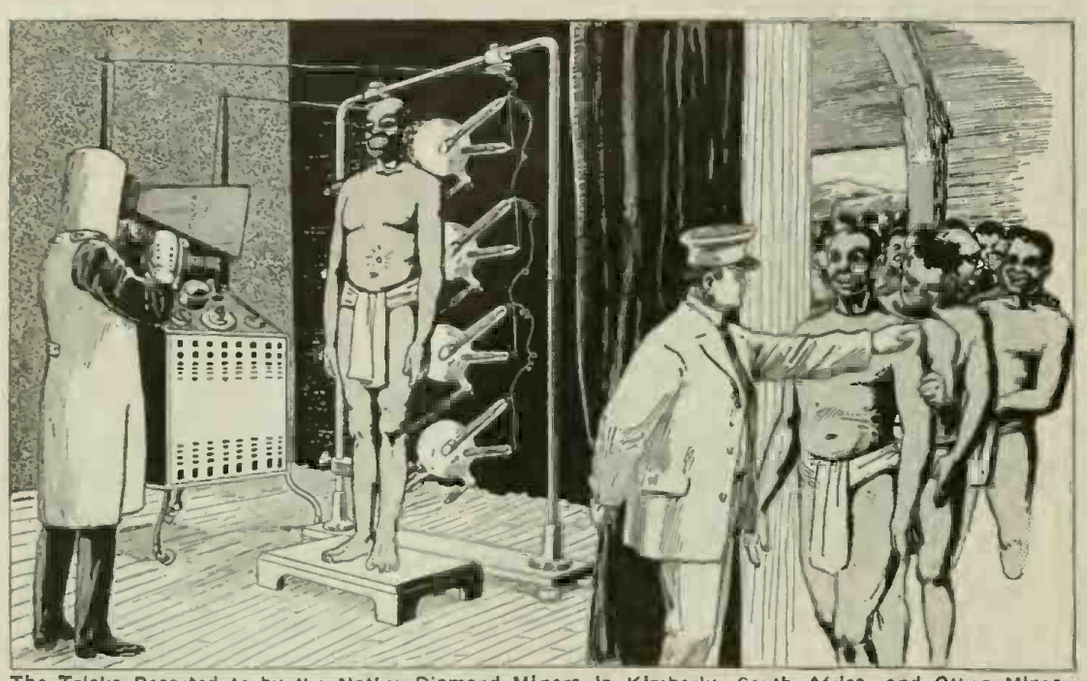
YOU CAN WHITTLE THIS IRON.

It is well known that rapid cooling of hot metals hardens them. That the opposite is true has recently been demonstrated in striking fashion by the General Electric Co. One of their scientists annealed American ingot iron surrounded by hydrogen gas for three hours at a temperature above 1,600° F. The product was very little harder than the softest copper, and could be whittled with a jack knife.

One of the largest electric plants in the world is being planned to supply power for nearly all the mines at Johannesburg, South Africa.

Locating Stolen Diamonds by X-Rays

Possibly you will remember having read from time to time of the remarkable tricks resorted to by the native diamond miners in the great Kimberly diamond region in South Africa and other parts of the world. So great has the temptation often become to steal diamonds, especially when an extra large one may have been suddenly unearthed, that these natives have been known to resort to the most unbelievable tactics in order to carry the diamonds out of the mine and to withstand inspection even when stript, as practically all of them are, before they leave the mine at the end of the day's labor.



The Tricks Resorted to by the Native Diamond Miners in Kimberly, South Africa, and Other Mines, Pass All Human Belief and Imagination at Times. Cases Have Been Known Where the Lucky Finder of a Particularly Fine Specimen Even Swallowed the Stone, Intending Presumably to Regain the Diamond Later. In Some Instances Diamonds Have Been Secreted in Self-Inflicted Wounds or Incisions in the Leg. But the X-Ray Spoiled All These Clever Ruses as Soon as It Was Adopted for Examining the Miners Every Day, Before They left the Mines. The Eye of the X-Ray Sees All.

One of the successful schemes which has been worked out by the superintendent of a large South African diamond mine is shown in the accompanying illustration, and it involves the use of a powerful X-ray machine having several X-ray bulbs excited simultaneously. As each miner passes before the X-ray bulbs, the examiner looks thru his fluoroscope and rapidly swings it up and down, so as to take in the entire body in a few seconds. This system of detecting the presence of a diamond, no matter whether it is buried in the flesh, resting in a throat cavity, or even in the stomach—an almost unbelievable practise resorted to in several instances on record—the X-ray examination quickly indicates the presence of the diamond.

Of course, the logical question that arises is—How can the X-ray detect the presence of a diamond inside of the body; especially when it may be temporarily lodged by the clever thief in proximity to large or fairly large bone structures, which would seem to preclude any possibility of detecting the precious stone? However, a perusal of a table showing the various transparencies of different materials under the X-ray will give the solution to the problem. It has been found that the diamond has a different transparency than any ordinary materials, including the bone and flesh of the body, which might happen to be in proximity to it at the time of such an X-ray examination. Also the diamond is a most peculiar substance, and it has certain fluorescent properties which render the facility of its detection all the more possible under an examination by X-ray, as it has a tendency to fluoresce or glow slightly when under the influence of X-rays, which phenomenon is readily detected on a sensitive fluorscope or X-ray screen.

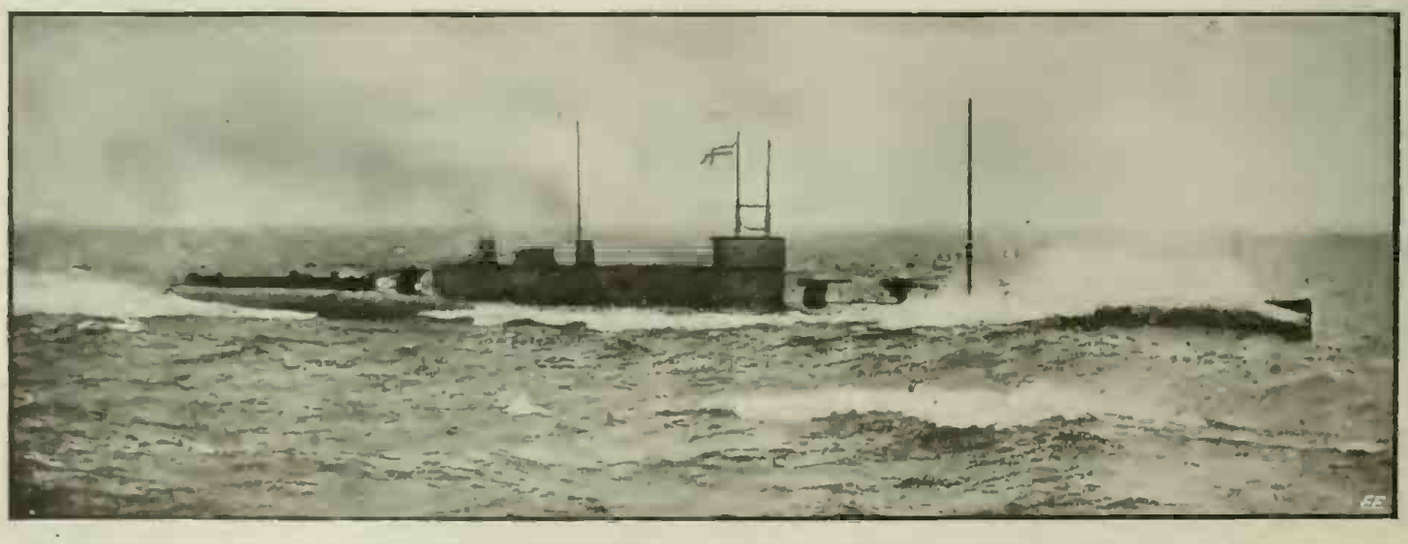
The X-ray machine here shown is connected to a battery of four powerful X-ray tubes of the latest Coolidge type, as otherwise if the tube had to be moved up and down behind the subject, considerable time would be lost in performing this operation, and where several hundred subjects have to be examined in a very short space of time, it can readily be imagined that such a device as here shown is imperative.

GIANT SUBMARINES HAVE 12-INCH GUNS AND STEAM PROPULSION.

We are now able to publish a photograph of one of the most jealously guarded secrets of the British Navy. While the Germans were boasting of the huge under-sea cruisers with which they proposed to gain the control of the seas, the British Admiralty were constructing submarines capable of matching the largest destroyers afloat and of fighting even cruisers in a surface contest.

The secret of these boats was their great size and speed and the fact that while on the surface they used steam as their propelling power, carrying two funnels like an ordinary surface warship. One photo shows a British "K" class, two funnel submarine "steaming" on the surface at sea. This is the largest class submarine produced by any nation and is 340 feet in length. It outclasses any U-boat built by Germany. Great Britain has a whole fleet of these sea terrors. Storage batteries and motors are used while running submerged.

The other photo shows a new British monitor submarine with a 12-inch gun, capable of giving battle to most any class of armed ship under favorable conditions. So far as known this is the first photograph to be received in this country showing Great Britain's combination of the U-boat and coast defense vessel. The 12-inch gun is the largest that was ever mounted on a submarine.



The Latest British Style in Submarines. It Is Capable of a Speed of 24 Knots on the Surface, When Propelled by Its Steam Power Plant. The Two Smoke Stacks Fold Down When the Submarine Submerges, and It Is Then Propelled by Storage Batteries Previously Charged While Running Awash. This Giant Craft Is 340 Feet in Length, and Is Armed with Three 4-Inch Guns, Two Forward and One Aft, as the Photo Shows. The Displacement of This Boat When Submerged Is 2,700 Tons and the Speed 10 Knots.

GERMAN RADIO FOR HOLLAND STATION.

Details of the giant wireless telegraph station to be erected in Holland by German interests for the purpose of facilitating communication between Holland and her East Indian possessions, according to a contract recently concluded between the Dutch Government and the Telefunken Company of Berlin, are found in a recent issue of Commerce Reports.

Paul L. Edwards, Commercial Attaché at The Hague, reports that the receiving station of the new plant, which is expected to cost about $2,000,000, will be at Boxmeer, in the Province of North Brabant, and the sending station will be located on a hill at Kootwijk, Province of Gelderland, near Apeldoorn, some thirty-five miles from the receiving station. The sending station will consist of six steel towers, each 200 meters (about 688 feet) in height. The *Radio-Nieuws* says that the Kootwijk sending station will have the same range as the German station at Nauen. The installation will be able easily to transmit to and receive from a station of like dimensions and capacity which is shortly to be built at Bandoeng, Java. The distance between the Kootwijk and the Bandoeng station is about 6,830 miles.

It is understood that an engineer representing the Telefunken Company is in Java with a view of supervising the construction of the station at Bandoeng. *De Nieuwe Courant* stated some time ago that all of the apparatus and raw material for the construction of the Bandoeng station were in Berlin ready for shipment at the first opportunity.

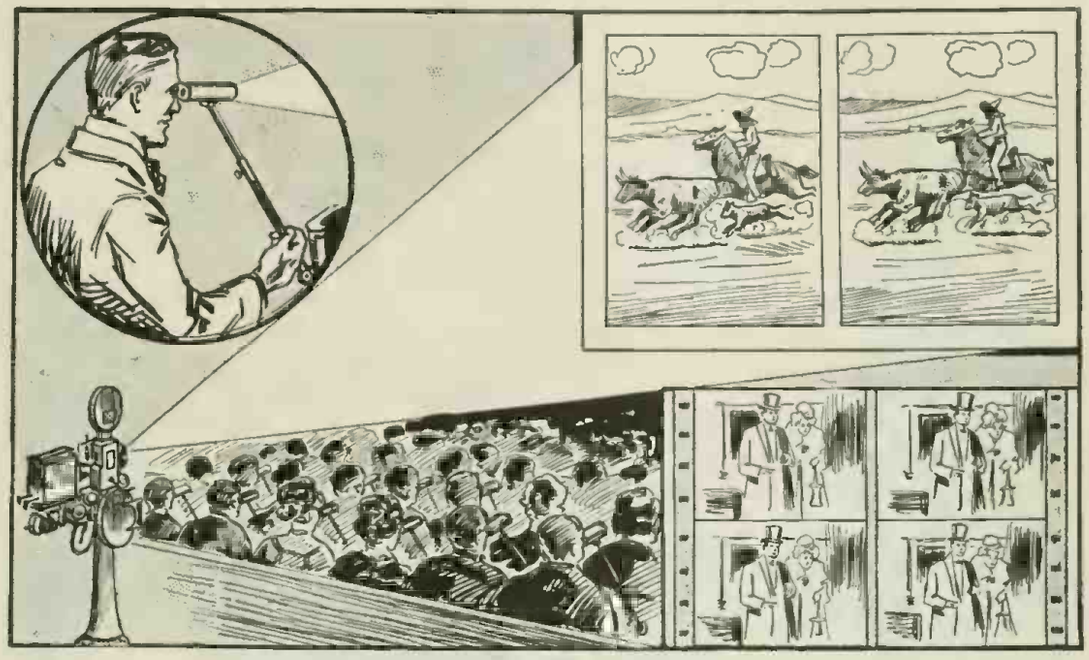
INSTRUMENT DISCOVERS COMING STORMS AT SEA.

A barocyclonometer, which locates the center of typhoons and other storms, and also indicates when they are due, and from what direction, has been invented by Father Jose Algue, director of the Manila Weather Bureau, and, according to Capt. A. W. Nelson, of the Pacific mail steamship *Ecuador*, is being used in safeguarding from storms numerous vessels plying in Chinese and Japanese waters.

Stereoscopic Movies

The accompanying illustration shows a possible later-day development of the present moving picture, which, altho it has been greatly perfected in the past few years, leaves considerable detail yet to be worked out. No matter how clear or flickerless a motion picture may be when viewed on the screen as projected by modern moving picture machines, it would still be one hundred per cent more perfect to our vision, if it could be thrown on the screen in duplicate or stereoscopic fashion in a similar manner to the parlor stereoscopes which we have all seen and used. Of course, if we ever do get to the stage of stereoscopic movies, then undoubtedly it will be necessary for the theater proprietor to provide or make readily accessible, by means of slot machines arranged on the back of the theater chairs, etc., a special small size stereoscope similar in appearance to a pair of opera glasses, thru which the duplicate moving images on the screen could be properly viewed and focust. These would of course be fitted with proper lenses for the purpose.

It might seem off-hand that this latter refinement would be unnecessary, but it is really one of the great marvels of science that causes us to see the images stand out, as it were, from the picture, when we look thru a stereoscope at the photographs or other views mounted in duplicate. The stereoscope operates on a very simple and yet peculiar physiological arrangement, based on the inter-action of the optical powers of the two eyes when they are focust on two properly made and similar images.



Of All the "Movie" Inventions That Have Past OurWay, We Have Yet to See Exploited, at Least Commercially, the "Stereoscopic Movie." If You Have Ever Used a Parlor Stereoscope Then You Will Appreciate What a Wonderful Improvement This Idea Would Make in the "Movie" Show, for Then the Figures Would Actually Stand Out in Relief. A Special "Stereoscope" Would Be Placed on Every Seat. Try This Experiment—Hold a Small White Card Vertically Between the Two Similar Views Here Shown, Move the Page Up and Down Until the Images Appear in Relief.

The names of the manufacturers of new devices and appliances in which readers are interested will be furnished free of charge by addressing our TECHNICAL INFORMATION BUREAU.

Here's the New British "Monitor-Submarine." It Sports a Dangerous Looking 12-Inch, 50-Ton Gun, Which Can be Traversed 6 Degrees. It Was Built for Bombarding the Forts at the Dardanelles Straits. This is the Famous "M-1," a 1,700-Ton Subsea Craft That Would Make Any Light Cruiser or Similar Warship, Not to Mention a Dozen or So Armed Merchantmen, Scratch as They Never Scratched Before. She Carries, Besides the 12-Inch Gun, Two Torpedo Tubes and an Anti-aircraft Gun, and Several Other Surprises Which Heinie Never Even Dreamed About.

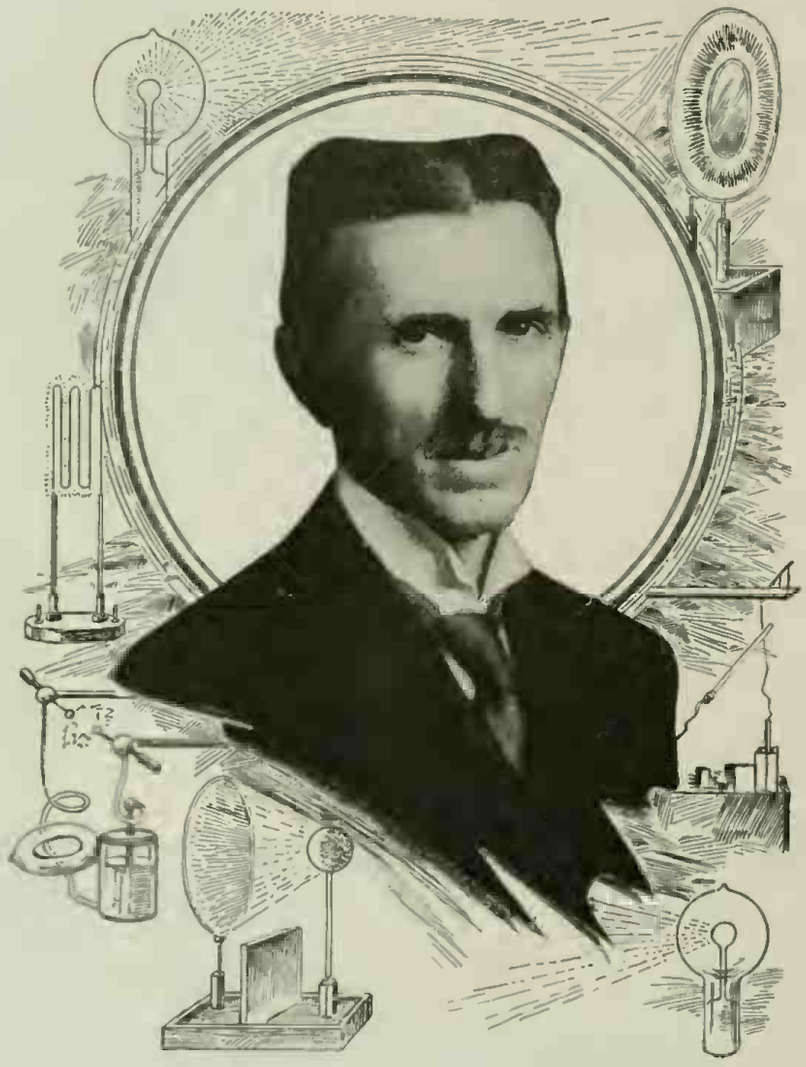
My Inventions

By Nikola Tesla

III. MY LATER ENDEAVORS

The Discovery of the Rotating Magnetic Field

AT the age of ten I entered the Real Gymnasium which was a new and fairly well equipt institution. In the department of physics were various models of classical scientific apparatus, electrical and mechanical. The demonstrations and experiments performed from time to time by the instructors fascinated me and were undoubtedly a powerful incentive to invention. I was also passionately fond of mathematical studies and often won the professor's praise for rapid calculation. This was due to my acquired facility of visualizing the figures and performing the operations, not in the usual intuitive manner, but as in actual life. Up to a certain degree of complexity it was absolutely the same to me whether I wrote the symbols on the board or conjured them before my mental vision. But free-hand drawing, to which many hours of the course were devoted, was an annoyance I could not endure. This was rather remarkable as most of the members of the family excelled in it. Perhaps my aversion was simply due to the predilection I found in undisturbed thought. Had it not been for a few exceptionally stupid boys, who could not do anything at all, my record would have been the worst. It was a serious handicap as under the then existing educational regime, drawing being obligatory, this deficiency threatened to spoil my whole career and my father had considerable trouble in railroading me from one class to another.



Nikola Tesla at 60. A Very Recent Portrait of the Great Inventor. An Excellent Likeness.

In the second year at that institution I became obsest with the idea of producing continuous motion thru steady air pressure. The pump incident, of which I have told, had set afire my youthful imagination and imprest me with the boundless possibilities of a vacuum. I grew frantic in my desire to harness this inexhaustible energy but for a long time I was groping in the dark. Finally, however, my endeavors crystallized in an invention which was to enable me to achieve what no other mortal ever attempted. Imagine a cylinder freely rotatable on two bearings and partly surrounded by a rectangular trough which fits it perfectly. The open side of the trough is closed by a partition so that the cylindrical segment within the enclosure divides the latter into two compartments entirely separated from each other by air-tight sliding joints. One of these compartments being sealed and once for all exhausted, the other remaining open, a perpetual rotation of the cylinder would result, at least, I thought so. A wooden model was constructed and fitted with infinite care and when I applied the pump on one side and actually observed that there was a tendency to turning, I was delirious with joy. Mechanical flight was the one thing I wanted to accomplish altho still under the disconraging recollection of a bad fall I sustained by jumping with an umbrella from the top of a building. Every day I used to transport myself thru the air to distant regions but could not understand just how I managed to do it. Now I had something concrete—a flying machine with nothing more than a rotating shaft, flapping wings, and—a vacuum of unlimited power! From that time on I made my daily aërial excursions in a vehicle of comfort and luxury as might have befitted King Solomon. It took years before I understood that the atmospheric pressure acted at right angles to the surface of the cylinder and that the slight rotary effort I observed was due to a leak. Tho this knowledge came gradually it gave me a painful shock.

I had hardly completed my course at the Real Gymnasium when I was prostrated with a dangerous illness or rather, a score of them, and my condition became so desperate that I was given up by physicians. During this period I was permitted to read constantly, obtaining books from the Public Library which had been neglected and entrusted to me for classification of the works and preparation of the catalogues. One day I was handed a few volumes of new literature unlike anything I had ever read before and so captivating as to make me utterly forget my hopeless state. They were the earlier works of Mark Twain and to them might have been due the miraculous recovery which followed. Twenty-five years later, when I met Mr. Clements and we formed a friendship between us, I told

Mr. Tesla's articles started in our February issue

him of the experience and was amazed to see that great man of laughter burst into tears.

My studies were continued at the higher Real Gymnasium in Carlstadt, Croatia, where one of my aunts resided. She was a distinguished lady, the wife of a Colonel who was an old war-horse having participated in many battles. I never can forget the three years I past at their home. No fortress in time of war was under a more rigid discipline. I was fed like a canary bird. All the meals were of the highest quality and deliciously prepared but short in quantity by a thousand percent. The slices of ham cut by my aunt were like tissue paper. When the Colonel would put something substantial on my plate she would snatch it away and say excitedly to him: "Be careful, Niko is very delicate." I had a voracious appetite and suffered like Tantalus. But I lived in an atmosphere of refinement and artistic taste quite unusual for those times and conditions. The land was low and marshy and malaria fever never left me while there despite of the enormous amounts of quinin I consumed. Occasionally the river would rise and drive an army of rats into the buildings, devouring everything even to the bundles of the fierce paprika. These pests were to me a welcome diversion. I thinned their ranks by all sorts of means, which won me the unenviable distinction of rat-catcher in the community. At last, however, my course was completed, the misery ended, and I obtained the certificate of maturity which brought me to the cross-roads.

THIS installment, no doubt the most interesting of the three published so far, reveals many extraordinary occurrences and experiences in the world's greatest inventor's life—experiences such as do not fall to the lot of ordinary mortals. And Tesla, the many sided, aside of inventing, knows the rare art of painting word-pictures. He does so here in a masterly fashion. He tells us how he finally conceived the induction motor—perhaps his greatest discovery—the invention which changed the face of the globe, the invention which made possible the street car, the subway, the electric train, power transmission, the harnessing of water falls and countless others. But let Tesla tell you himself how it all came about. It is a classic worth reading.

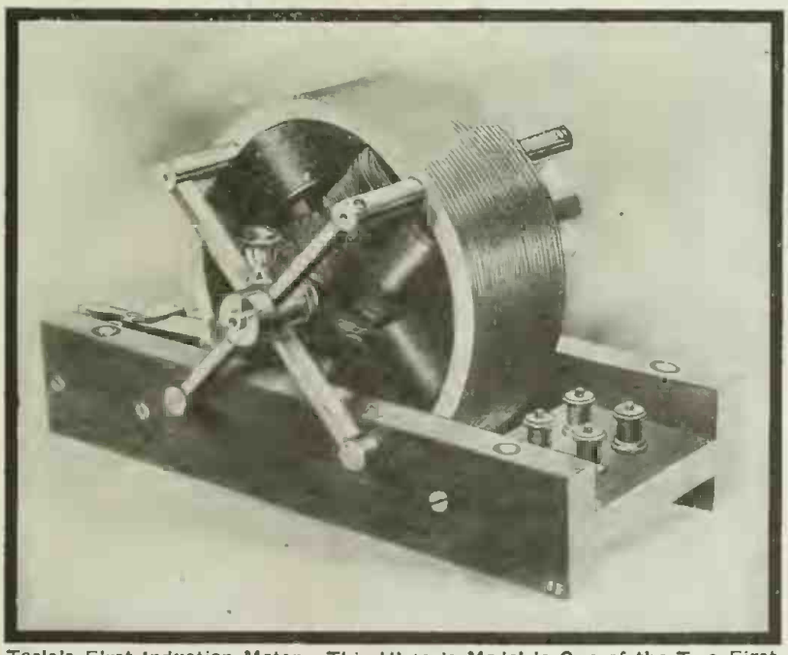
EDITOR.

During all those years my parents never wavered in their resolve to make me embrace the clergy, the mere thought of which filled me with dread. I had become intensely interested in electricity under the stimulating influence of my Professor of Physics, who was an ingenious man and often demonstrated the principles by apparatus of his own invention. Among these I recall a device in the shape of a freely rotatable bulb, with tinfoil coatings, which was made to spin rapidly when connected to a static machine. It is impossible for me to convey an adequate idea of the intensity of feeling I experienced in witnessing his exhibitions of these mysterious phenomena. Every impression produced a thousand echoes in my mind. I wanted to know more of this wonderful force; I longed for experiment and investigation and resigned myself to the inevitable with aching heart.

Just as I was making ready for the long journey home I received word that my father wished me to go on a shooting expedition. It was a strange request as he had been always strenuously opposed to this kind of sport. But a few days later I learned that the cholera was raging in that district and, taking advantage of an opportunity, I returned to Gospic in disregard of my parents' wishes. It is incredible how absolutely ignorant people were as to the causes of this scourge which visited the country in intervals of from fifteen to twenty years. They thought that the deadly agents were transmitted thru the air and filled it with pungent odors and smoke. In the meantime they drank the infected water and died in heaps. I contracted the awful disease on the very day of my arrival and altho surviving the crisis, I was confined to bed for nine months with scarcely any ability to move. My energy was completely exhausted and for the second time I found myself at death's door. In one of the sinking spells which was thought to be the last, my father rushed into the room. I still see his pallid face as he tried to cheer me in tones belying his assurance. "Perhaps," I said, "I may get well if you will let me study engineering." "You will go to the best technical institution in the world." he solemnly replied, and I knew that he meant it. A heavy weight was lifted from my mind but the relief would have come too late had it not been for a marvelous cure brought about thru a bitter decoction of a peculiar bean. I came to life like another Lazarus to the utter amazement of everybody. My father insisted that I spend a year in healthful physical outdoor exercises to which I reluctantly consented. For most of this term I roamed in the mountains, loaded with a hunter's outfit and a bundle of books, and this contact with nature made me stronger in body as well as in mind. I thought and planned, and conceived many ideas almost as a rule delusive. The vision was clear enough but the knowledge of principles was very limited. In one of my inventions I proposed to convey letters and packages across the seas, thru a submarine tube, in spherical containers of sufficient strength to resist the hydraulic pressure. The pumping plant, intended to force the water thru the tube, was accurately figured and designed and all other particulars carefully worked out. Only one trifling detail, of no consequence, was lightly dismist. I assumed an arbitrary velocity of the water and, what is more, took pleasure in making it high, thus arriving at a stupendous performance supported by faultless calculations. Subsequent reflections, however, on the resistance of pipes to fluid flow determined me to make this invention public property.

Another one of my projects was to construct a ring around the equator which would, of course, float freely and could be arrested in its spinning motion by reactionary forces, thus enabling

(*Continued on page 905*)



Tesla's First Induction Motor. This Historic Model Is One of the Two First Presented Before the American Institute of Electrical Engineers.

WHAT IS THE INDUCTION MOTOR?

The induction motor operates on alternating current. It has no commutator like a direct current motor, nor slip rings like an alternating current motor. Contrary to the two types just cited the "field" current is not steady, but the current itself rotates constantly pulling around with it—by induction—the only moving part of the motor—the rotor—or armature. Having no armature nor slip rings, the induction motor never sparks. It consequently knows no "brush" trouble. It needs no attention because of its ruggedness. Only the bearings wear out. Its efficiency too is higher. On account of all this the induction motor is used in a prepondering proportion in street cars, electric trains, factories, etc.

The Moon's Rotation

By NIKOLA TESLA

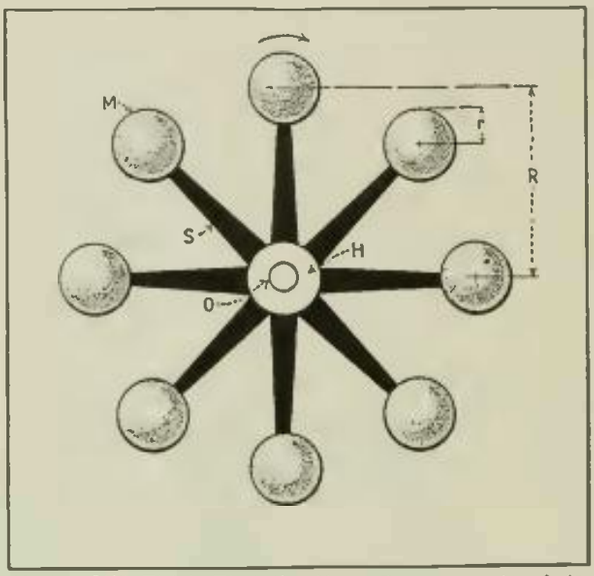
SINCE the appearance of my article entitled the "Famous Scientific Illusions" in your February issue, I have received a number of letters criticizing the views I exprest regarding the moon's "axial rotation." These have been partly answered by my statement to the *New York Tribune* of February 23, which allow me to quote:

In your issue of February 2, Mr. Charles E. Manierre, commenting upon my article in the *Electrical Experimenter* for February which appeared in the *Tribune* of January 26, suggests that I give a definition of axial rotation.

I intended to be explicit on this point as may be judged from the following quotation: "The unfailing test of the spinning of a mass is, however, the existence of *energy of motion*. The moon is not posest of such *vis viva*." By this I meant that "axial rotation" is not simply "rotation upon an axis nonchalantly defined in dictionaries, but is a circular motion in the true physical sense—that is, one in which half the product of the mass with the square of velocity is a definite and positive quantity. The moon is a nearly spherical body, of a radius of about 1,087.5 miles, from which I calculate its volume to be approximately 5,300,216,300 cubic miles. Since its mean density is 3.27, one cubic foot of material composing it weighs close on 205 lbs. Accordingly, the total weight of the satellite is about 79,969,000,000,000,000,000, and its mass 2,483,500,000,000,000,000 terrestrial short tons. Assuming that the moon does physically rotate upon its axis, it performs one revolution in 27 days, 7 hours, 43 minutes and 11 seconds, or 2,360,591 seconds. If, in conformity with mathematical principles, we imagine the entire mass concentrated at a distance from the center equal to two-fifths of the radius, then the calculated rotational velocity is 3.04 feet per second, at which the globe would contain 11,474,000,000,000,000,000 short foot tons of energy sufficient to run 1,000,000,000 horsepower for a period of 1,323 years. Now, I say, that there is not enough of that energy in the moon to run a delicate watch.

In astronomical treatises usually the argument is advanced that "if the lunar globe did not turn upon its axis it would expose all parts to terrestrial view. As only a little over one-half is visible it *must* rotate." But this inference is erroneous, for it only admits of one alternative. There are an infinite number of axis besides its own in each of which the moon might turn and still exhibit the same peculiarity.

I have stated in my article that the moon rotates about an axis passing thru the center of the earth, which is not strictly true, but it does not vitiate the conclusions I have drawn. It is well known, of course, that the two bodies revolve around a common center of gravity, which is at a distance of a little over 2,899 miles from the earth's center.



If You Still Think That the Moon Rotates on Its Axis, Look at This Diagram and Follow Closely the Successive Positions Taken by One of the Balls M While It Is Rotated by a Spoke of the Wheel. Substitute Gravity for the Spoke and the Analogy Solves the Moon Rotation Riddle.

Another mistake in books on astronomy is made in considering this motion equivalent to that of a weight whirled on a string or in a sling. In the first place there is an essential difference between these two devices tho involving the same mechanical principle. If a metal ball, attached to a string, is whirled around and the latter breaks, an axial rotation of the missile results which is definitely related in magnitude and direction to the motion preceding. By way of illustration—if the ball is whirled on the string clockwise ten times per second, then when it flies off, it will rotate on its axis ten times per second, likewise in the direction of a clock. Quite different are the conditions when the ball is thrown from a sling. In this case a *much more rapid* rotation is imparted to it in the *opposite sense*. There is no true analogy to these in the motion of the moon. *If the gravitational string, as it were, would snap, the satellite would go off in a tangent without the slightest swerving or rotation, for there is no moment about the axis and, consequently, no tendency whatever to spinning motion.*

Mr. Manierre is mistaken in his surmise as to what would happen if the earth were suddenly eliminated. Let us suppose that this would occur at the instant when the moon is in *opposition*. Then it would continue on its eliptical path around the sun, presenting to it steadily the face which was always exposed to the earth. If, on the other hand, the latter would disappear at the moment of *conjunction*, the moon would gradually swing around thru 180° and, after a number of oscillations, revolve, again with the same face to the sun. In either case there would be no periodic changes but eternal day and night, respectively, on the sides turned towards, and away from, the luminary.

Some of the arguments advanced by the correspondents are ingenious and not a few comical. None, however, are valid.

One of the writers imagines the earth in the center of a circular orbital plate, having fixedly attached to its periperal portion a disk-shaped moon, in frictional or geared engagement with another disk of the same diameter and freely rotatable on a pivot projecting from an arm entirely independent of the planetary system. The arm being held continuously parallel to itself, the pivoted disk, of course, is made to turn on its axis as the orbital plate is rotated. This is a well-known drive, and the rotation of the pivoted disk is as palpable a fact as that of the orbital plate. But, the moon in this model only revolves about the center of the system *without the slightest angular displacement* on its own axis. The same is true of a cart-wheel to which this writer refers. So long as it advances on the earth's surface it turns on the axle in the true physical sense; when one of its spokes is always kept in a perpendicular position the wheel still *revolves* about the earth's center, *but axial rotation has ceased*. Those who think that it then still exists are laboring under an illusion.

An obvious fallacy is involved in the following abstract reasoning. The orbital plate is assumed to gradually shrink, so that finally the centers of the earth and the satellite coincide when the latter revolves simultaneously about its own and the earth's axis. We may reduce the earth to a mathematical point and the distance between the two planets to the radius of the moon without affecting the system in principle, but a further diminution of the distance is mani- (Cont. on p. 892)

WE believe the accompanying illustration and its explanation will dispel all doubts as to whether the moon rotates on its axis or not. Each of the balls, as M, depicts a different position of, and rotates exactly like, the moon keeping always the same face turned towards the center O, representing the earth.

But as you study this diagram, can you conceive that any of the balls turn on their axis? Plainly this is rendered physically impossible by the spokes. But if you are still unconvinced, Mr. Tesla's experimental proof will surely satisfy you. A body rotating on its axis must contain rotational energy. Now it is a fact, as Mr. Tesla shows, that no such energy is imparted to the ball as, for instance, to a projectile discharged from a gun. It is therefore evident that the moon, in which the gravitational attraction is substituted for a spoke, cannot rotate on its axis or, in other words, contain rotational energy. If the earth's attraction would suddenly cease and cause it to fly off in a tangent, the moon would have no other energy except that of translatory movement, and it would not spin like the ball.—Editor.

Experimental Physics

By JOHN J. FURIA, A. B., M. A., (Columbia University)

LESSON TWENTY (Conclusion)

PHYSICS AND THE WORLD WAR.

As a fitting conclusion to this series of articles, let us consider to what extent Physics helped to beat the Huns. The bulk of the wonderful work done by all branches of science has as yet not been disclosed to the general public; but the following material disclosed by Professor Ames, of Johns Hopkins University, in his address at the University of Virginia, by Dr. Hale in his address before the New York Engineering Societies, by Professor Millikan, of the University of Chicago, in his address at the Philadelphia meeting of the American Institute of Electrical Engineers, and by Major-General Squier in his address at the New York meeting of the A. I. E. E., is more than sufficient to make it evident to us that Science in general and Physics in particular, deserves a lion's share of the glory accruing from the victory of the Allies.

Wireless Telegraphy — It Often Proved the Only Reliable Communication in Battle.

The American public at the beginning of the war held its scientific men in insignificant regard, and was very much surprised to learn of the high degree of mobilization of Germany's scientific men for war work. The "fool professor" was destined to come before the public eye. On our entering the war our wizard inventors with their efficient press agents won the war for us over night by their epoch-making inventions. Days went by, but our epoch-making inventions did not appear, and gradually the usual murder and divorce cases appeared in the papers again, displacing the names and ideas of our wondrous newspaper wizards. An Inventions Board received some 1,600 inventions from our inventors and found about half a dozen of them were worth considering. Magnets of tremendous size were proposed, which when placed in the bottom of the sea would attract all shells, etc., and thus stop the war. Others proposed magnets of various forms, which on trailing along beneath an airplane would drag up any submerged invisible submarine. Another proposed generating a wind so strong that it would push away any approaching airplane, balloon, etc. Thus airplaine raids were eliminated, submarine attacks were ended, and the war was over. These fool inventions were coming in so fast that the Board in self-defence determined not to consider any inventions sent in by these wonder-workers unless a "working model" accompanied the papers. It was evident that the road to a successful termination of the war lay in bringing together men possessing scientific knowledge, and equipt with scientific methods. In ordinary peace times the college professor is at a disadvantage —he is usually ignorant of, or not interested in commercial development, and does not come in contact with the technical trades. However, his researches in pure science are eventually commercialized and become of vast technical importance. In bringing together eminent scientists, presenting them with problems, showing them the conditions, having them perform their researches under the best of conditions and immediately making use of the fruit of their toil—this proved the way to victory. In Washington, London, Paris and Rome, some of the foremost of the Allied scientists were gathered. Among the Physicists we have Millikan, Ames, Mendenhall, Gale, Wood, Duff, Hubbard and others, all in uniform and commissioned as officers in the U. S. Army or Navy. Major-General G. O. Squier, the Chief Signal Officer of our army, is a Physicist of considerable reputation, having received his degree of Ph.D. in Physics at Johns Hopkins University. The rest of our Physicists served in civilian capacities.

Machine Guns — Another Weapon of Science, Worked Havoc to Both Sides Night and Day.

Giant Bombing Planes Were Threatening to Wipe Out Berlin When the Armistice Was Signed.

IN THE "MAY" EXPERIMENTER

The Editors have in preparation some exceptionally interesting articles for the May number of the ELECTRICAL EXPERIMENTER, *among which are the following:*

The Latest in Aërial Railways.

"My Inventions"—No. 4, by Dr. Nikola Tesla.

Electricity and Dynamite — How they help the farmer irrigate land, divert streams, loosen hard soil, and clear land of stumps and stones.

Recording Our Thoughts Electrically, by H. Gernsback.

New York to New Jersey Via Wagon and Auto Tunnel—A Gigantic Engineering Problem.

The Latest Electrical News from France, by Jacques Boyer, Paris Correspondent of the "E. E."

Springtime Fashions in Electric Fans—Several dozen new wrinkles with these useful devices that will interest the whole family.

X-Raying Our Teeth—How disease and mental ailments have been actually traced to ordinarily invisible infections of the teeth. Written by the Medical Director of a Prominent State Hospital.

How to Build a Professional Medical Induction Coil Outfit, by H. Winfield Secor.

Some Interesting Facts Concerning the Electron, by L. R. Jewett.

How to Build an Efficient Open-core Step-up Transformer, by William Holladay.

Choke Coils—How to compute their dimensions with data on actual coils, by Prof. F. E. Austin, Instructor of Electrical Engineering, Dartmouth College.

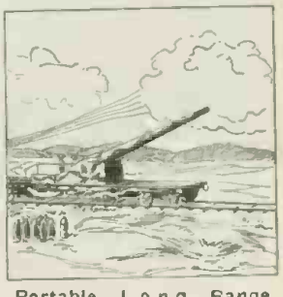
"Science in Slang" — Installment No. 3, by Emerson Easterling.

Let us now see how our war needs affected scientific research. It is a well-known property of charcoal that it has a high absorbing power for many gases. When the Huns brought forth their little surprise of "poisonous gas," the gas mask was immediately evolved. Research developed that a special treatment of charcoal, made in certain sizes from special kinds of wood had an increased absorbing power. The Physicist knew that charcoal had this absorbing power, and when the problem of increasing this power to make the combating of gas warfare more efficient was proposed, the problem was solved. Airplane engines have been manufactured for many years, but never before has the necessity arisen for high speed quantity production. The problem arose and was solved, the Liberty engine was designed, developing 400 horse-power and weighing only 800 pounds; about 2,000 per month were manufactured. The resistance offered by the wings of different sections, the stability of the airplane, the character of the covering surfaces, etc., have all been investigated in detail. The instruments of navigation and of signaling are perhaps every bit as important as the airplane itself. Instruments for indicating speed, direction, height, distance travelled, etc., have all required extended and careful research by the Physicist. In all airplane work, whether in observations or in making attacks, it is necessary for the men in the machines and the men on the ground to be in constant communication. The wireless telephone is the obvious solution. Wireless telephony has no doubt made more progress in one month of war than in one year of peace. The modifications and improvements made in wireless telephony apparatus in America's physical laboratories by her scientists (most of which have as yet not been disclosed to the public) are positively epoch-making. Our improvements have made it possible

(*Con. on page* 926)

The Submarine—A Terror of the Seas, with a Range of 4,000 Miles.

Tanks by the Thousand Frequently Turned the Tide of Battle for the Allies.



Portable Long Range Guns Routed the Enemy and Leveled His Cities as Well as Fortifications.

Popular Astronomy

The Planet Earth as Others See Us

By ISABEL M. LEWIS
OF THE U. S. NAVAL OBSERVATORY

The Earth As It Appears to an Observer Stationed At the Moon, One of the Most Wonderful and Awe-Inspiring Objects of the Heavens. On the Moon, the Earth Appears Sixteen Times Larger Than the Moon Appears to Us On the Earth. The Sun Shown At the Right Illuminates Only Part of the Earth, Which Therefore Appears in Crescent Form. It Is, However, Not In Total Darkness for Some of the Light Is Reflected By the Moon Onto the Earth and Back to the Moon, Hence the Darkened Portion Is Not Entirely Dark, But the Continents Can Be Faintly Seen. There Being No Atmosphere On the Moon, the Sky Appears Dead Black In Day Time. The Sun Will Be Seen With Its Corona and Streamers Somewhat as Shown in This Illustration.

WERE it possible for us to view the heavens from the planet Mars we might see in the hours just following sunset or preceding dawn a most beautiful star of first magnitude rivaling and at times surpassing the great star Sirius in brilliancy, closely attended by a small companion star considerably less brilliant. The smaller body is evidently a satellite of the brighter one, as its position relative to the larger body changes in such a way as to show it is revolving around it. It appears now to the east, now to the west of the chief star. At their widest separations the two form a very distinct double star, unique in the heavens of the Martians. As the little star travels from one side to the other of the bright star it usually goes above or below it tho occasionally it passes directly in front of or behind the brighter body and at such times only one star is then visible to our Martian observers.

This lustrous double star, the morning or evening star of the Martians, is our planet Earth and its satellite the moon.

Were we observing our planet from Mars it would be quite beyond our powers of imagination to conceive that this tiny point of light, glowing by the reflected light of the sun, has been for ages upon ages the abode of species and forms of life of well nigh infinite variety that have existed under widely different conditions of temperature and pressure not only on the surface of the planet but in the depths of the seas that cover three-fourths of its surface.

We can imagine conservative scientists of Mars frowning at the flights of fancy of the Martians in regard to the nature of the inhabitants of this other world in space. Yet in their wildest speculations the Martians could hardly exaggerate the wonders of our planet Earth or the strength of the conflicting forces for good and evil to be found upon it.

Let us consider for a moment how our planet Earth and its satellite would appear were we able to examine it telescopically from Mars. Most of the difficulties that beset us here on earth in our attempts to observe Venus telescopically would be experienced in attempting to view the planet Earth from Mars. A reference to Fig. 1, which shows the relative positions of the three planets, will make this clear. The earth's orbit lies between Mars' orbit and the sun, just as the orbit of Venus lies between us and the sun. As we will see later, Venus has a decided advantage over Mars for observations of the planet Earth. On Venus and on our own planet, Mars can be seen in opposition to the sun that is on the Meridian at midnight, with its disk fully illuminated like the full moon. To Mars, on the contrary, all the inner planets, Mercury, Venus and Earth, appear as half or crescent moons telescopically when they are in the best position for observation and they never appear with fully illuminated disks.

When the earth is nearest to Mars, in position E_0, see Fig. 1, it is invisible to the Martians, just as Venus is invisible to us in the corresponding position, owing to the fact that it is then *in line with the sun* and lost in the glare of its light. This position is known as the planet's inferior conjunction with the sun. Just before and after the earth is in this position it would show a very thin crescent if viewed telescopically from Mars.

In the position E_2 the earth is once more in line with the sun and Mars in what is

known as superior conjunction, and is again invisible. Just before and after it is in this position its disk is like a gibbons moon almost entirely illuminated, but it is unfavorably situated for observations from Mars because it is so near the sun and on the far side of its orbit from Mars. In position E_4 and E_3 the earth is at its greatest distance from the sun, spoken of as its greatest eastern and western elongations, as seen from Mars. It is then a half-moon in the telescope, is at its highest elevation above the horizon and is evening or morning star to the Martians, according as it is east or west of the sun. We might expect that it would now be in its most favorable position for observation, but this is not so.

Looking at Fig. 1 we see that as the earth passes from the position E_3 toward inferior conjunction with the sun at E_0, its distance from Mars *decreases* and therefore the apparent size of its disk *increases*. The *form* of the illuminated portion now changes from half moon to crescent but the *total area* of the illuminated portion increases up to a certain point. When the area of the illuminated portion of the planet has its greatest value the brightness of the planet is at a maximum. The exact time when this will occur can be worked out mathematically. The best observations of the earth seen from Mars would be obtained when the planet is in this position and the corresponding one lying between inferior conjunction and western elongation. (See positions E' and E" in Fig. 1.) We can therefore imagine the Martians observing our planet at its best in the morning or evening twilight. The brilliancy of the earth in Martian skies at this time usually surpasses that of all other planets. Mercury and Venus, tho also evening and morning stars to the Martians, appear considerably less brilliant than they do to us. The earth appears to the Martians much as Venus does to the earth, tho less brilliant, owing to the fact that Venus comes nearer to the earth than the earth does to Mars. The only planet that may rival the earth at the time of its maximum brightness is the giant planet Jupiter, which appears at times brighter to the Martians than does our own planet.

In their telescopic observations of the earth the Martians would experience the same difficulty that we experience in our observations of Venus. When the planet is in its most favorable positions for observation the greater part of its disk is darkened, owing to the fact that the phase is the same as that of the crescent moon.

The Martians, however, would not be handicapped by a dense cloud-ladened atmosphere such as surrounds Venus and makes it so difficult for us to observe. As the earth's diameter is twice that of Mars, our surface markings would appear considerably more extensive to the Martians than the markings on Mars appear to us, tho drifting clouds and snow storms on our planet would frequently hide temporarily some of the markings on our planetary disk.

We can imagine the Martians puzzling over our seas and continents and largest islands and lakes, our polar snow caps and tropical vegetation showing in green and grey-green splatches, our reddish-tinted deserts, our mountains and our great level plains just as we puzzle over the canal-system and the desert and marshy tracts on the planet Mars.

The fact that our planet rotates on its axis in twenty-four hours and has marked seasonable changes could be as readily determined from the distance of Mars as the seasonal changes and rotation of Mars on its axis have been determined by us. We can imagine the interest that our large satellite would arouse and the speculations that would be made concerning its indistinct surface markings. In one respect the Martians would have an advantage over us in their observations of the moon. They would be able to examine one side of the moon that we have never seen. The side of the moon that is never turned toward the earth would be visible frequently to the Martians.

Fig. 4. The Earth As Seen from Mars. At the Time of Its Greatest Brilliancy the Earth Appears As a Crescent to the Martians. To Better Understand This See Figs. 2 and 5. To the Martians the Planet Earth Can Never Be Viewed As a Full Disc—Only In Crescent Form. When Entirely Illuminated By the Sun, It Is Lost In Its Rays and Is Therefore Invisible to the Martians

The Planet Earth and Its Satellite the Moon As It Appears Among the Stars When In Opposition to the Sun, Viewed from the Planet Venus

Let us now consider how our planet would appear if we were stationed on the planet Venus, assuming that it is possible at times to see the beauties of the starry heavens thru occasional rifts in dense clouds that apparently shut the surface of this interesting planet almost completely away from the universe beyond.

Seen telescopically at the time of its opposition to the sun, the planet Earth and its satellite the moon would be for the inhabitants of Venus the most beautiful and interesting object in the heavens. No planet appears to any other planet as magnificent as the Earth-Moon system does to Venus at the time of nearest approach. The brilliancy of the earth seen from Venus at this time is twice that of Venus as it appears to us at its best. As the earth's disk is then fully illuminated the inhabitants of Venus would have a great advantage over the inhabitants of Mars in their study of the surface markings of our planet. Objects on the earth's surface fifty miles in diameter could be made out easily by the inhabitants of Venus with the assistance of such telescopes as we employ for the observations of the planets. When Mars is most favorably situated for observation from the earth the diameter of its disk is between fifteen and twenty-five seconds of arc, according to its distance from the earth at the time of opposition. When the earth is most favorably situated for observations from Venus the diameter of its disk is sixty-three seconds of arc and that of the moon is seventeen seconds of arc. So even the disk of our moon appears at certain times as large seen from Venus as the disk of Mars seen from the earth. The markings on the earth itself seen from Venus stand out more distinctly at opposition than the markings on Mars do to us at the most favorable opposition of Mars as we are nearer to Venus than to Mars.

It is when we take our station on our own little satellite, however, that we behold our planet earth as the ancients wished to consider it—the most wonderful and awe-inspiring object in the heavens. To the inhabitants of the moon, were there such, the earth's disk would appear four times greater in diameter and *sixteen times greater in area than the moon's disk appears to us.* Since the moon, in its revolutions around the planet Earth, always keeps the same face turned toward it, *the position of the earth,* for any one point of observation on the moon, *remains immovable in the heavens,* and it goes thru the various phases of its illumination by the sun in the reverse order to that followed by the moon. When the moon appears to us to pass from new to full the earth appears to the moon to pass from full to new and vice versa.

The rotation of the earth on its axis is plainly visible from the moon even to the naked eye. A distinctive marking will appear at the western edge of the earth's disk, say the Black Sea or Central America. It will be carried gradually eastward by the rotation of the planet and will finally disappear twelve hours later at the eastern edge.

Oceans and continents and polar caps appear in their general outlines and contrasting shades, visible easily to the naked

(*Continued on page* 911)

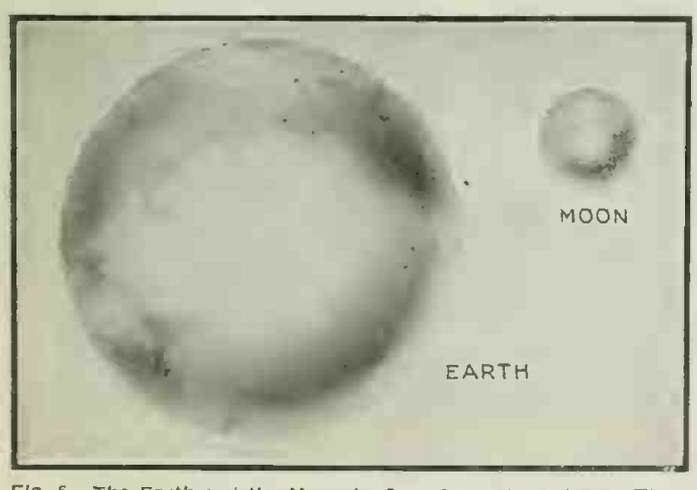


Fig. 6. The Earth and the Moon As Seen from Planet Venus Thru the Telescope At the Time of Its Opposition to the Sun

Radiophony to Airplanes a Great Success

A CONSIDERABLE time before the United States entered the world war the Bell Telephone system supplied the American Navy with a wireless telephone outfit designed for communication between an airplane and a station on land or on a ship. From that time on until this country entered the world-conflict, the Western Electric Company, as a part of its general study, conducted the work of perfecting light, compact wireless telephone sets, which would be available on small vessels and on airplanes. The first successful wireless test between an airplane and the ground after our entry into the war was made with one of the sets designed and completely built by this enterprising engineering organization prior to our entry into the war. The test was made on Langley Field.

U. S. Army Airplane Pilot and Observer Equipt with Wireless Telephone Sets for Transmitting as well as Receiving Speech. These Sets Are Provided with a Change-over Switch Which Permits the Instruments to Be Utilized as a Regular Telephone Between the Two Birdmen.

On May 22, 1917, Gen. George O. Squier, Chief Signal Officer of the United States Army, sent for Dr. F. B. Jewett, chief engineer of the Western Electric Company, to confer with him with reference to the matter of equipping airplanes with wireless telephone apparatus. At this conference, which was held in Washington, besides Gen. Squier and Dr. Jewett, there were present E. D. Craft, one of Dr. Jewett's principal assistants; Capt., now Col. C. C. Culver, of the Signal Corps, and Col. Rees, of the British Army Air Service. The possibility of providing airplanes with wireless telephone service was discust, and the reports of the development work being done by the Western Electric Company made by Dr. Jewett were so promising that he was ordered in writing by Gen. Squier to proceed with the development of the system, and to actually equip 'planes with it.

The Bell system engineers had progrest so far at that time that they were able on July 1, 1917, five weeks after the first conference, in a test at Langley Field, to actually demonstrate the working of the wireless telephone between an airplane and the ground. This test also showed that it was practical to operate the system between two or more airplanes in the air.

"All this sounds very simple, but it would take volumes to describe the innumerable experiments and heart-breaking failures before the first real successes. So far as the radio part of the equipment was concerned we had an answer in a short time. We had developed some very successful forms of vacuum tubes and it was a simple matter to assemble them with the necessary coils, condensers and other apparatus that comprise the transmitting and receiving elements. Working this apparatus under ordinary conditions on the ground, and in a swift-moving and tremendously noisy airplane, were two entirely different propositions. The noise of the engine and rushing air was such that it was impossible to hear one's own voice, to say nothing of the weak signals of the telephone receiver," stated Edward B. Craft, Assistant Chief Engineer of the Western Electric Co.

One of the first problems was to design a head set which would exclude these noises, and at the same time permit of the reception of the telephone talk. A form of aviator's helmet was devised with telephone receivers inserted to fit the ears of the pilot or observer. See accompanying illustration of the helmet with 'phones complete. Cushions and pads were provided for adjusting the receivers to the ears and the helmet fitted close to the face so as to prevent as far as possible, the sound being heard either thru the ear passage or thru the bony structure of the head, which acts as a sort of a sounding board. A helmet, such as that illustrated, was finally developed and was found to solve this portion of the problem. The earpiece finally adopted was made of sponge rubber (made so by blowing air thru it while molten), reënforced by tinfoil, and the receivers themselves embedded therein. These were mounted in a thick leather helmet, to be clamped over the flier's head and ears. It effectually muffles bone transmission also, besides permitting the use of oxygen or gas masks.

Everyone knows how sensitive the ordinary telephone transmitter is to extraneous noises, and it does not require a wide stretch of the imagination to picture how this would act alongside the exhaust of a 200 horsepower gasoline engine. A brilliant line of experimentation finally resulted in a form of a telephone transmitter or microphone, which possest the remarkable quality of being insensitive to engine and

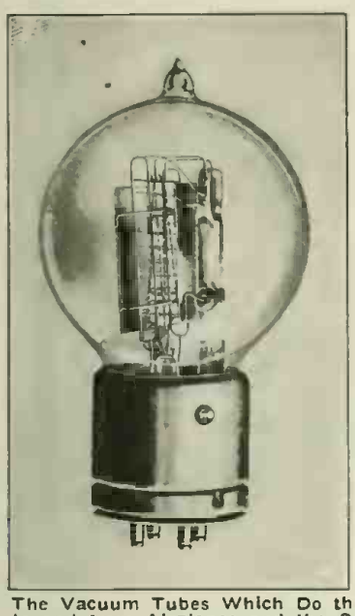
Photo by Central News Photo Service

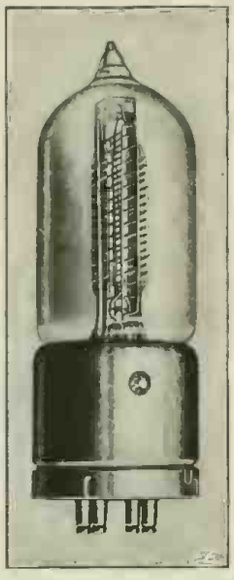
Testing the Radiophone Between New York and Washington. A Photograph of U. S. Naval Operators Communicating with the U. S. Navy Department at Washington, D. C., from the Bankers Club in New York, Thru the Radio Telephone. Many of the Country's Leading Bankers Were Present to Witness the Demonstration. Afterward Tests Were Made from this Station to Airplanes and Dirigibles Flying over New York City, Various Orders Having Been Successfully Sent to the 'Planes.

wind noises, and at the same time very responsive to the tones of the voice. With these two elements in hand, the problem was apparently solved. The fact remains, however, that three solid months of the hardest kind of work was necessary to iron out all the kinks and get the thing in shape so that it might be considered a practicable device for the everyday use of other than experts, as Mr. Craft points out. The microphone perfected for this work has no mouthpiece, but instead a flat cap having three tiny openings about 1/16 inch in diameter. The voice waves pass thru these onto the diafram easily, but the engine noises swirl round it in other directions and do not enter in sufficient volume to be heard at all.

A typical performance of the radiophone between 'planes and ground will prove of interest. Here is the way it worked at one of the first official army tests at the flying field at Dayton, Ohio, December, 1917, as related by Mr. Craft.

"The 'planes left the ground and after what seemed to be an interminable length of time, we got the first sounds in the receiver, which indicated that they were ready





The Vacuum Tubes Which Do the Work in Radiophoning to and from Airplanes and the Ground. At the Left—the Transmitting Tube; at Right—the Receiving Tube. America Was Turning Out These Bulbs by Thousands Every Day When the Armistice Was Signed, so Rapid Had the Standardization and Production Progress.

to perform. The spectators were only mildly interested, and some seemed to be a bit bored. Suddenly out of the horn of the loud speaker came the words, "Hello, ground station. This is 'plane No. 1 speaking. Do you get me all right?" The bored expression immediately faded, and looks of amazement came over their faces. Soon we got the same signal from No. 2, and the show was on. Under command from the ground the 'planes were maneuvered all over that part of the country. They were sent on scouting expeditions and reported what they saw as they traveled thru the air. Continuous conversation was carried on, even when the 'planes were out of sight, and finally upon command they came flying back out of space and landed as directed."

Electric current must be supplied to operate the wireless set on the 'plane, as we well know, this current being used to heat the filaments of the vacuum tubes and to operate the transmitter. But the 'planes were already loaded down with all the gear they could carry, and the use of heavy storage batteries was out of the question. The airplane engineers would allow nothing to be connected to their engines, so there was nothing left but to supply a separate radio dynamo, and drive it by a wind propeller, taking its power from the rushing air. Airplanes are in the habit of flying at various speeds, and the specifications stated this to be from forty to one hundred and sixty miles per hour, the latter figure representing the speed when the machine was diving. The little dynamo, therefore, had to deliver a constant voltage with a speed varying from 4,000 to 14,000 R.P.M.

In our next issue will appear an important article by Nikola Tesla entitled

"TRUE WIRELESS"

In this article Dr. Tesla will make known his views of the propagation of the wireless waves.

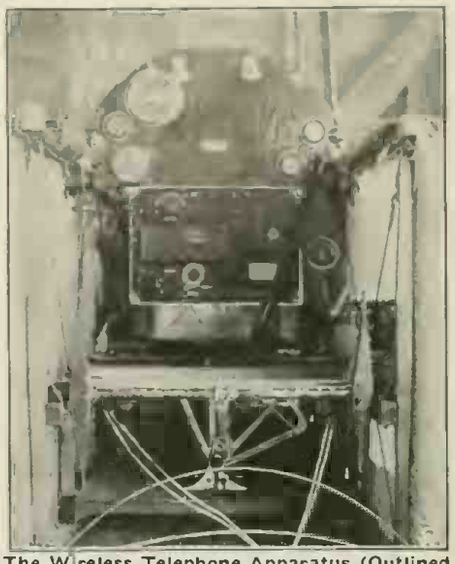
The microphone and receivers used for radiophoning from 'plane to 'plane or 'plane to earth are arranged by means of a switch so that the pilot and observer can converse over the telephone circuit between the pilot and his mechanician with ease, and by throwing a switch can connect themselves with the radio apparatus and talk with the men in another 'plane three or four miles away, or to the ground.

The primary object was to make it possible for the commander of an air squadron to control the movement of his men in the air, the same as a squad leader of infantry does on the ground. For this purpose extra long range is not required, and the distance over which they can talk is purposely limited to two or three miles, so that the enemy cannot overhear, except when actually engaged in combat, and then nobody cares.

The Navy also makes use of these sets in their seaplanes, and here the range is somewhat greater, up to twenty miles in some cases. The Navy has also made use of a modified form of this set in their 110-foot submarine chasers. The chasers hunt submarines in packs, and by means of the radio telephone, their commanders keep in constant touch with each other, thereby greatly increasing the effectiveness of their operation.

Finally, with the formal demonstration completed, pressure was immediately applied to produce the necessary quantity of sets with their multitude of auxiliary and subsidiary parts. From January 1, 1918, to the early summer of that year the Western Electric Company established factories and trained thousands of operatives so that when the armistice was signed the necessary transmitting and receiving tubes for radio telephone sets were being produced at a rate in excess of a million and a half good tubes per year. Improvement in vacuum pumps has resulted in a wonderfully high degree of exhaustion being attained—about one-billionth of an atmosphere.

Altogether thousands of radio telephone sets of different types have been manufactured and delivered to the Army and Navy since the early part of 1918. In spite of the fact that prior to July, 1917, no commercial types of this apparatus were in existence, and some of the fundamental problems had not yet been solved, the resources of this great telephone engineering organization were sufficient to establish



The Wireless Telephone Apparatus (Outlined in White Square) Installed in Cock-pit of Airplane. It Takes up But Little Room and Has Such a Small Weight as to Be Insignificant, Compared to the Lifting Power of the Plane.

on a commercial basis, within this short space of time, practically speaking, *an entirely new art!—Photos Courtesy W. E. Co.*

HOW AIRPLANES FIND THEMSELVES BY RADIO.

In his recent lecture before the American Institute of Electrical Engineers at New York Major-Gen. G. O. Squier, in connection with his description of the war's developments in radio apparatus, spoke as follows concerning the problem of aërial navigation:

"One of the principal problems of airplane navigation has been the evolution of a suitable compass, particularly for night bombing work. Magnetic and gyroscopic compasses have limitations at present which make impossible reliable air navigation by dead reckoning.

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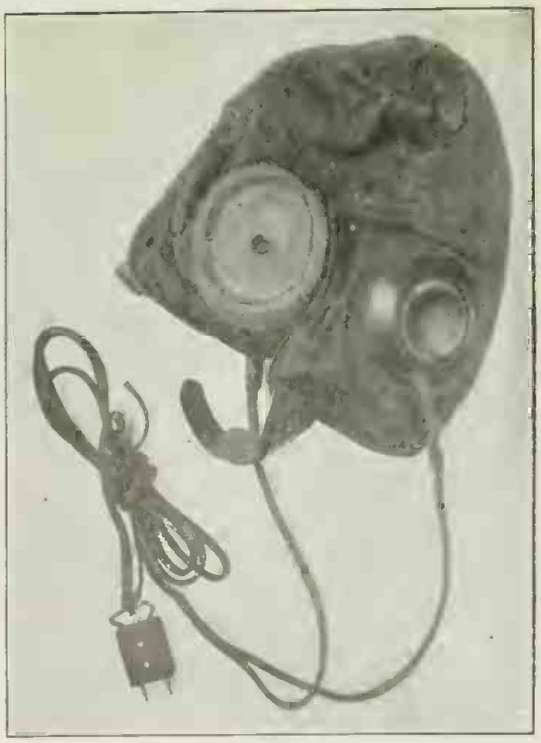


Aviator's Radiophone Helmet Fitted with Special Sound-proof Pads and Having the Two Receivers Mounted Tightly Therein. The Receivers Are Moulded In Sponge Rubber. The Helmet Is Made of Leather.

Do Radio Waves Travel Above the Earth or Thru It?

By DR. LEE de FOREST

(Written exclusively for the Electrical Experimenter)

THE article on "Radio Around the World" is very interesting. From my own rather extended experience and based also on the calculations and results obtained by most of the serious workers in this field, I think there can be no doubt but that the *etheric wave* component is by far the more important one. Understand, however, that these are not ordinary space waves, *but are grounded waves gliding over the surface of the earth*, thus following the contour of the earth. See Fig. 1. The depth of the wave in the ground or sea water has been shown by actual measurements, as well as by theoretical calculations, to be ordinarily and until recently only a few feet; sufficient, however, to explain the interesting results obtained with an horizontal antenna lying close to the surface of the earth, or even in trenches a few inches below the surface and extending, of course, in the general direction of wave propagation.

Unquestionably the molten interior of the earth would conduct low frequency oscillations with comparatively little loss, but it is obviously impossible to make connection to this molten interior, ordinarily. If one cared to experiment with two volcanoes at a comparatively short distance apart, making each crater the terminus of a line connecting with the terminals of an A. C. generator, and at some distant spot of the earth's surface between two neighboring volcanoes another parallel wire, in which a tuning and detecting device was located, very interesting results might be obtained. See Fig. 2.

However, if such a combination could be found there would probably exist not the slightest excuse for sending telegrams between stations thus situated. Unfortunately, or fortunately, we cannot locate our volcanoes as we would subway tubes.

If, as you suggest, a powerful wireless station could be operated at a sufficient distance from the earth's surface, and completely isolated therefrom, remarkable distances of transmission thru the ether might be achieved. However the energy obtainable at the moon from a given output of energy transmitted near the earth's surface can be calculated, by inverse square law. It will be found that a tremendously powerful station would be required to transmit signals to any such distance. You doubtless are aware of the remarkable distances obtainable from airplanes to the earth, using comparatively small transmitters. Just recently an army airplane carried on radio communication successfully over a distance of 150 miles. The distances are usually much greater than where a similar transmitter is located on the earth's surface, using a similar length of antenna.

The phenomena involved in such transmission, where the airplane is, say, two miles above the earth's surface, are doubtless complex. Here the ground wave is originally a *free space spherical wave*, but when the surface of this wave reaches the earth it doubtless cuts into the earth for a small depth and becomes then a true *grounded wave*, just as if it originated from an earthed antenna. See Fig. 3. There is great need for interesting data on the phenomena of transmission from airplanes and whoever will collect and publish such data will be conferring a great service to the Radio Art.

Concerning your question as to whether the wireless waves travel or glide along the surface of the earth in the manner which I have described above, each wave having a grounded foot or base penerating a short distance into the earth, I might mention a very interesting phenomenon which we have encountered in installing wireless stations in mountainous or mining country in the western part of the United States. Figs. 4 and 5 illustrate this phenomenon. Fig. 4 shows a case which often happened in the early commercial days of radio-telegraphy, where a mine owner or other party wished to install a station in a valley or cañon, which happened to have sharply rising cliffs on either side. Apparently the composite etheric and ground waves became so stretched out or attenuated in their effort to leap across this valley, that the station was only able to intercept either very weak signals or no signals at all. Therefore it was found advisable in-

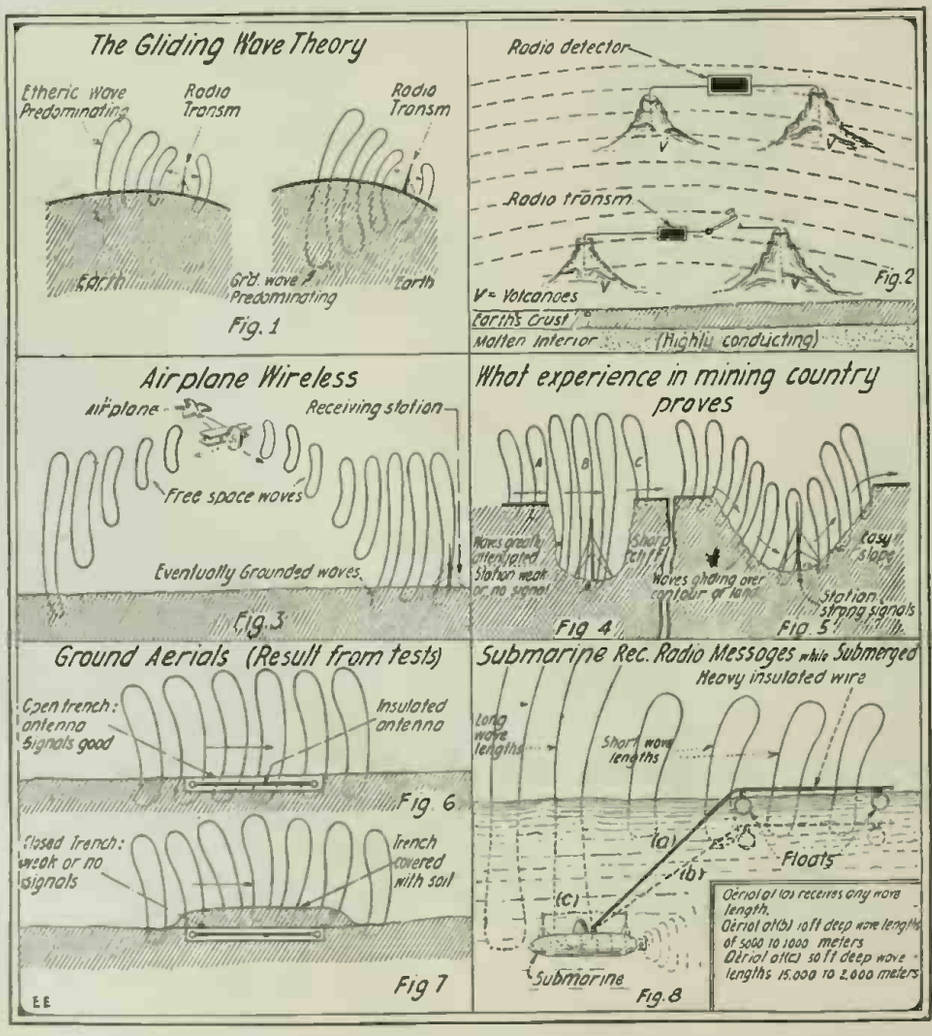
(Cont. on page 919)

THE editors sent a copy of the article published in the December issue of the ELECTRICAL EXPERIMENTER entitled "Radio Around the World," and also the editorial in that issue by Mr. H. Gernsback, covering several interesting and more or less doubtful theories concerning the propagation of these electric waves over a distance of 12,000 miles, i.e. between Carnarvon, Wales, England and Sydney, Australia, to Dr. Lee de Forest, the prominent American radio engineer and scientist. The editors asked Dr. de Forest the following questions:

First: What is your opinion concerning the etheric wave transmission above the surface of the earth, i.e., free space wave propagation? Do you believe that the etheric wave wireless transmission is better beyond the computed fifty mile atmospheric envelope surrounding the earth, and how far into interstellar space do you believe these signals might be carried? Imagine for the moment that an airship fitted with sensitive wireless receiving instruments could have traveled away from the earth for any desired distance? Do you think these waves would be felt on the moon, approximately 238,000 miles distant, considering of course that suitable receiving instruments were available at that point?

Second: What is your opinion concerning the ground wave transmission, i.e., do you believe, with the geologists and others, that the earth presumably being a molten mass in the interior, might be a better conductor than the soil and rock crust surrounding it, and that this gaseous interior of the earth might therefore prove a better conductor than the soil and rock strata, and thus that the ground radio wave may have traveled directly thru the earth or a distance of nearly eight thousand miles—corresponding to the diametrical axis—or do you believe it much more likely that these ground waves followed around the curvature of the earth in the manner explained by Prof. J. Zenneck and other investigators, each ground wave gliding over the surface of the earth?

Third: Is it your opinion at the present day that the pure etheric space wave, gliding over the earth in accordance with the generally accepted theories concerning radio transmission, is the predominating wave, both as to electrical energy involved and amplitude, compared to the ground wave; or is the ground wave superior in its energy component and amplitude? These conditions are shown in one of the following diagrams, Fig. 1, and we would request your opinion on the relative extent above and below the surface of the earth, of the space wave and the ground wave respectively.



Various Phases of Gliding Wave Wireless Transmission Used In Discussion Here Given. In General, the Etheric Space Wave Glides along the Surface of the Earth, Accompanied by Its Grounded or Foot Wave.

Aërial or Ground Radio—Which?

The Opinions of Two Leading Wireless Experts

Do Radio Waves Travel Above the Earth or Thru It?—by Dr. L. W. Austin, Radio Expert, U. S. Naval Radio Laboratory.

REPLYING to your queries of recent date, I am very glad that you have asked these questions and will answer them to the best of my ability.

Q-1. I see no reason to doubt the validity of the old theory of wireless transmission which supposes a wave in ether (and under certain circumstances in the upper layers of the earth, provided they are sufficiently bad conductors), the lower ends of the electric lines being grounded on the conducting surface. The space wave under most circumstances certainly carries the *greater* part of the energy, except where the wave front is bent very far forward. This theory, it seems to me, is sufficiently proven by quantitative observations on received radio current which at moderate distances always agree within a few per cent with the theory that the antenna produces a field corresponding to a Hertz oscillator of twice its length.

Q-2. I believe that the currents in the earth are only incidental to the presence of the ether waves.

Q-3. In the case of transmission between airplanes and the earth, the phenomenon is similar. In sending from a 'plane, the wave must start as a *pure ether wave* which spreads downward and *grounds itself*, and then spreads out longitudinally (with a more or less bent wave front) very much like the wave from a grounded antenna.

Q-4. In antennas close to the ground or buried in the ground which, by the way, behave exactly alike except for a slight difference in static-signal ratio, the reception is accomplished by picking up the earth currents produced by the wave. These, of course, become relatively more powerful at greater distances from the sending station, owing to the usual bending forward of the wave front. The sending from earth or buried antennas is probably accomplished as follows:

In the first place, *ground currents* are formed which produce an electric field in the ether above the earth's surface. This field in spreading out and upward gradually rights itself and travels off very much like the field from an antenna, except that it is *directive.*

Q-5. I do not believe that it is probable that any wireless radiation passes thru the Heaviside layer. (Ed. Note: This would seem to eliminate the "Mars" radio story which has been going the rounds of the daily press.)

Q-6. Experiments indicate that *long waves* can be detected at *greater depths* than short ones, as would be expected from the ordinary skin effect phenomenon of alternating currents.

I am very sorry I have to disagree with Mr. Tesla in this matter, for I consider him the father of wireless telegraphy. His lectures in the early '90s contain full descriptions of a wireless system superior to anything which we actually had in practise before 1910, except for the lack of a proper detector.

Here Are the Questions the Editors Submitted

Q. 1. Do you believe that wireless transmission is effected by complex ether waves having a grounded foot, these waves gliding over the surface of the earth from the antenna, and if so:

(a) Do you think that the etheric space wave above the ground is the predominating one in energy component and amplitude?—or

(b) Do you believe that the ground wave component is the predominating one in energy component and amplitude?

Q. 2. Do you believe that underground wireless transmission is effected by means of ground impulses or currents radiating thru the earth from the base of the antenna, and that the etheric space wave radiation from the antenna is merely an incidental and separate phenomenon, which dissipates itself at a comparatively short distance of a few hundred miles or so?

Q. 3. Do you not believe in this general direction of thought on the matter, that it is the etheric space wave radiation from the antenna that accounts entirely for airplane radio transmission; either 'plane to 'plane, 'plane to earth, or earth to 'plane communication?

Q. 4. How do you account for the results obtained with the Rogers underground and undersea radio transmission and reception? Do you believe that this is accomplished by the grounded components or "feet" of the gliding etheric space waves in conformity with the usual theory accepted theretofore by the Hertzian wave school, or do you think that it is due to ground impulses or high frequency oscillating currents propagated thru the conducting shell of the earth?

Q. 5.—Do you think that, all things considered, and in the light of present day radio developments, such as the Rogers underground and undersea system, that radio transmission would take place with higher efficiency in free interplanetary space, or do you believe that our wireless signals produced at stations on the earth are retained within the atmospheric envelope of the earth due to reflection from the "Heaviside" ionization layer?

Q. 6. It has been hinted at by several naval radio experts and others that it has recently been found that the penetration of the ground wave component in radio transmission increases with increase in wave length, and this phenomenon they are inclined to believe accounts for the results obtained with the underground system. Do you believe this to be a fact?

How I Believe Radio Wave Transmission Is Accomplished

By F. H. KROGER

Chief Engineer, International Radio Telegraph Co., Formerly Chief Engineer, National Electric Signaling Co.

IN response to the request of the Editors of the ELECTRICAL EXPERIMENTER, I give below my replies to the questions here submitted:

Q-1. Practically all the energy delivered by the radio transmitter is radiated in the form of waves *gliding on the earth's surface.* Any energy which may be found to exist in the earth's surface is supplied by the waves sent out from the antenna. The *poorer the conductivity* of this surface, the more energy is taken from the wave, and consequently the less there is available at the receiving station.

Q-2. There must exist in the earth's surface, currents at the feet of the waves referred to in question number one. Means for detecting these currents will give a method of receiving messages. These currents, however, represent only a small per cent of the energy of the traveling wave. It is quite generally agreed that the wave above the surface cannot exist without the current in the surface and vice versa.

Q-3. Yes.

Q-4. Currents due to the gliding wave.

Q-5. The "Heaviside" ionization layer must be a boundary to the waves. One of the explanations of the marvelous work done in the North during the winter is the fact that the ionized layer of the Aurora, coming close to the earth, provides a boundary to the waves which prevents the usual attenuation.

Q-6. The ground losses are higher with longer wave-lengths for poorly conducting earth, in the vicinity of the antenna, which indicates that a greater volume of the earth is affected by the currents. This greater penetration would also hold for the gliding wave. Ground tests made some years ago indicated that the ability to receive signals *did not depend* upon the quality of the ground nor the wave-length: therefore Mr. Rogers' system probably does not depend upon a penetration due particularly to long wave-lengths, but upon a penetration which is sufficient for his purposes, given by any wave-length.

EXAMINATIONS FOR AMATEUR FIRST GRADE RADIO OPERATOR'S LICENSE AT NEW YORK.

Examinations for amateur first grade radio operator's license are being given at Room 603, Custom House, Bowling Green, New York City, every day after 9 a. m., announces Charles D. Guthrie, Radio Inspector of that district.

Attention is called to the fact that applicants for amateur first grade radio operator's license must qualify in the transmission and reception of Continental Morse code at the rate of *ten words per minute* instead of five as heretofore.

Papers covering these examinations will be rated by the examining officer as soon after the examination as possible *but no licenses will be issued until amateur stations are permitted to operate.*

PLEASE NOTE: By taking this examination authority is NOT granted to open your station. It will be necessary after the stations are authorized to open, to furnish on form 762, Applicant's Description of Apparatus, the particulars required and await the issuance of station license as well as the operator's license before operating the station and form 762 cannot be filled in and filed until the station has been made ready for operation as it is important that the exact dimensions of the antenna and the amount of power to be used be stated in this application.

You are hereby cautioned that it is unlawful to operate an unlicensed station, and all amateur licenses (operator's and station) issued prior to the war are now void.

When authority is granted to issue amateur licenses, new station numbers and call letters will be given.

CHAS. D. GUTHRIE,
Radio Inspector.

The How and Why of Radio Apparatus

By H. WINFIELD SECOR

No. 11. How to Make and Use a Direct-Reading Wave Meter and Decremeter.

From time to time we will describe one particular instrument used in either the radio transmitting or receiving set, explaining just how it works, and why. We have received so many requests from new readers asking for such explanations that we have decided to publish this matter in seriol form. In the course of several issues all of the principal transmitting and receiving apparatus will have been covered. The subject for the eleventh paper is HOW TO MAKE AND USE A DIRECT-READING WAVE METER AND DECREMETER.

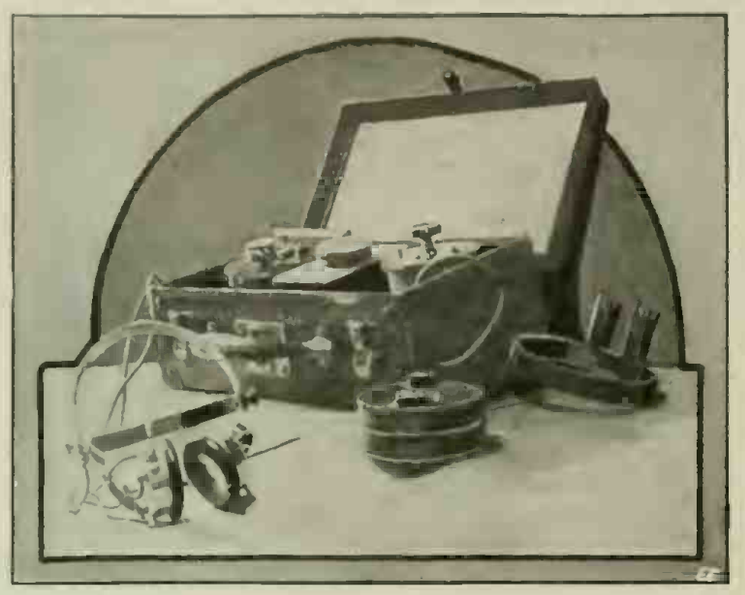
THE present time seems an opportune one for the radio student and the radio amateur to prepare for the forthcoming opening of experimental radio opportunities, and we believe that no better use can be made of the spare time than to construct and study the use of the *wave meter and decremeter*. The accompanying text and illustrations show how to build a home-made wave meter which will give very satisfactory service. The dimensions given for the various parts of the instruments are taken from an experimental one which was carefully calibrated for the writer.

We will first take up the construction of the wave meter and will afterward consider the calibration curves to be used with it, and also the determination of decrement.

Perhaps the first part of the instrument that will come to hand as the student sets about the building of it, is the *inductance*, or rather the inductances. These coils are also referred to as the *exploring coils* or exploring inductances. They are used to pick up sufficient energy from a radio transmitter or receiving set, so as to cause oscillations to be set up in the wave meter circuit, which will be of sufficient strength to give a positive indication of resonance or non-resonance of the circuit, and thus to determine the exact period at which the current being measured is oscillating.

The illustration, Fig. 1, gives the details of construction for the three inductances used with this wavemeter. The wooden forms on which the coils are wound are best turned on the lathe from some fine grained hard wood such as mahogany or maple. The physical dimensions of the forms are given in the drawing and the length A, of each of the three coils varies with the number of turns on each, the table in the figure providing these values for the different coils. The winding in each case consists of one layer of No. 20 B. & S. gage enameled magnet wire. These inductances have been accurately calibrated by comparison with a standard wave meter at the Radio Standardization Laboratory of the College of the City of New York, thru the courtesy of Dr. Alfred N. Goldsmith, Director, and the specifications for building these coils must be rigidly adhered to. Where the accuracy of the instrument within a few per cent below or above the calibrated values is not imperative, No. 20 gage magnet wire, covered with a single winding of silk may be used; but due to the peculiar qualities of enameled magnet wire and the number of turns per inch of winding, etc., it will be seen that the specifications here given should be carefully followed to obtain the inductance values in centimeters here given. The three coils, numbers 1, 2 and 3, have inductances of 36,000, 126,000 and 259,000 centimeters respectively.

The manner of attaching the inductance coils to the wave meter cabinet is shown at Fig. 1, and consists of two lugs made of 1/16 inch brass and having slots at the lower ends of each. This enables the operator to slip the coils on and off the binding posts quickly. The inner and outer leads from the winding of the inductance should be carried thru diagonally drilled holes in the wooden form, as is indicated by the dotted lines, and they should be soldered to the two brass lugs, which are screwed to the form by means of small flat-head brass wood screws. The wooden form may be varnished or shellacked before winding, but the winding itself should not receive any coating of shellac or varnish, as this changes the distributed capacity of the coil. Do not use any iron in building these inductances.



Photograph of Author's Wave Meter Fitted with Calibrated Condenser and Inductance Coils of the Dimensions Given in the Present Article.

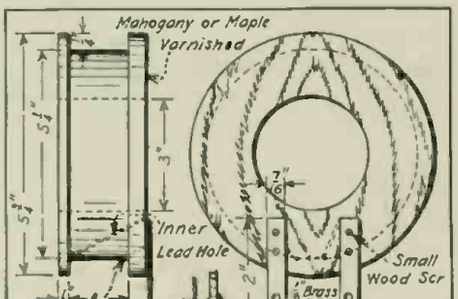


Fig. 1
Inductance Coil Data

Dimensions of 3 Inductance Coils				
Coil No. 1	12 Turns No. 20 B&S Enam. Mag. Wire	A: ¾"	Ind. cms. 36,000 cms.
" " 2	24 "	"	"	4¼"	" " 126,000 "
" " 3	36 "	"	"	4¼"	" " 259,000 "

Details of Inductance Coils, Three of Which Are Used to Give the Wave Meter a Desirable Range.

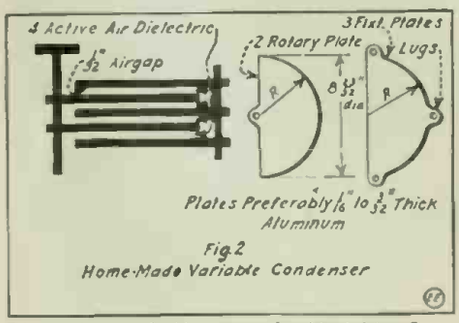


Fig. 2
Home-Made Variable Condenser

Dimensions of Home-made Variable Condenser of the Required Capacity for Wave Meter Here Described.

The next item claiming our attention is the variable condenser, and we might say a great deal concerning this part of the apparatus, and then again we might just as well say very little. Experience dictates that this comes out about as follows: in the first place many radio experimenters would rather obtain on the open market a small rotary type variable condenser having the proper capacity for use in this particular wave meter, and this should be .00086 microfarad. Of course any condenser having this capacity within a small fraction one way or the other may be used, but if the student wishes to have a good accurate wave meter, and intends to eventually have it calibrated or checked against a standard wave meter, then he will do well to select a good sturdy and reliable make of rotary condenser. Some of the points to be watched in the design of such a condenser are that it should not have the rotary and fixt plates too closely spaced, or else it will frequently give trouble by short-circuiting; the rotary plates should be accurately locked on the rotary shaft either by having their hubs molded on the shaft or else they should be mounted on a square shaft so as not to turn, or again they can be keyed on the shaft. For the purpose of a wave meter there should also be practically no up and down movement or play in the vertical shaft supporting the rotary plates. For all practical purposes, the capacity of a rotary variable condenser (see Fig. 2), is determined by the usual capacity formula using a K value of 1, which is that for air.

Many radio amateurs and experimenters

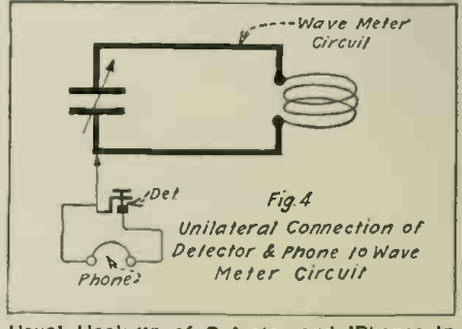


Fig. 4
Unilateral Connection of Detector & Phone to Wave Meter Circuit

Usual Hook-up of Detector and 'Phones In Unilateral Fashion. Where There Is Sufficient Energy to Actuate Detector Properly.

will undoubtedly wish to construct their own variable condenser having this required capacity, and the physical dimensions of such a variable condenser are given in Fig. 2. As will be seen, this particular design comprises three stationary and two rotary aluminum or brass plates. These plates should preferably have a thickness of 1/16 to 3/32 inch so as to be perfectly flat and retain their shape, and thus maintain the accuracy of the condenser when once assembled. The four active air dielectric spaces between the plates should be exactly 1/32 inch. The diameter of the rotary plate, as Fig. 2 indicates, should be 8-23/32 inches, and by cutting the lugs on the stationary plates as well as on the rotary plate in the manner indicated, will permit of the accurate interleaving of the rotary and fixt plates so as to give the proper capacity.

Thus we see that the two principal parts of any wave meter are—an accurately cali-

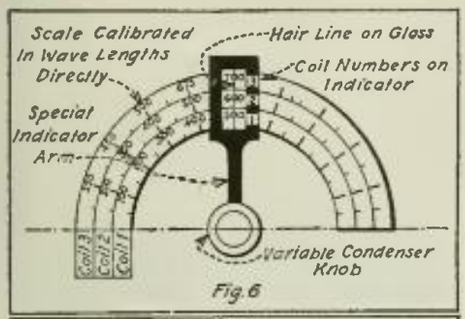


Fig. 6

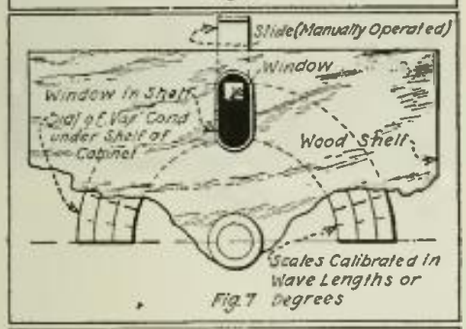


Fig. 7

Fig. 8

Three Schemes for Improving the Wave Meter Dial and Indicator so as to Make It "Direct Reading." Fig. 8 Shows an Automatic Dial Arrangement Which Causes the Correct Reading to Appear, no Matter Which of the Three Coils Is in Use.

brated precision variable condenser and an accurately calibrated inductance. In practically all cases this inductance and capacity of known values are connected together in parallel or shunt as shown at Fig. 3-A. Referring to Figs. 3-A and 3-B, the lead wires joining the inductance or exploring coil to the variable condenser are composed of two pieces of No. 16 flexible lamp cord, each 6 inches long. A 3-inch length of copper strip joins the two pairs of binding posts. Fig. 3 shows one set of binding posts being used for the inductance coil and the other set intended for the connection of a hot wire milliampere meter or thermo-couple and galvanometer. Ordinarily this latter pair of binding posts are fitted with a piece of copper strip about 1/16 inch thick forming a *jumper*.

It is well in all cases to fit a safety spark gap across the terminals of the variable condenser as shown at Fig. 3-B, as when the wave meter is used in close proximity

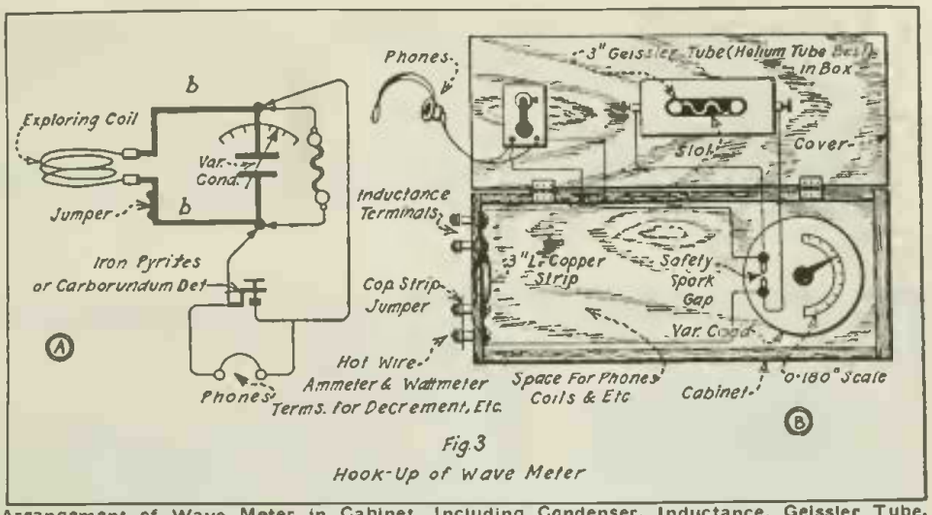


Fig. 3
Hook-Up of Wave Meter

Arrangement of Wave Meter in Cabinet, Including Condenser, Inductance, Geissler Tube, 'Phone (1,000 or 75 ohm), Etc. The Diagram Shows Geissler Tube and Detector and 'Phone Indicator Circuit, Either of Which Can Be Used.

to radio transmitting sets, there is very often a sufficiently heavy current induced in the wave meter circuit to cause a puncture of the insulation of the inductance coil or a short-circuiting of the variable condenser, especially if the latter happens to have closely spaced plates.

For indicating the maximum resonance when measuring the wave length of a transmitting set, where the induced current in the wave meter is of course quite strong in any case, a very good indicator, as proven by practise and experience, is an ordinary 3-inch Geissler tube, or better yet a small *helium* gas tube. It is best when using either a Geissler or helium tube as an indicator of maximum resonance, to place the tube in a small box mounted on the lid of the wave meter, the box being blackened inside and provided with a slot in the front so that the degree of glow in the tube may be easily seen. It is also common practise to connect a hot wire milliampere meter in series with the inductance and condenser of the wave meter by removing the jumper on the series binding post terminals and connecting the meter to this; in this case the maximum resonance, and therefore the wave length at which the circuit under test is oscillating, is indicated by turning the condenser handle until the needle of the hot wire meter reaches a maximum reading. Some operators prefer to use the well-known detector and telephone receiver method of determining the maximum resonance point in the wave meter circuit as the diagrams at Fig. 3 show. The detector and wireless 'phones are connected (in series or in multiple) across the variable condenser for the purpose. This arrangement is extremely sensitive, and is the one invariably used in measuring the wave length of received signals. The Geissler tube or other apparatus is, of course disconnected from the wave meter circuit, if the detector and 'phone method is to be used. With respect to the detector used on the wave meter, it may be said that either carborundum or iron pyrites proves best, as either may be subjected to a very strong current without harm.

Figures 4 and 5 show two more circuits used with the wave meter. Fig. 4 shows a detector and telephone receiver circuit, connected to the main oscillating circuit of the wave meter by a unilateral or one-wire connection. This method is highly recommended in many text books treating on the wave meter and its uses, and at the present time it is used on many of the best commercial wave meters. This connection of the detecting circuit possesses the advantage that it cannot have any detuning or offsetting effect on the oscillating circuit as is the case where it is placed in shunt to the capacity and inductance composing this circuit, and it is very efficient for the purpose in hand, as with this connection the detector and 'phone receive just a sufficient amount of energy to operate

(*Continued on page 921*)

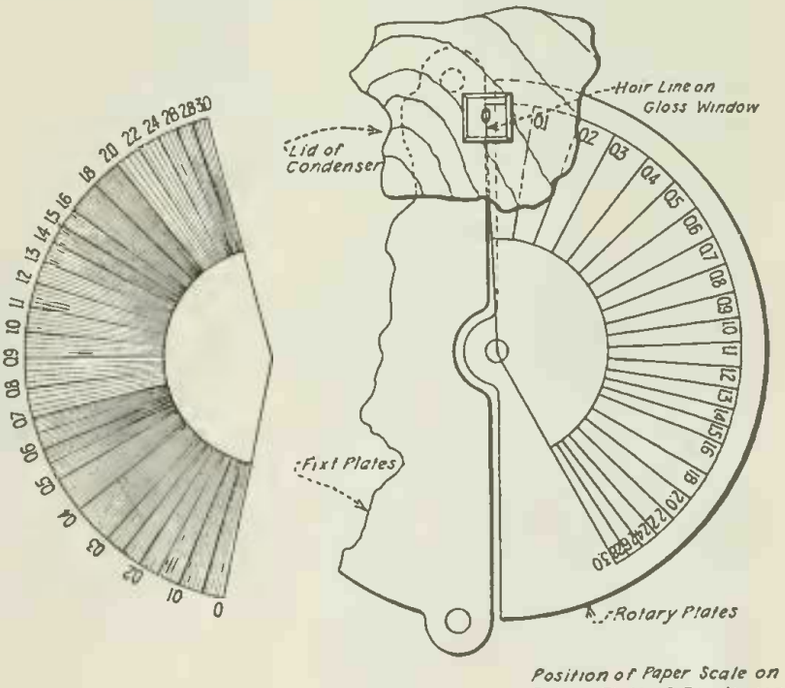
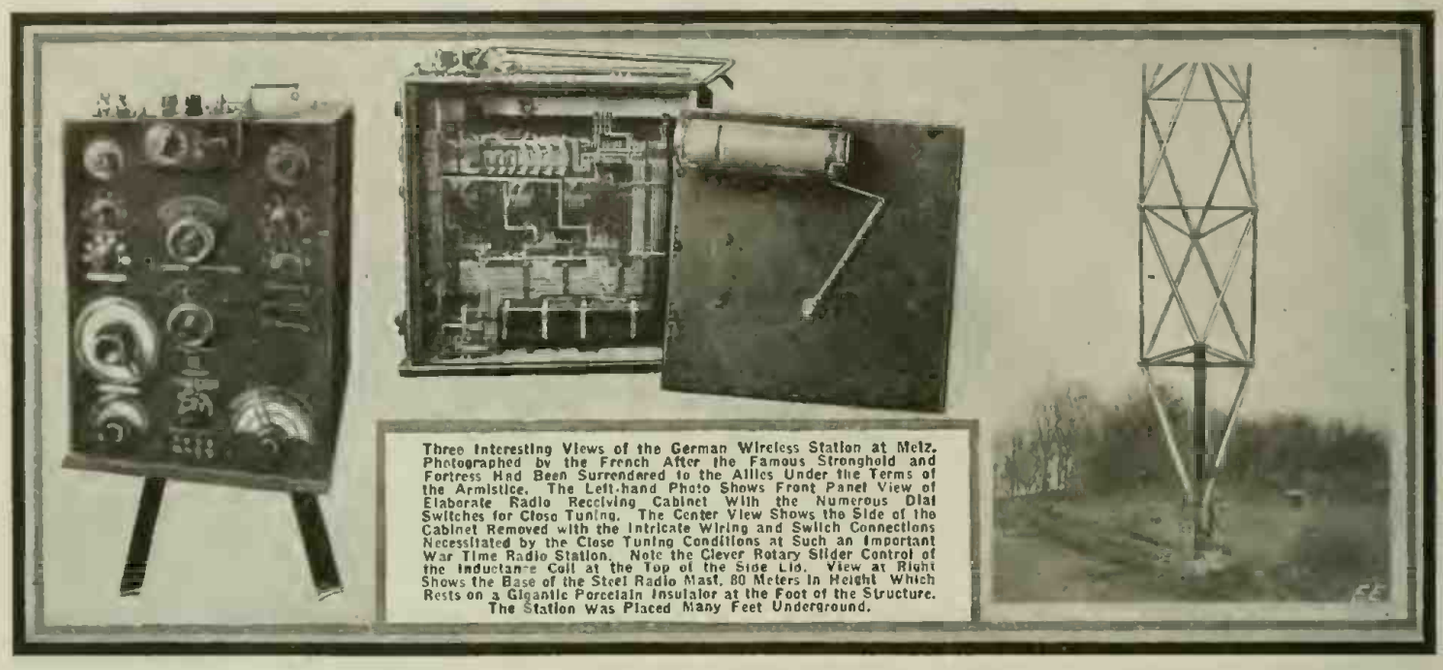


Fig. 10

To Make a "Direct Reading Decremeter" of Your Wave Meter, Cut Out the Paper Scale at the Left and Mount It on the Variable Condenser Shaft or on the Top Rotary Plate in the Manner Here Shown. The Decrement Is Read thru the Window When Resonance Is Indicated.

German Radio Apparatus Used at Metz

THE accompanying illustrations show the interesting radio apparatus and antenna mast used at the famous German military base at Metz. These photographs were taken by the French Army when they entered Metz after the signing of the armistice. The photograph of the aërial mast is interesting as it shows a very novel construction whereby a strongly braced tower structure is formed of steel tubes or pipes, provided with flattened ends thru which bolts are past. The base of this radio mast, measuring 80 meters in height, is tapered to a point at the bottom, as the photograph shows, and rests on a large porcelain insulator. Suitable guys and pins were used in arranging this insulating base support, so that the foot of the mast could not slip or break away if for any reason the insulator should break. The mast was well-guyed with steel cables running in different directions, and the antenna was supported in umbrella fashion from the top of the mast. As the photograph discloses, a high steel fence enclosed the grounds connected with the station to preserve secrecy, and also to prevent any one coming in contact with the highly charged aërial conductors.



Three Interesting Views of the German Wireless Station at Metz, Photographed by the French After the Famous Stronghold and Fortress Had Been Surrendered to the Allies Under the Terms of the Armistice. The Left-hand Photo Shows Front Panel View of Elaborate Radio Receiving Cabinet With the Numerous Dial Switches for Close Tuning. The Center View Shows the Side of the Cabinet Removed with the Intricate Wiring and Switch Connections Necessitated by the Close Tuning Conditions at Such an Important War Time Radio Station. Note the Clever Rotary Slider Control of the Inductance Coil at the Top of the Side Lid. View at Right Shows the Base of the Steel Radio Mast, 80 Meters in Height Which Rests on a Gigantic Porcelain Insulator at the Foot of the Structure. The Station Was Placed Many Feet Underground.

The remaining two photographs show respectively front and side views of the receiving apparatus used at Metz. One of the first interesting things we note in connection with the design of the apparatus, and plainly visible in the side view is the rotary control of the inductance slider. This is accomplisht by a lever secured to a rotary knob, the free end of which is joined by means of a link member to the slider of the inductance in the manner shown, so that as the handle is turned in rotary fashion, the slider will move back and forth along the coil. The detectors, of which there are several in duplicate, are observed at the top of the instrument, while an elaborate multiplicity of control handles with graduated inductance pointers, are provided for changing the wave length of the primary and secondary receiving circuits, as well as the coupling between the coils of these circuits, and also the capacity values used.

The telephone receivers, several sets of which may be used when desired, are connected with the receiving set cabinet by means of flexible cords and jacks, eight of which are placed in a group at the lower center of the front panel.

Among other things, we find it interesting to note the very neat arrangement of the interior wiring of the cabinet, the various connections being run symmetrically in straight lines, evenly spaced and held rigidly in place by means of insulating cleats. In the side view of the apparatus, which shows the interior, one may perceive the neatly wound inductance coil at the bottom of the cabinet, and as will be seen, it is square in form with a number of inductances placed along the form on which it is wound. This set is designed so as to be suitable for receiving either spark or arc signals. No vacuum bulb detectors or oscillators are shown, but we know that they were used in many of the German sets, the bulb employed being that devised by Lieben and Riez.

Wireless Terms Illustrated—"Beat Receiver" —Courtesy The Oscillator.

MORE BUNQUE.

By J. A. Weaver.

I often wonder how Noah made the arc light.

And it sure does get my goat why insulators wear petticoats.

And of what possible use is a vacuum cleaner, being as a vacuum is always clean?

And whether undamped waves oscillate or vibrate?

And whether it would be murder to kilowatt?

And whether you can measure water with a wavemeter?

And how a bus-line can run from place to place without moving?

And whether it would be nice to be a miner in the mines of Asia-Minor?

And if a condenser is over charged by a conductor would it cause a disturbance on the trolley line?

And where does the dago when nite approaches?

And how to tell when onion plants armature?

And what is the price of a drink at the bus bar?

And why some boobs persist in saying a.c. current and d.c. current instead of a.c. and d.c.?

And whether there are any seeds in a transformer core.

CHAIN OF RADIO STATIONS.

The establishment of a chain of radio stations, approximately 30 miles apart along the Atlantic Coast, was announced at the headquarters of the 1st Naval District recently. The statement intimated that by this arrangement incoming vessels, when 150 or 200 miles off coast, could determine their position easily by communicating with shore stations, regardless of weather conditions. Along the 250 miles of coast included within the 1st District eight stations are already in operation.

COAST GUARD STATIONS TO HAVE WIRELESS.

In the near future radio stations will be installed at the coast guard stations at the Isles of Shoals, at Station No. 2 at Cross Island, Buck's Harbor, Me., and Station No. 8 at Damiscove Island, Boothbay Harbor, Me. A number of radio operators will be sent to these stations.

A Timely Reinforcement

A Copper Plated Stomach

By THOMAS REED

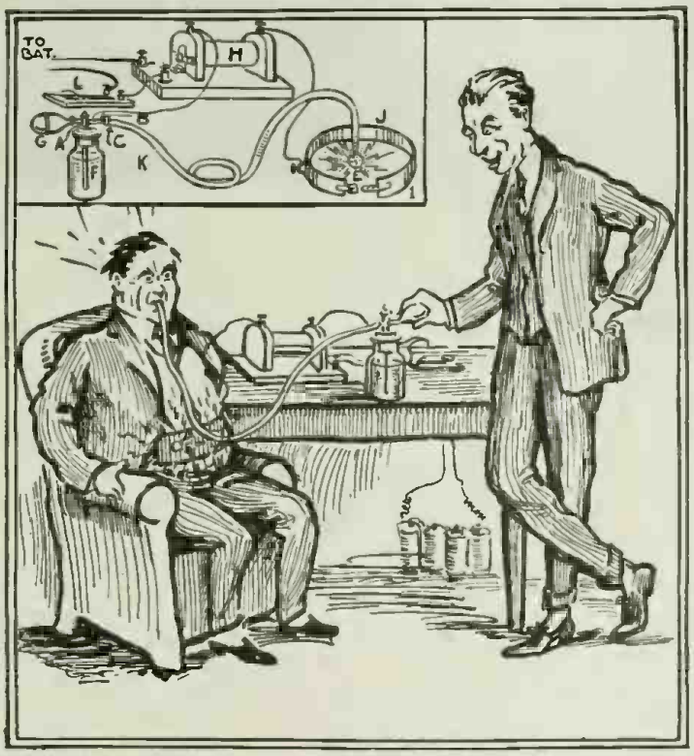
THERE'S a lot in being forehanded. Mother was that way. Every Saturday we used to have salt fish for dinner, so she wouldn't be bothered with getting up anything to eat on baking-day. That sounds like a paradox, but it wasn't, it was a shame, for the "baking" was very appetizing and savory, while the fish was—well, not so savory.

Now, when you wanted salt fish on Saturday, you had to begin way back in the week somewhere. Tuesday was a good day because there wasn't much of anything to do (on top of the regular chores) except the ironing, and you had a chance to think. Follow me carefully—you know how long it is from Tuesday before Saturday comes around? Well, mother used to plan ahead all the time, foreseeing she was going to be heated and tired, and all fust up with cooking formulas, and would need an accommodating viand for dinner that she could slap down most anywhere without hurting it, and tell us children to go to it and forget the whole business. On Tuesday she commenced *deodorizing* the fish.

You see, while the fish abode with the grocer, it was always picking up scents like coffee and spices and matches and kerosene, from the clerk's habit of wiping his hands on it in passing, and the hostler would chuck a horse-blanket on it often enough to give it a quaint stable tang. But what you'd call the basic flavor was imparted by "Tabby"—the store cat. The pile of codfish was the place where the cat slept and took her bath (the kind of dry-cleansing a cat calls a bath); also her refuge from stray dogs—or ambush, according to whether she could lick the dog or not. The result was you couldn't say the cat smelt fishy, or the fish catty, but they smelt about alike! It was a blend, like this fancy-named toilet-water you have to have pronounced for you, *eau de* something or other.

If you just wanted the fish for a smelling fish, you didn't have to do anything to it, it was all right as it was. But when you wanted to use it for an eating fish, you had to go to work and separate the fish part from the odor part, or as much of it as you could. It wasn't difficult or laborious at all, but it took time, and that's why you had to be forehanded. You put this fish into a good stout pan—a pan that wasn't particular whom it associated with—and covered it with common ordinary water. The water didn't stay that way very long. In a few hours it was most *un*common water, yelling to heaven and casting into the air bunches of assorted perfumes, like Spring-time tripping o'er the lea and scattering flowers—I mean the operation was the same, not the raw material.

When one dose of water had suffered about enough you poured it off and renewed it, and so on. If you tended right to your business thru Tuesday and Wednesday and Thursday and Friday and Saturday morning, then by Saturday noon there was your fish—transformed into a regular eating fish—at least those who had to eat it could. That's how you had to plan meals in those days—no frittering away your time at *tea-dongsongs* till the last minute, and tossing on a preserved pig's foot for supper.



To Copper Plate Human Stomachs So as To Digest the Present Post-War Foods, Thomas Reed Here Shows Us How To Set About Rigging Up the Necessary Apparatus. When You Once Receive This Treatment You Will Be Able to Swallow Nails, Old Milk Cans, Sections of Steam Boilers, Bricks, et Cetera, and Then the Undertaker Will Nail You Up.

Examples like this gave me the same habit of being forehanded. I'm always looking ahead and spying out some situation that's liable to be dangerous or disagreeable, and providing against it. It's a lucky thing I am, as it happens, and you'll say so, too, when I tell you.

Perhaps you remember we had a "war", or something like that, recently. Well, just when we were thinking it was going to last forever, we began to hear noises from the Other Side that sounded like "By gorry we've got 'em licked!" "They're quitting!" "The war is over!" "Honk-honk!" "Wow!" and other expressions of quiet satisfaction. From that moment nothing was thought of but comebacks to hand to Germany in return for her favors of the past 40 years, with the accent on the last 4—which was righto, and success to the job; but in the rush of business, a very important point was overlooked by everybody but ME. I'll tell you what I mean.

You know how thick and fast the celebrations came, along there in November? They made a record for thickness and fastness that won't be beaten till "Bill" gets back from Hell. There was the "Fake Peace Celebration" on Thursday, and the "Real One" on Monday, and the "Regular One" on Tuesday. I don't know how it was with you, but by Wednesday I had food for thought—and it was the only kind of food I was able to sit up and take any notice of.

The thought, being fed, was mainly to the effect, how nice it would have been if I'd had one of those *copper-lined stomachs* that are always being talked about and never realized. I don't know as I ever appreciated before how reliable copper is. Viewing the ruin of my faithful Gastric Cavity thru handling the few easy objects I'd sent down to it, I envied the old copper boiler at home—how it used to digest 3 or 4 bushels of the family wash, or boil up a barrel of soft soap, or a tub or two of whitewash-stunts really exacting, you know—and get away with it year after year.

Ah me, as the fellow says. With a tummy built on the lines of that boiler, one could celebrate Peace till the cows came home with their 16-cent milk, and then tackle a New Year's Eve and a couple of "wakes" on the side, instead of rueing the day—whatever that is—as I was doing.

But the real horror of the situation was this; here were a million or two of soldiers and sailors due to come home and go thru this celebration-thing multiplied to the hundredth-power. The big cities were going to stuff 'em, then the smaller branch cities, and the railroad towns, and the home towns—the strain all the time increasin as the burg grew smaller—till finally they'd fetch up at "Home" itself, the one with the Big "H", with Mother roasting chickens and frying flapjacks and baking pies in a wild effort to make up a year's deficiencies in army rations all at one meal. All that, and only an ordinary membranous stomach to stand it! Was there any time to lose? No. The copper stomach, so long postponed, had to be invented *tout de suite* if it was going to be ready for the occasion.

Well, here it is, all ready and waiting,

(*Continued on page* 927)

The Alkaline Storage Battery

By J. F. SPRINGER

STORAGE batteries are of two principal kinds—(1) the lead-acid battery, and (2) the alkaline battery. Our attention is now directed upon the latter. There is but one alkaline cell of prominence on the market—the Edison battery. Each cell is a complete self-contained unit and may be used alone or in conjunction with other cells. A typical cell will have a voltage of about 1.2 average discharge potential; the maximum discharge potential is about 1.45 volts at the start. The charge and discharge voltage characteristics are given in the accompanying graph, Fig. 1. While charging the cell voltage may rise as high as 1.85 volts. The amperage will vary with the size of the cell. By connecting a battery of cells *in series*, it is possible to run the voltage up to any desired point; see Fig. 2-A. A usual voltage for rather short circuits—under 300 feet—is 30-32 volts. Accordingly, about 30 cells are required. The battery used as a unit will have a voltage equal to the sum of the voltages of the individual cells. The amperage will remain the same as with the single cell. It is necessary, therefore, to choose a size of cell that will give the amperage required for the service or else use more than one battery, connecting the batteries—not the cells—*in parallel*, see Fig. 2-B. For a 110-volt system, a large number of cells will be needed. In making such calculations, it will be best to rate the alkaline cell at just about 1 volt. Thus, for 110-volt service use 110 cells, connected in series.

In purchasing a battery, it will be necessary to decide on the voltage to be used. There are probably more household and similar devices on the market that are designed for the 110-volt system than for any other. At the same time, there is a considerable range of such devices which are adapted to, and available for use on 30-32 volt circuits.

The alkaline cell has a tight-fitting cover. As in all batteries there will be generated a certain amount of gas; this escapes thru a special valve. The cell is well suited to rough usage, partly because of the tight cover and partly because the container is of sheet steel and not of glass or hard rubber. The liquid is of an alkaline character. It loses but little of its water as time goes on. In order to determine whether the strength is normal, a hydrometer may be used. The electrolyte consists of potassium hydrate (21 per cent solution) to which has been added a small amount of lithium hydrate. The specific gravity of the alkaline cell does not change during charge or discharge. The normal specific gravity will be 1.210, but this may drop at times to as low as 1.160 without affecting the cell. A brand new alkaline battery will not develop its full capacity at once. After a number of chargings it will settle down to a standard performance. This settlement into a standard condition is understood to be due to the improvement in the conditions of the negative plate consequent upon regular charging and recharging. This process of self-forming continues over a period of from one to three months.

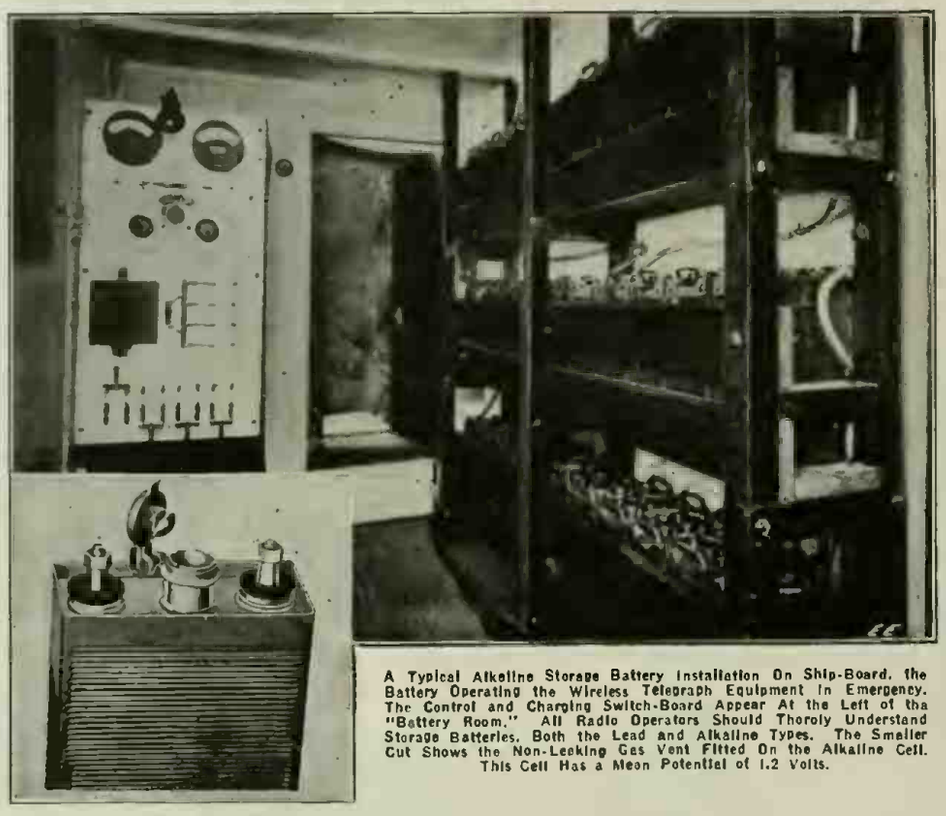
The care of an alkaline battery will ordinarily be simple. The density of the liquid may be watched and corrected, if necessary. This will usually mean the addition of a little water to bring the hydrometer reading down to 1.210. Regularity of handling will probably give better results in an alkaline battery than any other one thing. This is especially true in connection with the charging.

A battery may be charged slowly or rapidly or at a medium rate. That is, it may be done *normally* in 7 hours, or rapidly in 1 or 2 hours, or at a moderate rate in 4 or 5 hours. Slow, regular charging at the normal rate is to be preferred, if conditions make slowness conveniently possible. Whether the battery is charged slowly or rapidly, evenness of charging is always to be adopted.

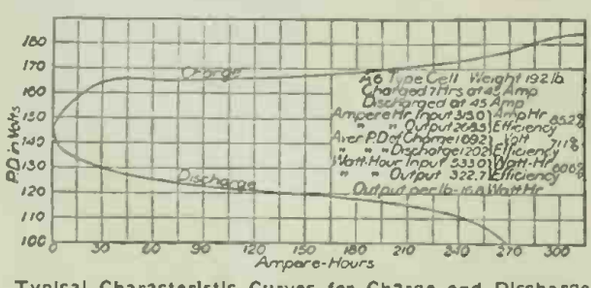
Direct current only is usable in charging. If alternating current is the only source of energy available it will be necessary to convert it into direct current and to use the latter with the battery. There are several methods which may be employed. First, there is the motor-generator. The alternating current is used to operate a motor. The motor drives the generator and produces the direct current for charging. A mercury arc rectifier is another device for converting the alternating current into direct. This device is often more economical and convenient if only a small current is to be handled.

Of course, direct current may be generated at once. The equipment necessary will be (1) an engine or some equivalent means of operating the generator; (2) a generator, and (3) a switchboard. It would probably be cheaper to use the current direct from the generator to operate the lights, etc., and to dispense with the storage battery, if the current were required in a steady, even stream. But current is not ordinarily required thus in a home or on board a boat.

(*Continued on page* 931)



A Typical Alkaline Storage Battery Installation On Ship-Board, the Battery Operating the Wireless Telegraph Equipment In Emergency. The Control and Charging Switch-Board Appear At the Left of the "Battery Room." All Radio Operators Should Thoroly Understand Storage Batteries. Both the Lead and Alkaline Types. The Smaller Cut Shows the Non-Leaking Gas Vent Fitted On the Alkaline Cell. This Cell Has a Mean Potential of 1.2 Volts.



Typical Characteristic Curves for Charge and Discharge of Edison Type Alkaline Storage Battery. The Average Discharge Potential Is Seen to Be 1.2 Volts. Fig. 1.

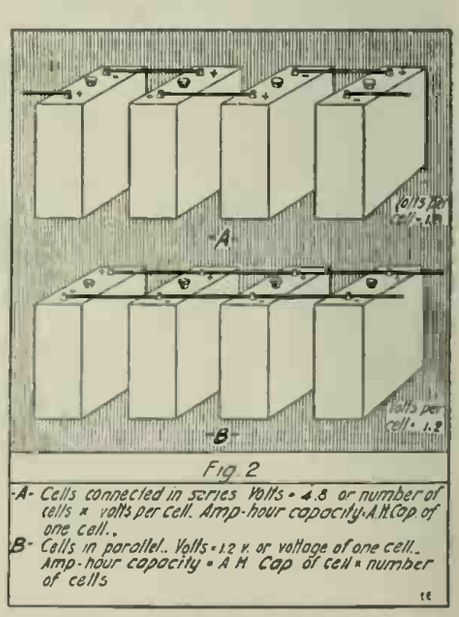


Fig. 2

-A- Cells connected in series Volts = 1.2 or number of cells × volts per cell. Amp-hour capacity A.H. Cap of one cell.

-B- Cells in parallel. Volts = 1.2 v. or voltage of one cell. Amp-hour capacity = A.H. Cap of cell × number of cells

Diagram Showing Voltage and Amperage With Series and Parallel Connections of Battery Cells.

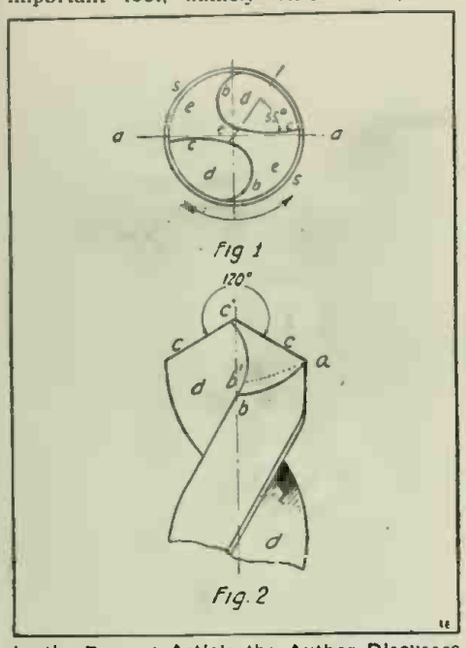
Experimental Mechanics

BY SAMUEL D. COHEN

LESSON XI

THE THEORY OF TWIST DRILLS.

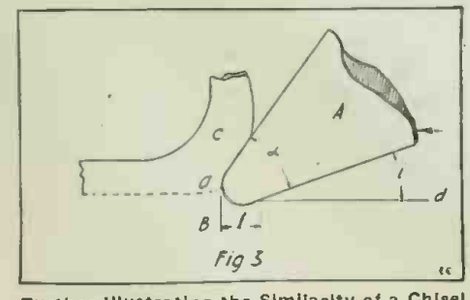
THE student who has been following the past lessons in "Experimental Mechanics" may now find himself confronted by a more or less difficult task in properly utilizing a very important tool, namely—*twist drills*, and



In the Present Article the Author Discusses the Theory of Twist Drills, the Shape of the Grooves, the Pitch of the Cutting Edges, Et Cetera. The Lips C-C May Be Considered as the Cutting Edges of Two Chisels, Which Turn about the Axis of the Drill.

the writer gives below a brief resumé of the subject of twist drills and their grinding. Because it is very essential to follow understandinly the subject of twist drills, a short mathematical treatise of simple nature will be given in order to more readily facilitate the understanding of the subject.

The twist drills stand in use so far above flat drills that they are now an indispensable tool in every workshop for metal working. They may be manufactured by milling or forging two spiral grooves out of a cylindrical bar, or by twisting a bar of the desired cross-section, so that the lines originally running parallel to the axis become spiral lines. The first method of manufacturing is today still the most common one. When we take a spiral drill and turn it with the top towards us, we shall see it as shown in Fig. 1. *dd* are the spiral grooves, *cc* both cutting edges, so the drill will have to turn in the direction of the arrow. *ee* is the solid part of drill; the top of the drill nearest to us is the edge c^1, which unites the two edges *cc*, making an angle of about 55 degrees with each of them. The cylindrical surface of the drill at *ss*, only exists for the part *aa*, for, to prevent unnecessary friction against the walls of the hole, the rest of the surface is brought to a somewhat smaller diameter. Sometimes the surface *s*, is gradually backed off, beginning at the edge without a distinctly perceptible step, as in Fig. 1. The profile of the grooves *dd*, is chosen so that the intersection with the top plane *b*, gives as far as possible a right angle line *C*. The shape of the line *b* is of lesser importance provided that the groove *d* is wide enough to allow the chips to pass easily. The dimension of the weakest point of the drill where the edge c^1 is found, is fixt by the demand of strength in the drill. The edge c^1, which cuts very badly, should he as short as possible. Ordinarily, it is taken 1-10th of the diameter at the point of the drill and gradually increases to the upper end, for reasons of strength.



Further Illustrating the Similarity of a Chisel Cutting Into a Piece of Metal to the Two Cutting Edges of a Twist Drill.

When looking at the drill sideways we now see it as shown in Fig. 2; *cc* are the sectants which form together an angle of about 120 degrees, c^1 the connection, *dd* the grooves, the pitch of which amounts to 5 to 8 times the diameter of the drill. We consider *cc* as being the cutting edges of two chisels, which, turning around the axis must cut chips from the metal. The form and the position of these chisels in regard to the metal will have to answer the same requirements as every other cutting chisel, which are these: In Fig. 3 *A* represents a cross-section of the chisel, *B* the piece of work from which the chip *C* is cut by moving *A* in the direction of the arrow.

To prevent the chisel breaking its cutting edge—the angle α—obtained by grinding, and therefore called the *grinding angle*, must be sufficiently strong. For cutting mild steel and iron α is made upon an average of about 55 degrees; with very good steel the angle can be some degrees smaller; with a poorer grade steel it must be some degrees larger. The loosening of the chip from the metal is not done at the lowest point of the chisel, but at *a*, being the point most advanced. The metal is pushed down at a length *l*, Fig. 3, and thereafter returns to its level *a-d*. The smaller the angle *i*, which may be enlarged or diminished by the position of the chisel, the longer *l* will be, and the greater will be the resistance of the metal being pushed down. Experience tells us how large the angle *i* must be; it varies between 4 degrees to 8 degrees for lathe and planer tools. We shall see how great it must be made for twist drills. In no case may it be smaller than 4 degrees, or the chisel will refuse to cut.

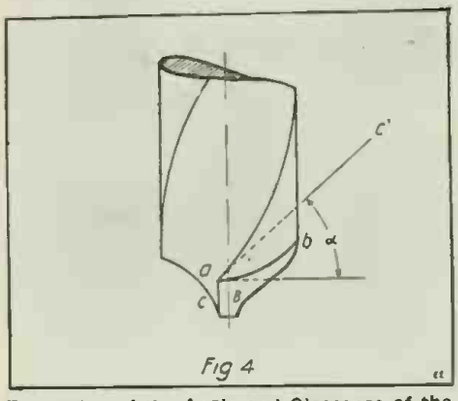
Don't Miss the Next Lesson—"Grinding Twist Drills."

It will discuss the various factors involved in properly grinding twist drills, both by hand and machine or jig. A real practical article which every amateur machinist will want to read.

Referring to Fig. 4, the point *a*, of the cutting edge *c*, situated on the cylindrical surface of the chisel, we find the grinding angle *a*, appointed by the tangent to the spiral and by the tangent to the line *ab*, sectant of the cylindrical surface of the drill, and the ground top *B*. So the size of this angle is determined with regard to the strength of the edge and practically amounts to about 55 degrees. Then follows the angle *i* in Fig. 3; where to find it. While turning around on its axis the drill advances into the metal. So each point describes a spiral line with the pitch equal to the feed of the drill for one revolution. These spiral lines, however, are of unequal diameter. Point *a*, in Fig. 4, on the circumference of the drill is given in Fig. 5, as if moving on the spiral line a^1a. The diameter of the drill being $D = 1$ in. and the feed 1-50th in.; the inclination of the spiral line is found by:

$$\text{Tan } \beta = \frac{\text{feed}}{\text{circumference}} = \frac{1}{50 \times \pi} = 0.00637$$

$$\beta = 0° 22'$$



Discussion of the Angle and Clearance of the Cutting Edge of a Twist Drill.

Point *a*, in Fig. 4, at a distance of 1-20th in. from the drill axis, describes the spiral line c^1c with the same pitch *h*, Fig. 5, as a^1a; the angle of inclination γ however, is quite a different one; for the case of 1-20th in. it is:

$$\text{Tan } \gamma = \frac{1}{50 \times \pi \times 1/10} = 0.0637$$

$$\gamma = 3° 39'$$

In Fig. 5 the value *h* of the feed has been given immoderately large for the sake of clearness, and the angle γ has consequently been drawn much larger than it is in reality.

The spiral lines, a^1a and c^1c, are the lines in regard to which the angle *i*, in Fig. 3, has to be measured. They agree with the line *a-d*, in that figure. From this it follows that for point *a* of the drill the setting angle *i* is measured in regard to the line, inclining already 0° 22', and therefore must be so much greater than usually. For point *c* this difference becomes 3° 39'. The setting angle becomes a changeable value, increasing towards the center of the drill. In giving it everywhere the same value for simplicity's sake, that is to say the largest cutting cross-section desired in the center, the edge would become too weak at the circumference.

With the above facts in mind the writer will give a complete practical discourse on how to handle twist drills, grinding, *et cetera*, in the next installment.

(To be continued)

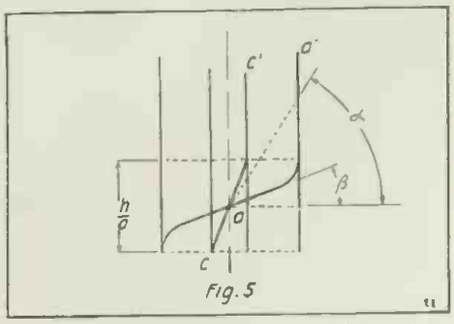


Diagram Used in Explaining the Value of the Angles of Grinding of Twist Drills.

Practical Chemical Experiments

Butter and Butter Substitutes

By ALBERT W. WILSDON

BUTTER is obtained by skimming the milk and putting it thru the process of churning, the globules coalesce and the solid fat separates more or less thoroly from the other constituents of the milk. As found on the market, butter is rarely found to contain more than 80 to 85 per cent fat; the rest

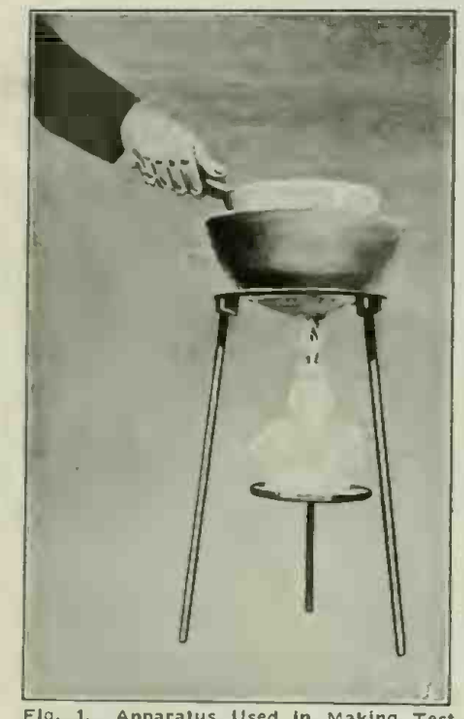


Fig. 1. Apparatus Used in Making Test for Butter and Oleomargarin or Renovated Butter.

being principally water, with some proteids and lactose from buttermilk still remaining in it, and more or less salt or saltpeter, to flavor and preserve it. It quite frequently is colored with some harmless vegetable compound.

Oleomargarin is usually prepared from the fat contained in the intestinal folds of beef cattle. It is carefully stript from the fresh carcass, washed, chilled and hashed exceedingly fine. It is then *rendered* in water-jacketed kettles at a temperature of about 50 deg. C. The scum which separates out at the top is drawn off and the scraps settle at the bottom. The liquid fat is then run into vats and there permitted to stand for a day or two at about 27 deg. C., at which temperature butter is just liquid. The semi-liquid mass is then wrapt up in cloths and prest to remove the thin yellow liquid oil (oleo oil) from the solid fat (oleo-stearin). To turn this liquid oil (oleo oil) into a very good substitute for butter it is churned with some milk so that it can absorb some of the butter taste, then some coloring matter is added (vegetable compound), and the mass is finally run into ice-water, thus chilling it rapidly. It can then be salted and packed like ordinary butter. Two marked advantages which this material has over butter are: (1) It is much cheaper, and (2) owing to the absence of buttermilk and butter fats it has much better keeping qualities. Its flavor ranks well with second-class butter.

"*Renovated*" or "*Process*" butter is in general prepared as follows: Old, rancid, and unsalable butter is melted in a large vat surrounded by a hot water jacket at a temperature of about 45 deg. C. The curd and brine are then drawn off at the bottom, the scum being taken off at the top. Air is blown thru the mass, to remove the disagreeable odor, and after mixing with some milk, the mass is churned and then run into ice cold water to make it granular in structure. It is then ripened, worked to free it from buttermilk and salted. It is required by law in some states that this product be marked "Renovated Butter."

SIMPLE TEST FOR BUTTER

Experiment No. 1. See Fig. 1.

Heat about 3 grams of the sample in a large iron spoon over a low Bunsen flame, stirring constantly. Genuine butter *will boil quietly*, with the production of considerable froth or foam, which may, on removal

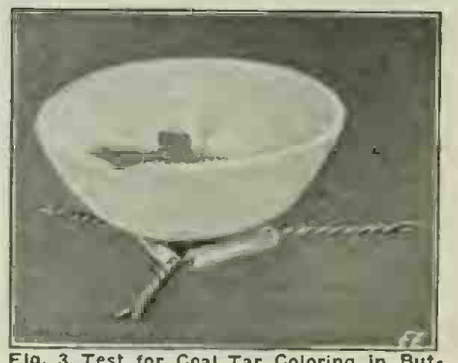


Fig. 3. Test for Coal Tar Coloring in Butter Which Can Be Made by Anyone in a Few Minutes' Time.

from the flame, boil up over the side of the spoon. *Renovated butter* or *oleomargarin* will sputter and act like hot fat containing water, but will not foam. Examine also the curdy particles when the sample is removed from the flame; in the case of genuine butter these particles are *small* and *finely divided*, but in the case of oleomargarin the curd *will gather in large masses.*

MILK TEST FOR BUTTER

Experiment No. 2. See Fig. 2.

To make a "milk test" for butter, place

Fig. 2. Set-up of Simple Apparatus Utilized in Making the "Milk Test" for Butter.

about 60 cc. of sweet milk in a wide-mouthed bottle, which is set in a vessel of boiling water. When the milk is thoroly heated, a spoonful of the butter is added and the mixture stirred until the fat has melted. The bottle is then placed in a dish of ice-water, and the stirring continued until the fat solidifies. If the sample is butter, either fresh or renovated, it will be solidified in a granular condition and distributed thru the milk in *small particles*. If, on the other hand, the sample consists of oleomargarin, it solidifies practically in *one piece*, so that it may be lifted by the stirrer from the milk.

By the two tests just described, the first of which distinguishes fresh butter from process butter or renovated butter and oleomargarin; and the second of which distinguishes oleomargarin from either fresh butter or renovated butter, the nature of the sample examined may be determined.

Every house-wife should know how to test butter and oleomargarin and the important differences between them. That is one object of the present paper. The author trusts it proves of value.

BEGINNING with this issue, "EXPERIMENTAL CHEMISTRY", as will be noted, has been changed to "PRACTICAL CHEMICAL EXPERIMENTS." For several years past, Mr. Albert W. Wilsdon, who will continue the new department, has become familiar to our readers thru his chemistry articles. There has, however, been an urgent demand from our readers for articles on everyday chemistry, practical experiments, etc. We are, therefore, beginning with this issue a series of practical chemistry, free from technicalities. We think the change will be welcomed by our friends.

In the same department we are also inaugurating a Question and Answer Department, and every reader is invited to ask any question on chemical phases which may occur to him. Such questions will be answered every month hereafter in these columns. When sending questions, they should be addrest to "Editor, Chemistry Department."—Editor.

(*Continued on page* 894)

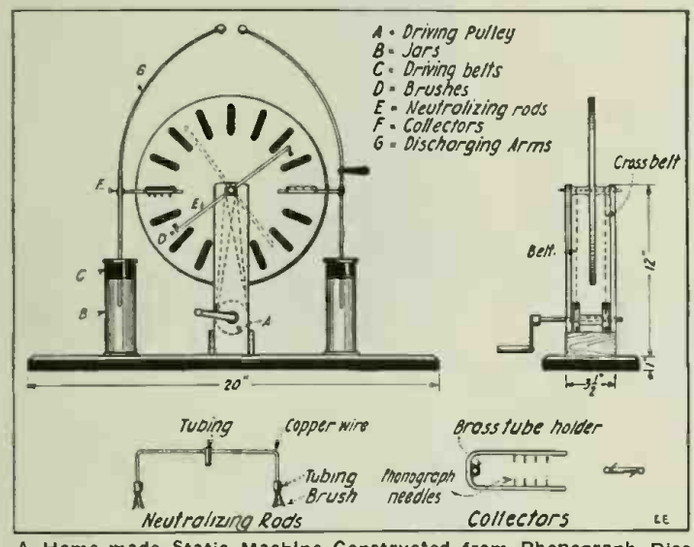
This department will award the following monthly prizes: First Prize, $3.00; Second Prize, $2.00; Third Prize, $1.00.
The purpose of this department is to stimulate experimenters towards accomplishing new things with old apparatus or old material, and for the most useful, practical and original idea submitted to the Editors of this department, a monthly series of prizes will be awarded. For the best idea submitted a prize of $3.00 is awarded; for the second best idea a $2.00 prize, and for the third best prize of $1.00. 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, $3.00

A SIMPLE WHIMSHURST INFLUENCE MACHINE.

By Melville Fisk.

THE static machine described herein is made of simple materials, is easy to construct and the work does not require the use of special tools. A similar machine built by the writer produces a violent and steady spark discharge about an inch or more in length, without the use of Leyden jars.



A Home-made Static Machine Constructed from Phonograph Disc Records.

The plates are two twelve-inch phonograph records of the disk type. Select two which have one side blank. The tinfoil sectors are cemented to the smooth side. It is not necessary to varnish the plates. The bosses that keep the plates parallel on the shaft are small cotton spools, that have a hole in them the size of the one in the record. Fit the spools up with brass tube bearing and fasten to the plates with glue. A thin cloth or paper washer inserted between the boss and plate will help the glue to hold. Rubber tire cement will hold better if at hand. The shaft on which the plates revolve extends out ¾ of an inch on either side of the wooden standards; it is held stationary by a cotter pin inserted in a hole bored down thru the top of the standard. Glue a cardboard washer 1½ inches in diameter to the inside of one of the plates. The base and standard are made of wood in the manner illustrated.

Make the double driving pulley from a large spool such as wire is sold on. Fasten it to the shaft by drilling thru the shank and shaft and inserting a cotter pin or screw. Be sure and make the grooves in the pulleys deep enough to hold the belts securely. Rubber bands tied together make very good driving belts. Tie them with strong linen thread and leave a half inch of slack between each band. As the plates are to revolve in opposite directions, cross one belt.

The neutralizing rods are made from ⅛ inch copper wire bent to shape. They are pivoted on the protruding ends of the shaft by a short piece of tubing soldered to the center. Press the tubing slightly together at the open end to make it grip firmly. The brushes are made from very fine copper strands secured from wire such as is used in receiver cords (gilt tinsel). Cut about twelve strands two inches long; tie a knot in the center, and fold over so that all ends are together. The brushes are then slipt into the small tubes soldered onto the ends of the rods and are fastened by squeezing the end of the tube together.

Make the collectors as per sketch, using heavy copper wire. The points are long phonograph needles, fastened to the arms by drilling and then soldering. The needles should be slanted slightly in the direction in which the plate rotates. The supports are brass tubing, soldered on.

The discharging arms are of brass rod of a size that will fit in the collector supporting tubes. Make a small dent in each tube so that the rods do not slip all of the way thru. Fit balls to the ends of the rods by boring, then pegging and soldering.

The jars are used as supports only. Varnish them inside and out and fit with stoppers, bored to hold the collector tubes. A simple stopper is made by cutting a large wire spool in half and then winding paper around the shank to make a fit with the jar. Before using soak the stopper in melted paraffin. Further insulation can be obtained by placing pieces of a broken record under the jars. Glue the jars to the base.

In operation the neutralizing rods should be at right angles to each other, the best angle, however, can easily be found by trial. The brushes should touch the plates lightly—no pressure is necessary. The collector points should be about ¼ inch away from plates. Be sure that they are all the same distance away or else some will not contribute to the collecting. The distance between the plates should be about ⅛ to ¼ inch.

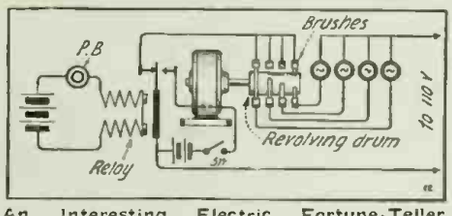
SECOND PRIZE $2.00

BLINKING LIGHTS TELL YOUR FORTUNE.

A glance at the illustration will show that while the magnet side of the relay is open, the small battery motor is running, revolving the drum. A gear may be used if a slower speed is necessary. When the push button is prest, the armature of the relay is attracted, breaking the motor circuit and making connection on the other side of the relay which goes to the one set of brushes on one side of the drum. The armature is itself connected to one side of the battery for the motor, and to one side of the current supply for the lamps. On the other side of the drum are the brushes connecting to the different rings on the drum. These brushes also connect with the various lamps which are again connected to the other side of the current supply for the lamps. As the button is prest, the motor stops and the circuit thru one of the lamps is made, the particular lamp depending upon the position of the drum when the motor stopt. In front of each lamp is a pane of glass on the back of which is pasted the fortune telling matter. The front of the glass may be painted with a thin white paint.

Contributed by

WILLIAM F. HAASE, JR.

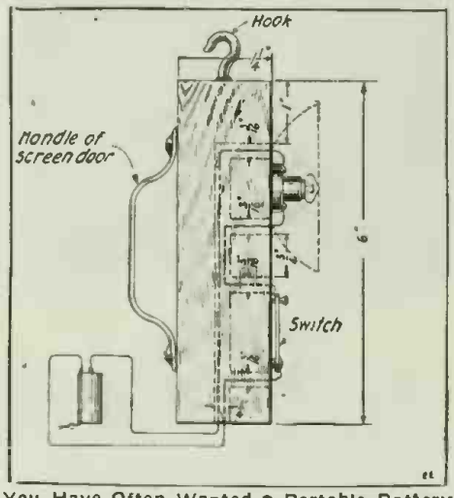


An Interesting Electric Fortune-Teller, Which Will Provide Hours of Amusement.

THIRD PRIZE, $1.00

PORTABLE BATTERY HAND LAMP FOR THE HOME.

The articles for the construction of this lamp can be purchased at a small sum, if you haven't them at home. Flexible lamp wire is the best for the wiring of this light.



You Have Often Wanted a Portable Battery Hand Lamp—Here's How to Make One at Practically No Cost.

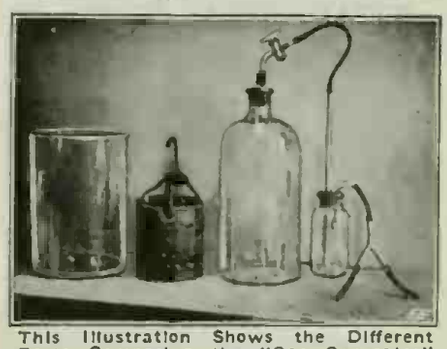
About ten feet of wire is needed, when a large dry cell is used which cannot be carried around. For a pocket (flashlight) battery only a few feet is necessary. By means of the hook the lamp can be hung anywhere or in any corner on a nail, etc. A 1½ volt tungsten lamp is right for a single dry cell. A reflector adds greatly to the efficiency of the light.

Contributed by RAYMOND WAGNER.

A Simply Constructed Gas Generator

By IVAN CRAWFORD

AMONG the automatic gas generators on the market there are few within reach of the average experimenter. To meet this condition, Prof. C. D. Dilts has recently developed a generator which may be easily and cheaply constructed. In experimenting with qualitative analysis a constant supply of hydrogen sulfide is essential. This generator, being self-regulating, will furnish a constant flow of hydrogen sulfide, carbon dioxid, or hydrogen. The principle of operation is the same as that of the well-known Kipp generator, namely that when the gas formed is not allowed to escape the solid material is automatically raised out of the liquid, but when the pressure is relieved the solid substance is lowered into the liquid, and the generator begins to function. As will be seen in the drawing, the four parts are: first, a glass jar or container; second, a bottle of slightly smaller diameter, with the bottom removed, and fitted with a stopcock in the top; third, a lead basket for holding the solid material; and fourth, a small wash bottle.

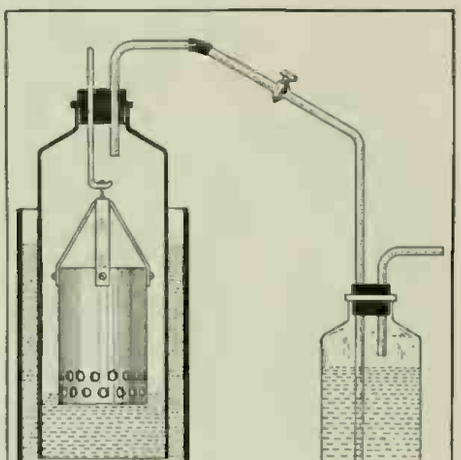


This Illustration Shows the Different Parts Composing the "Gas Generator" Here Described.

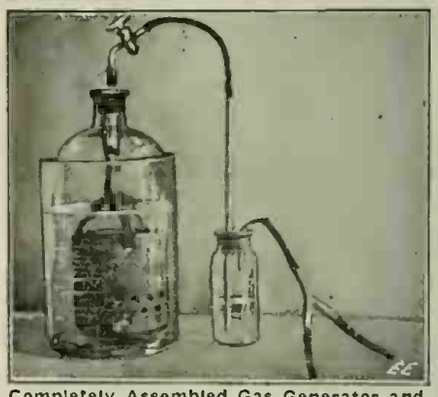
The glass jar may be easily made by cutting off the top of a large bottle. There are many methods which may be employed in removing the bell of the bottle, but by far the best and surest is the one described below.

Several long strips of newspaper, about an inch wide, should be soaked in water and wound about the bottle in two bands at the place where it is desired to break the bottle. About a quarter of an inch should be left between the two bands. The bottle should then be slowly revolved with the hands, allowing a blow-pipe flame to play upon the exposed part between the bands. When this portion is heated sufficiently the application of a drop of water will cause the glass to be evenly broken. The edges should then be smoothed on a soft grindstone. The bottom of the smaller bottle is removed in the same manner.

The sheet lead for the basket may be procured at any plumbing shop. It may be easily bent to the required shape, leaving small holes in the bottom to allow the acid to enter. The basket is suspended by means of a closed piece of glass tubing, bent to form a hook, which runs thru the two-hole stopper. The delivery tube from the bottle may be fitted either with a glass stop-cock or with rubber tubing and metal pinch-cock. Altho not absolutely necessary, a wash bottle is a desirable addition to the generator, as it not only steadies the flow but cleans and purifies the gas.



Sectional View of Gas Generator.



Completely Assembled Gas Generator and Wash Bottle.

The apparatus should now be assembled as is illustrated in the drawing and photograph. The solid material, such as iron sulfid (when H_2S is desired) is placed in the lead basket and the dilute acid in the glass jar. When the smaller bottle is placed in the jar the acid, reacting with the iron sulfid, engenders a flow of H_2S which forces the acid out of the basket if the stop-cock is closed. When the stop-cock is opened, the gas escapes and allows the acid to touch the iron sulfid, again causing the formation of H_2S. Thus gas is always easily procurable without waste of material.

TESTED CHEMICAL LABORATORY STUNTS.

1. *Spoons That Will Melt in Hot Water.*—Fuse together in a crucible 8 parts of bismuth, 5 of lead, and 3 of tin. These metals will combine and form an alloy, of which spoons can be easily made which possess the remarkable property of melting in hot water, coffee or tea.

2. *A Self-dancing Egg.*—Take a thin glass tube about 3 inches long and fill it with mercury then seal both ends with good hard wax. Next have an egg boiled and then break a small piece of the shell from the smaller end and thrust the tube with the mercury in, lay it on a table and it will not cease tumbling until the egg is cool. The same can be done by taking a small bladder putting a little mercury inside and blowing it up, then warm the bladder, it will skip about as long as the heat remains.

3. *To Give a Piece of Charcoal a Coat of Silver.*—Lay a crystal of silver nitrat upon a piece of burning charcoal; the metallic salt will catch fire and will emit sparks of various colors. The silver is reduced, and, in the end, produces upon the charcoal a very brilliant and beautiful appearance.

4. *In Water But Not Wet.*—Powder the surface of a large or small vessel of water with some lycopodium, which may be obtained at any drug store; you may then challenge any one to drop a coin into the water, and that you will get it without wetting your hand. The lycopodium adheres to the hand and prevents its contact with the water.

5. *Artificial petrifactions* (turning into stone).—In a retort place a small quantity of pounded fluor-spar and sand, and pour upon it some sulfuric acid; fluosilicic acid gas will be disengaged, holding silex in solution. The subjects you wish to petrify must be moistened with water and placed in a vessel connected with the neck of the retort, the silex will be precipitated upon them like a frost and will have a beautiful appearance. It will wear for years. Note—Do not breathe in this gas.

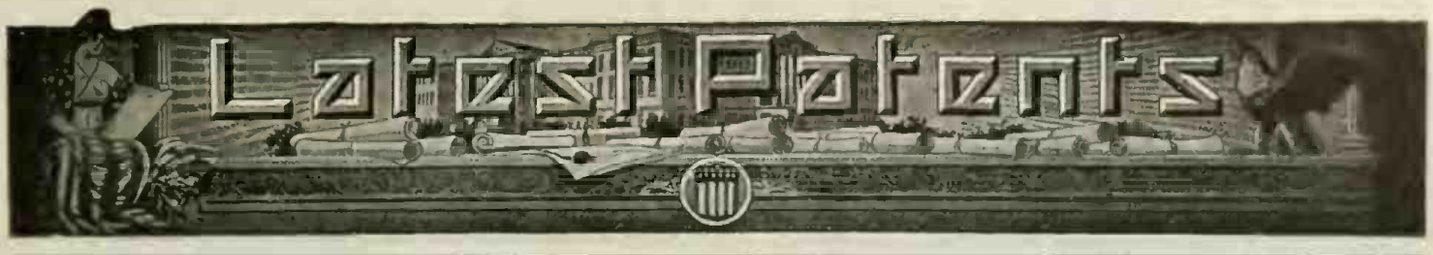
6. *An Experiment With Sugar.*—Take about 5 or 6 pieces of lump sugar and place them in a cup; next pour about 3 tea spoons full of boiling water upon them, and then add some sulfuric acid. It is truly a wonderful spectacle, and more instructive than reading, to see the sugar turn black, then boil, and now, rising out of the cup in a black color. It is now charcoal.

7. *To Melt Steel.*—Heat a piece of steel to redness in a fire, then hold it with a pair of pincers. In the other hand take a stick of brimstone or roll sulfur and touch the piece of steel with it. Immediately after their contact the steel will melt and drop like melted butter.

8. *Explosion Without Heat.*—Take a crystal or two of nitrat of copper and bruise them; then moisten them with water and roll them up in a piece of tin-foil, and in a minute the foil will begin to smoke and soon after will take fire and explode. Unless the crystals of copper are moistened, no heat will be produced.

9. *To Melt Lead in Paper.*—Wrap up a very smooth piece of lead in a piece of paper, then hold it over the flame of a taper; the lead will be melted without burning the paper providing there are no wrinkles in the paper and that it is in contact with the lead everywhere.

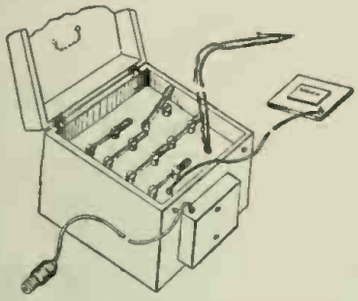
Contributed by EUGENE McGOWAN.



Electric Engraving Apparatus

(1,289,000; issued to Andrew M. Robinson)

An electric engraving apparatus employing a source of electric current forming an arc to produce the engraving. It consists of an ap-

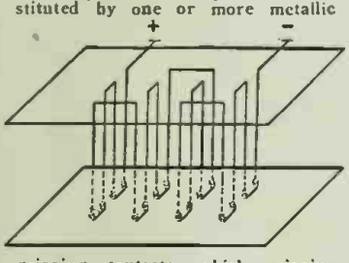


paratus employed with graduating tools, etc., for marking metal parts of machines, etc. A further object in the invention provides an auxiliary electric current or circuit connected to the pencil, and means in the pencil for controlling the make and break of the auxiliary circuit, to open and close the main circuit so as to prevent arcing when it is raised from the work. This apparatus eliminates this objectionable feature. The case contains a transformer, also a number of switches, by which the character of the current may be varied at will.

Current Modulator

(1,288,117; issued to Francesco Morano)

The chief object of this invention is a metallic microphone for high currents, which microphone is constituted by one or more metallic



gripping contacts, which gripping contact is formed of two contact elements, so arranged that one of them grips the other. The vibrating element is firmly mounted by the diafram, while the other element is supported by such means that the pressure of the contact which is formed by both elements accurately affects it. In consequence, the electrical resistance of the contact itself may be capable of varying in rigid conformity with the vibrations of the diafram according to the amplitude of said vibrations.

Apparatus for Locating Sunken Bodies

(1,287,907; issued to Patrick B. Delany)

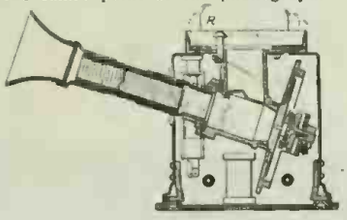
Sunken ships and bodies, by the use of this invention, may be found very readily. It is an electrically operated device, used with some form of communicating device, such as a telephone receiver, and acts upon the principle of the circuit

being closed, and having normally a certain definite resistance, i.e., the inventor does not use coils conductively or otherwise for the detection. The bare electrode is lowered by means of an insulated wire thru the water, and depends upon actual contact with some metallic body for its location. The circuit is formed thru a pair of sensitive head receivers, the bare electrode, the water and the electrode, and normally is of high resistance.

Recording Telephone

(1,290,621; issued to John F. Malthaner)

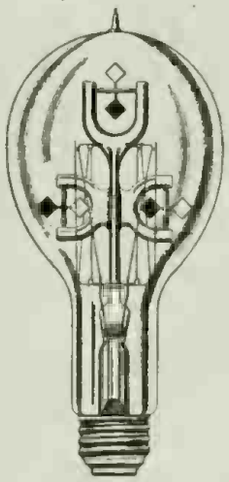
A new form of recording telephone, more or less on the style of the dictating telephone. A device in convenient size and weight for use on office desks, etc. It is so constructed that it may be used for receiving direct dictation over the phonograph, and also may be used to receive telephone messages from the ordinary telephone receiver, and in this manner to record the same on a phonograph record. Particular attention is attached to a new form of reed diafram constructed of the same width from end to end; approximately at its center is mounted a square soft iron disc held in place by clips, which on its underside has a holder for supporting the saffire point of the phonograph.



Advertising Lamp and Radiometer

(1,290,749; issued to Edward J. Hunt)

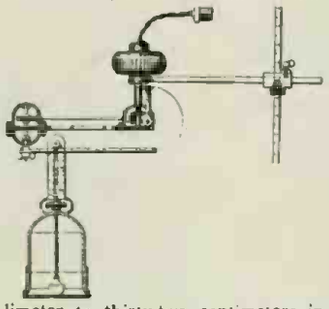
The device consists of a motor operating on the principle of the radiometer, in which the moving motor elements are caused to rotate upon their axes by the action of light. The device is primarily intended to be inserted with the enclosure of any ordinary incandescent lamp bulb and combined with the filament support in a manner permitting the use of the usual lamp filament, so that the light issuing therefrom shall cause the rotation of the several motor vanes. The motor element consists of a series of vanes, preferably four or more, which are silvered upon one side and blackened upon the other side with carbon or lamp black.



Radium-Applicator

(1,288,048; issued to George Kunkle)

A radium applicator adapted for the use of radium and other radioactive salts. The applicator is properly calibrated in advance and so arranged that the physician using it can accurately measure and administer by any of the approved methods the correct dosage at any moment by a simple adjustment of its parts. This instrument automatically and evenly irradiates surfaces of widely variable areas, as, for instance, areas of from one mil-

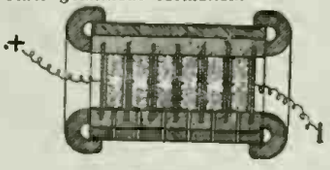


limeter to thirty-two centimeters in diameter.

Secondary Or Storage Battery

(1,285,660; issued to Bruce Ford)

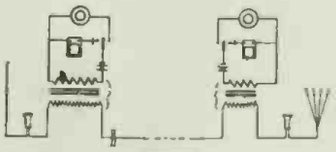
A new type and form of storage battery, its principal object being to minimize leakage between cells and still have a multiple voltage battery of sufficient strength to withstand the stresses and wear acting on such a battery. The structure may be described as a number of plates having a central portion, one face provided with a negative formation and the other face having a positive formation, with a rim projecting beyond both formations so as to fit and be prest into soft rubber tubing, which will make it nonleakable. The spaces between are filled with an electrolyte, which may be any plain liquid, or else held soaked in blotting paper or some other gelatinous formation.



Method of Telephonic Transmission Without Return-Wire

(1,287,180; issued to C. Bardeloni)

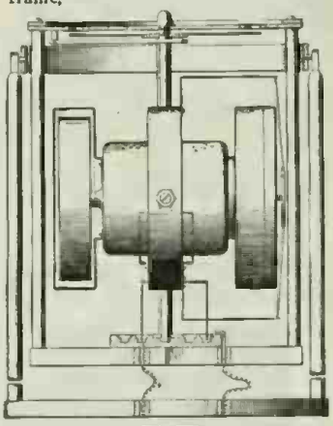
A new method of transmitting speech without a return wire. It is sometimes necessary to use a single wire for telephonic transmission without earthing its end. A condition like this might exist in connection with an observation balloon where the stringing of the separate telephone cable would not be feasible. Under these conditions the circuit does not close by conductivity, but remains as an open circuit, the return being formed by one or more metal conductor squares, electrostatically and electromagnetically connected between each other. This invention has the object of effecting telephonic transmission by the variations of the electrostatic and electromagnetic conditions, without any metallic conductors, or the earth, connecting the extremities of the system.



Compass-Gyroscope

(1,289,813; issued to Emil Klahn)

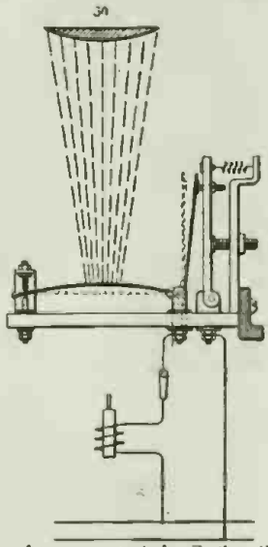
The invention consists primarily in mounting the gyroscope so that at all times it is unaffected by gravity, and in utilizing this potential function of the gyroscope to regulate the position of the controlled member, when a disturbing force is acting on the gyroscope. Its application is mainly a non-magnetic compass, when such disturbing or directive force results from the rotation of the earth, and for movements and changes in the course of a vessel carrying the compass, and apparent rotation of the compass card or controlled member taking place and serving as a measure of the change in course. The gyroscope is a means to partly suppress freedom of rotation about its vertical axis and a frame within which said gyroscope is pivotally mounted. A resilient means is connected with the frame adapted to work on the gyroscope, when the control member or compass card is in connection with said frame.



Thermostat

(1,287,188; issued to Henrich Beck)

A new design of thermostat, which to a certain extent eliminates many of the troublesome factors of the old style instrument. This type of thermostat is one which employs but one movable contact, the other being fixt, altho adjustable, and the two thermostat elements generally control the single movable contact, in response to a variation in temperature. But only one is subject to the action of radiant heat, and acts directly upon the carrier, and thereby acts directly upon the movable contact. The heat ray



may be concentrated on the thermostatic element by means of a condensing lens. When the element is at a normal room temperature it is straight, but when the radiant heat strikes the thermostatic element, then it curves slightly upward, moves a crank upon the carrier, which presses the fixt contact, thereby closing the circuit.

With the Amateurs

Our Amateur Laboratory Contest is open to all readers, whether subscribers or not. The photos are judged for best arrangement and efficiency of the apparatus. To increase the interest of this department we make it a rule not to publish photos of apparatus unaccompanied by that of the owner. Dark photos preferred to light-toned ones. We pay $3.00 prize each month for the best photo. Address the Editor, "With the Amateurs" Dept.

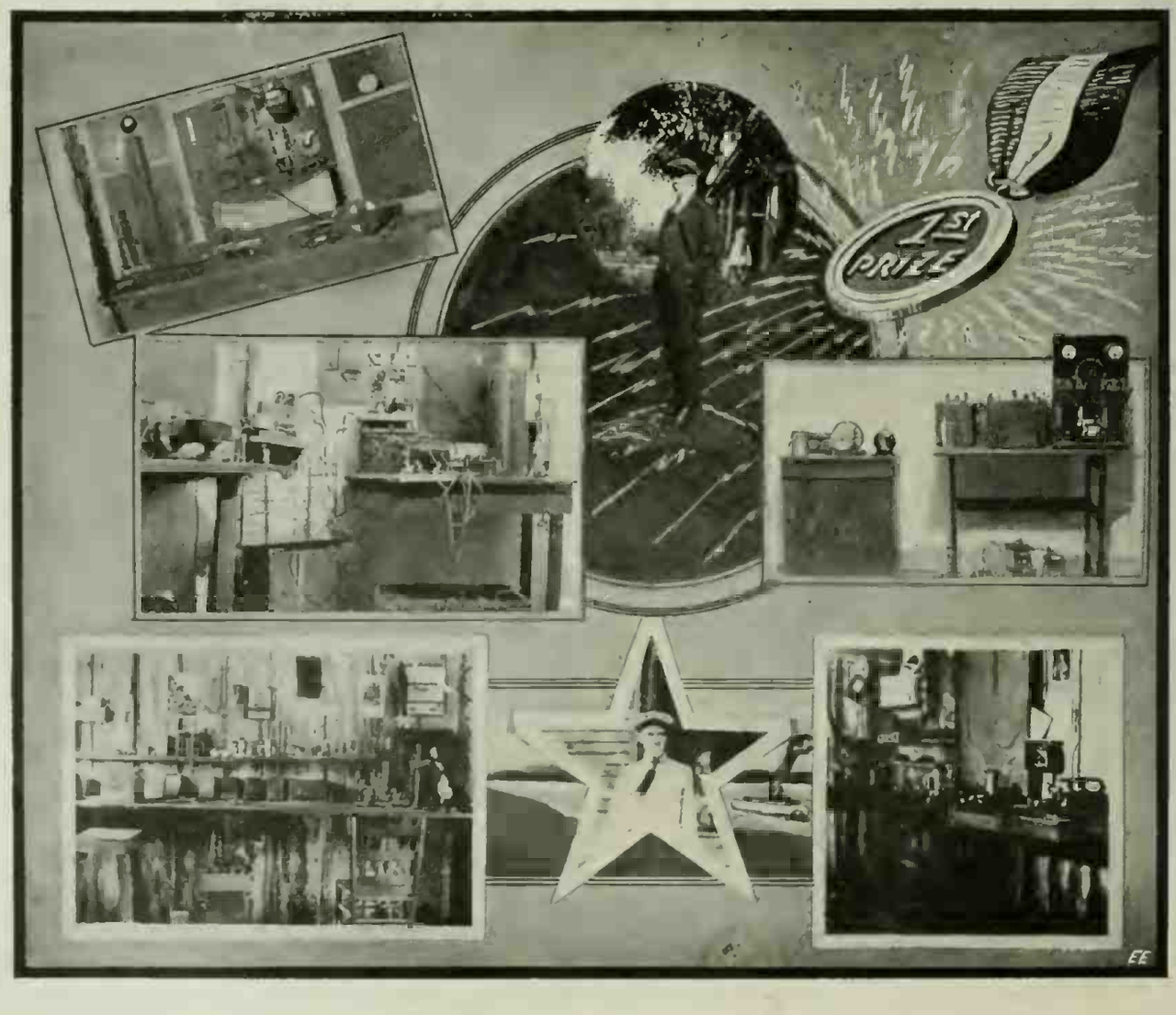
"Amateur Electrical Laboratory" Contest

THIS MONTH'S $3.00 PRIZE WINNER—RAYMOND L. CASSELL

HEREWITH I present three pictures of my Electrical Laboratory. In this "Lab" you can find anything from a binding post to a six hundred thousand volt Tesla coil. I have constructed two high potential transformers and one welding transformer with an output of three volts and five hundred amperes. Practically everything in this "Lab" was built by me. There are several motors, both A. C. and D. C., dynamos, about a dozen spark coils, transformers, storage batteries, small steam engine, rectifiers, Tesla coil (Oudin type), switches of all kinds, telegraph instruments, condensers, volt and ammeters, et cetera. I can get a twelve to fourteen inch spark from the Oudin coil. If the spark is not drawn off, it will brush discharge to a length of ten inches, crackling and waving like a thing alive. I perform some very interesting experiments with the coil. I also have a small storage battery set with a separate switch-board for charge and discharge. I have a search-light (arc), which will throw a beam about two miles. I operate this on a 110 volt circuit with a transformer built for the purpose. I am now building a 330 watt D. C. dynamo. I experiment with about everything going and a lot more.—Raymond L. Cassell, Roanoke, Va.

HONORABLE MENTION (1 year's subscription to the "ELECTRICAL EXPERIMENTER")—J. H. ENGLAND

HEREWITH are photographs of my Laboratory. In one of the photographs may be seen my "Wireless Table," which contains all the different instruments used for both sending and receiving. The transmitting set consists of a ¼ K. W. step-up transformer, condensers, spark gap, key, ammeter, et cetera. There is also a 1 inch spark coil for sending short distances. For receiving I have used successfully (before the war) a tuning coil for short distances and a loose coupler for long distances, in connection with a silicon detector, 2,000 ohm Brandes' phones, loading coil, variable and fixt condensers. To the left may be seen my switch-board, which is home-made. It contains a number of different switches, a buzzer, a lamp resistance, and a pilot lamp. To the left of the switch-board there are several shelves on which are different electrical books, such as "Hawkin's Electrical Guides," Houston's "Electricity in Everyday Life," and many others. There are various other instruments on this table, such as telegraph key and sounder, electric fan, Solderall torch, and an interrupter. Another photograph shows the chemical and and photographic table. This table consists of a complete developing and printing set. To the left will be seen the printing box, which is home-made. The frame is an Auto Mask Printing Frame and is secured to the box by means of small hooks, so as to permit it to be removed easily. Inside there is a red and a white light. To the right there are a large number of chemicals, such as nitric acid, bromin, sodium, et cetera. This part of my "Lab." comes in handy when I need a picture of some electrical experiment. This laboratory is the result of but one year and a half of earnest work and study.—J. H. England, 509 George, Greenwood, Miss.



Science in Slang

Jazz Stokes on Wireless Dope

By EMERSON EASTERLING

"I SAW a while back in a paper that Tesla and Marconi were expressing their ideas on interplanetary wireless communication. It don't look very reasonable to me that it could be done in the way that they proposed it, but I don't say that the feat is impossible," remarked Jazz Stokes the other night.

"How does a wireless wire?" asked Bender.

Heiney Hertz — Who While Monkeying Around Spark Coils and a Micrometer Spark Gap, Fell over the Hertzian Wave.

"It don't wire, that is why they call it wireless," returned Jazz.

"Well," I put in, "of course, Punk and I know all there is to know about wireless; but for Bender's sake I wish you would tell us a little about wireless."

"You are probably familiar with the African tum-tums and the Indian signal fires," he began. "They were the original form of wireless.

"A scientist by the name of Hertz. Herr Heinrich Hertz, got to monkeying around with spark coils and developing the micrometer spark gap or resonator. This apparatus worked on the principle that electro-magnetic waves radiate from a point of discharge. The twinkling spark between the gap was due to induced current, being virtually a secondary coil of one turn. Well, this set Heiney to deducing, and he deduced the present Hertzian theory of wireless wave radiation.

"While Hein*rich*, never having caught up with the second syllable of his first name, died a poor man. Nick Tesla hadn't been napping either. The whole wireless dope to this bird was an unsealed book as early as 1893, when Marconi still slid down the banister in his knickers. Thus we see Nikola two-stepping it nonchalantly to the Pat. Office, where he grabs the first REAL wireless patent along in 1900. The old boy had it all down in black on white, aerial, ground, spark gap, *et al*—the real, honest to goodness dope. This earned him the title of "Papa of the Wireless." But in those days there were no detectors and few experimenters to boot. So the then wiseacres sniffed at Nick's Patents, tapt their foreheads significantly and made known that this wireless stuff was all loco, bunque, and then some. The same ginks today however sing a different tune and admit that in 1900 THEY were fast asleep and deader than an Egyptian mummy, with heads as solid.

"Then along comes Kid Marconi and devils around with oscillators, sending waves thru buildings and other masses until he gets to work and builds a real wireless telegraphing station. By sticking his aerials up so as to clear the buildings and other masses he finds that he can send and receive for miles instead of blocks. In 1901, on the twelfth day of December, he shoots a 'can-you-get-it' across the Atlantic—and they got it. Soon all the first class vessels were equipt with radio men and added antennae to their rigging, so that they could let the world know that all was off with them by their C. Q. D. and S. O. S. yelps, instead of leaving floating spars upon the briny deep for some brig to sight later.

"Marconi went on improving his apparatus and handled the financial end so that besides being a first rate experimenter and Italian gentleman of standing, he don't have to eat macaroni with a pencil.

"The world wallows along, and the patent offices pile up the documents in the wireless department, when an ardent bird, Dr. Lee de Forest, waltzes on the stage of industry to the tune of "N' EVERYTHING' and shows us *something*. You might mistake it for an incandescent bulb, but it is as much like a light globe as a Victrola is like a centre table. We call it the Audion Amplifier, and with it in your receiving set you are able to make a squeal a scream. The wireless nuts first found that it was a scream when the ionizing sunlight failed to close the Hula-hula island and 'Frisco communication in the wee sma' hours of the morning, after the hour that the other detectors went bad on 'em.

"For Bender's sake I will give you 'Kicks'* the line up on a simple wireless station. First the transmitting apparatus obtains its juice from batteries or other sources. Is that plain? Yes, well next there is a spark coil that steps the voltage up to a dangerous stage and a spark gap that lets the high tension current break down across the air space. This discharge sets up an oscillating current of high frequency. To increase the efficiency there are condensers inserted in the circuit—these store

Doc "Nick" Tesla—Papa of the Wireless, Who Grabbed the First REAL Wireless Patent in 1900

up and discharge the juice like a nigger squirting prune juice thru his teeth, only very much faster."

Taking a pen and pad from his pocket, Jazz proceeded. "It is like this—see the K is the key; C, coil; c^1, condenser; A, aerial; G, ground; and B is for the source of juice. Then the receiving station is like this—A, aerial; D, detector; R, receiver. There is added more stuff to sensitize the layout, but they would only look like a telephone central station wiring diagram here on paper, and besides, there are more different kinds than there are ways for a young boy to go wrong.

"In Guglielmo Marconi's original contraption the Signor used a *coherer*, where we use a detector or audion now. The coherer works by being welded by the incoming waves, the electrical resistance being less when the filings in the coherer are welded. The current is so regulated that when the wave waltzes in and unites the nickel and silver filings, the sounder that is connected in the circuit bangs down with a faint tap. The coherer is tapt by a de-coherer, jarring the nickel and silver filings loose for the next dot or dash—*ad infinitum*.

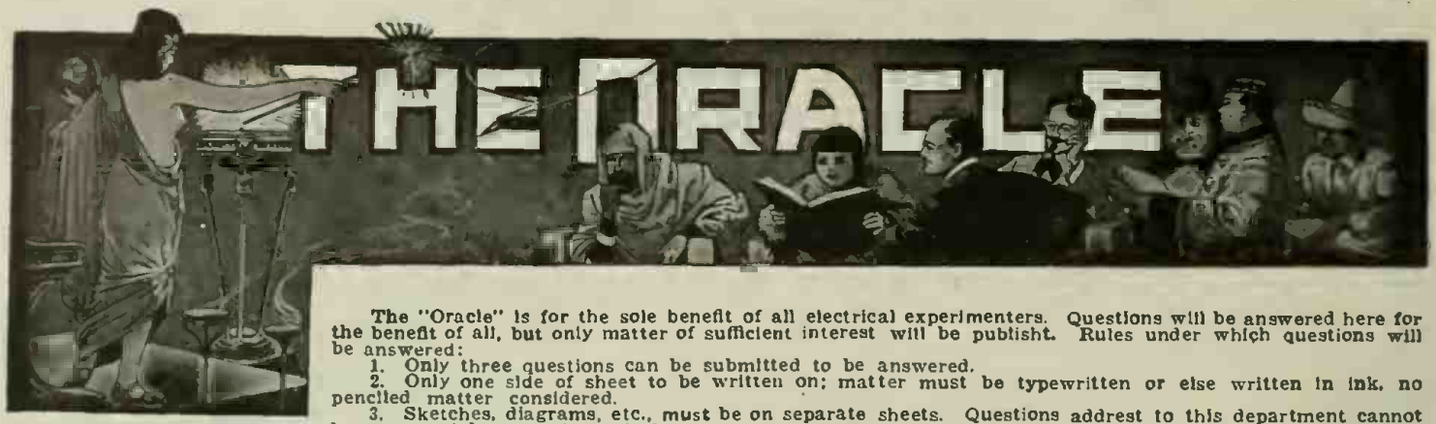
"The detector rectifies the oscillating current, making it fit to vibrate the diafram on the receiver that the 'Radio-bug' has glued to his ear.

"The audion is an incandescent bulb with a parallel grid and plate, working on the theory that current will flow

Kid Marconi Who Deviled Around Oscillators and Who Shot "Can-You-Get-It" Across the Atlantic.

*That word is Kick and not Hick. Kick is a San Francisco slang word—it means almost anything, originating from a kick in booze and now applying to almost anything, good, bad, and indifferent.

(*Continued on page* 911)



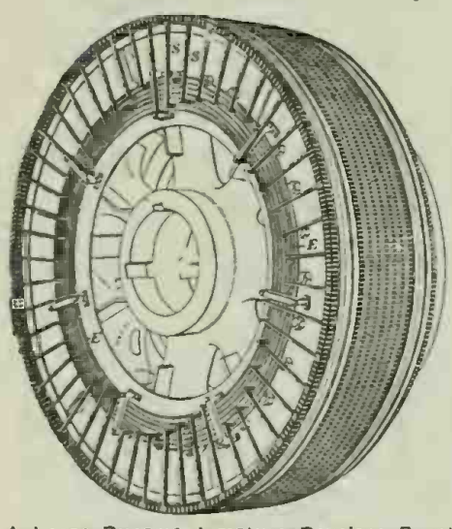
The "Oracle" is for the sole benefit of all electrical experimenters. Questions will be answered here for the benefit of all, but only matter of sufficient interest will be publisht. Rules under which questions will be answered:

1. Only three questions can be submitted to be answered.
2. Only one side of sheet to be written on; matter must be typewritten or else written in ink, no pencilled 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.

500 K. W. DYNAMO DEVELOPS BURNT SPOTS ON COMMUTATOR.

(990) Geo. W. B., Chicago, Ill, inquires of the "Oracle":

Q. 1. What causes commutator bars to burn, blacken and roughen up in the following manner? There are about 4 bars under a set of brushes and every set of 4 bars spaced equally between centers of field poles will blacken. Description of machine: D. C. 500 K. W. rope drive, 8 poles, compound wound. 220 volts. Even airgap all around, commutator undercut, commutator true, field coils equal strength, no reversed coils, no overload, machine runs alone most of the time; sometimes in parallel with a 150 K. W. Brushes have a perfect gloss, practically no sparking. Four hundred segments to the commutator, all tight. Sanding commutator stops the trouble for 2 to 6 months. What causes it?



A Large Dynamo Armature Develops Burnt Spots on the Commutator at Equally Spaced Points, Corresponding to the Pole Pitch. One of the Remedies Suggested Is That the Armature Be Equipt with Balancing or Current Equalizing Rings, as Here Illustrated, which Shows Them Applied to a Parallel-Wound D. C. Dynamo Armature. These Rings Help to Equalize Any Heavy Cross Currents In the Armature which Might Produce Such Troubles.

A. 1. We were particularly interested in the phenomenon you describe where the 500 K. W. D. C. dynamo, which altho apparently in perfect shape and maintenance, develops burnt spots all around the commutator at points corresponding to the spacing of the brush studs.

The Editor of the Oracle, while serving as engineer in a large power house some years ago, had similar trouble, and it practically defied solution by any of the experts who attempted to remedy it. Also in this case, it is clearly recollected that the machine, of about the size you mention, was in very fine running condition, and everything semed to be in favor of its perfect operation. But still these spots developed just as you state. After some thought on the matter it would seem from later experiences, that some of the following troubles might be the cause of these burnt spots appearing on the commutator:

ODD PHOTOS WANTED AT $1.00 EACH!!!

Now is the time to make your Kodak pay for itself in a real practical way. We are after interesting photographs of out-of-the-ordinary electrical, radio and scientific subjects and are willing to pay $1.00 *cash for every one we can use. Please bear in mind that for half-tone reproduction in a magazine, a photograph should be particularly sharp and clear. Of course, if a subject happens to interest us particularly well, we can have the photo retouched. For the general run of subjects, however, it does not pay to go to such expense. Therefore, please take pains to properly focus and expose your pictures. It often happens that a really mediocre subject well photographed wins approval over an excellent subject poorly photographed. And don't send us plate or film "negatives"; send unmounted or mounted "prints", preferably a light and dark one.*

As to what to photograph: Well, that's hard for us to say. We leave that up to you, and every reader now has the opportunity to become a reporter of the latest things in the realm of Electricity, Radio and Science. But, please remember—it's the "odd, novel or practical stunts" that we are interested in. Every photo submitted should be accompanied by a brief description of 100 *to* 150 *words. Give the "facts"—don't worry about the style. We'll attend to that. Enclose stamps if photos are to be returned and place a piece of cardboard in the envelope with them to prevent mutilation. Look around your town and see what you can find that's interesting.*

Address photos to—Editor "Odd Photos", ELECTRICAL EXPERIMENTER, *233 Fulton Street, New York City.*

1. From experience with several smaller machines, especially motors on elevator service, it would seem that field discharge currents, which are often of very high instantaneous e.m.f. value, would be liable to cause this burning. The remedy, or rather safeguard, against such trouble from this source would be to provide a field break switch fitted with an extra contact, so that when the switch is open half-way it makes connection, so that the field can discharge thru a resistance. This resistance in some cases has been formed of a lamp bank, and if you try this, you will be surprised to see how brightly the lamps flash up whenever the field switch is open, i.e., when the dynamo is being shut down and after the main D. C. bus-bar switch has been opened. The field magnet, of course, possesses very high self induction, and when the field switch is opened, a very high self-induced current occurs in the field windings, tending to prolong the magnetization, and causing therefore, a very heavy current of high e.m.f. to occur when the switch is suddenly opened. Practically all dynamos above 50 K.W. capacity are and should be provided with proper protective field discharge resistance and field break switches of the type described.

2. It seems that insufficient brush tension would also cause this trouble, not perhaps while the machine is rotating at its normal speed and load, but due to a tendency which the brushes in such a case might have to jump when the machine was started.

3. Another possible but hardly probable source of this burning might be traced to *hard* commutator bars. High mica would also cause the trouble, but as you state, in your particular case the mica has been undercut.

4. Trouble is often experienced in power-station work where two or more dynamos are run in parallel, and especially if there is any weakness in the design of the equalizing circuit between the two or more machines, which may cause heavy cross currents to pass between the two machines. As you will readily conceive, such a current which might be caused by a parti l unbalancing of the load between the two machines, might cause a momentary and in fact a fairly high e.m.f. transitory current to pass thru the brush and commutator system of one of the machines, and such a current would tend to have the effect of producing the burnt commutator.

5. Another trouble which would seem to point very strongly as a frequent source of this trouble, and one also that is very often overlooked entirely, is the *unequal distribution of the armature current* in such a large machine as this. The Editor recollects a case at one of the southern universities a few years ago, where no end of trouble was experienced in the operation of a large D. C. generator unit, due to this very reason, i.e., the unequal distribution of the current thru the armature windings. This defect in design, for that, of course, is what it is, causes a number of current paths to be set up periodically around the armature, and comparatively heavy currents will start flowing around these paths, their area being that enclosed between the axial lines of the two field poles in most instances. In the case in question, this was finally solved by the proper designing and installation of

(*Continued on page* 888)

The Opportunities In Draftsmanship

By CHAS. W. MOREY
President Chicago Technical College

During the twenty-five years in which I have had exceptional opportunities to observe the progress of technical work of every character, I have never known of such opportunities as exist today for competent draftsmen.

Very naturally the war had a great effect in producing the present conditions. Men were called from the drafting room to the trenches, leaving great gaps in our industrial organization which have not yet been filled.

And now when the war is over, we find many men not returning to their old jobs. We see business pushing harder than ever for markets. We hear of great building operations to be undertaken. We see a vast area of Europe devastated beyond description, to be rebuilt and very largely I believe with American material and with the help of American technical experts.

When it is considered that the draftsman must be employed on every detail that goes into the manufacture of structural work of every kind, machinery, ships, railroads, buildings, etc., the vast field for men in this profession can be somewhat appreciated.

The problem before thousands of ambitious young men is not whether to become draftsmen or not, but how and where to learn most quickly and thoroughly.

Formerly it was necessary to attend a resident school, which often meant giving up a position and spending time as well as money. It also often meant, if a man wanted to graduate, taking studies not really bearing upon technical training. Some got their training in drafting rooms of factories, architects' offices, or other places where they started out as boys and slowly worked their way up.

It has remained, however, for correspondence instruction to give every man a chance to become an expert in any branch of draftsmanship without leaving any job he may have and as quickly as his industry will let him pass from one lesson to another.

The Chicago Technical College by its method of training has prepared and is now preparing men everywhere to study in spare time at home and then to step into high-paying positions.

By this method no time is wasted on unnecessary branches. The student gets exactly the training he will use in practical work and in every case he has the direct personal instruction of specialists in the branch he has selected.

Before he decides about enrolling, any man can easily find out just how well qualified he may be to follow Draftsmanship. A test lesson is sent free to show the plan of instruction and to give the prospective student a chance to "size himself up."

We are ready to help ambitious men to get into this great profession with the least expense of time and money. We here know what the opportunities are. The calls we have to furnish good draftsmen to every kind of an organization prove every day that the job is always ready for the man who can fill it. If young men throughout the country could only realize what a future there is in Draftsmanship, many a one now wondering what his future is to be would come to a quick decision.

I hope that every reader of the Electrical Experimenter who is now doubtful about the calling he is to follow will write for information on one of our Drafting courses. If in doubt about which branch to take up, a letter sent to me personally will bring suggestions based on my own experience and that of our staff.

THE ORACLE.

(*Continued from page 886*)

current equalizing rings placed on the back of the armature, as shown in the accompanying illustration.

Many different windings have been proposed and used successfully, but the majority of direct-current armatures are wound with either the single-parallel ring winding, the single-parallel drum winding, or the single-series drum winding. The single-parallel drum winding is probably more used than any other, and, on large multipolar machines, any unbalanced condition in the magnetic circuits is likely to cause the current to divide unequally among the several paths thru the armature. For example, if the air gap on one side of the armature becomes *slightly shorter* than that on the opposite side, which may easily occur due to wear of the bearings, the flux in the short air gap will become unduly dense, thus causing the generation of higher e.m.f. in the armature conductors on that side than in those on the other side, and the path that develops the highest e.m.f. takes the greatest share of the current. In some cases this unbalanced condition may not be bad enough to cause trouble other than some slight sparking, but in extreme cases, the e.m.f. of one path or of the paths on one side of the armature may become so excessive as to reverse the current in some of the other paths, making part of the armature act as a generator and part of it as a motor at the same time. This condition is usually accompanied by severe vibration of the whole machine, due to excessive mechanical strains, with more or less violent sparking or flashing at the brushes, and the machine is said to be "bucking." On account of the effects of armature reactions, bucking is somewhat more liable to occur in motors than in generators. The bad effects due to unbalancing can be eliminated by providing the armature with equalizer rings as shown. By means of equally spaced leads these rings connect points of equal potential in the winding and allow an equalization of current between the various paths in the armature.

Sometimes erratic line disturbances, motor flare-backs, defective motor control apparatus, will cause the effect you describe.

We would recommend that you look up some of the better class books on D. C. machinery operation and design, particularly those by Hobart and Parshall, which you can procure at your local library.

BALLAST COIL FOR ALTERNATING CURRENT ARC-LAMP.

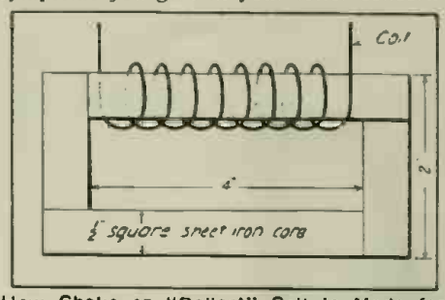
(991) Henry Tustin, Ocean Grove, N. J., writes:

Q. 1. I am having trouble in operating an experimental arc-lamp on 110 volts. What can you suggest?

A. 1. Regarding the operation of arc lamp at 110 volts house lighting current, you do not state what kind of current you have, whether alternating or direct. For one thing, this factor would determine whether your experiment would be a success or not, for the reason that if you are trying to operate the arc on alternating current, then you will find invariably that it will not operate well using a simple resistance coil or rheostat in series with it.

For alternating current operation the proper *ballast* is always composed of an adjustable impedance or choke coil made up of an iron wire or laminated sheet iron core on which several layers of magnet wire are wound. Where an ordinary 1,200 C. P. arc, such as used in ordinary store lighting, etc., is employed and taking about 5 amperes on a 110-volt circuit, the impedance coil may be composed of an iron core about 4" x 2", as shown in the diagram, and on one leg of which is wound about six layers of No. 14 D. C. C. magnet wire, taking off taps from the third, fourth, fifth and six layers.

We very strongly surmise from the symptoms you give in your letter concern-



How Choke or "Ballast" Coil Is Made for Use in an A. C. Arc Lamp Circuit. This Takes the Place of the Resistance Coil in a D. C. Arc Lamp.

ing the failure of the arc to operate, that this is the trouble, as on A. C. circuits *resistance* will give a very poor break spark, and for this purpose there is required an inductance of the order described above.

HOMOPOLAR DYNAMO.

(992) O. S. M., U. S. N. R. F., writes:

Q. 1. Giving a sketch of a commutatorless D. C. dynamo which he has invented and believes to be entirely new.

A. 1. We have looked over your drawings and description of what you term a direct current commutator-less dynamo, and while you appear to have something new in the peculiar design of the pole-shoes of the field magnet and the arrangement of the armature inductors, the whole principle of this type of dynamo has been known for the last forty years or more.

In other words what you have shown is simply the well-known "homopolar" dynamo, also called the "unipolar" dynamo. Faraday's first disk type dynamo belonged to this class. All machines of this type have the disadvantage of producing a very low electromotive force or voltage and are not usually practical, altho a few machines of this type have been used, where a very heavy current at a potential of a few volts was desired. You will find all the information you may desire in this direction by referring to the following works:

"Elementary Lessons in Electricity and Magnetism," by Silvanus Thompson, page 498. Also you would do well to refer to Professor Thompson's complete treatise, "Dynamo Electric Machinery," and a most thoro work covering the complete design and calculation of the electrical as well as the magnetic circuits of the "homopolar" dynamo is given in Prof. Alfred E. Wiener's excellent book, entitled "Continuous Current Dynamo Electric Machinery Design." These books are available thru our "Book Department."

The outline of the action of the machine you show is in accordance with the opinion of this machine given by Prof. Silvanus Thompson, in which he says in part:

"There is a class of dynamo-electric machine, differing entirely from any of the commutating types, in which a coil or other movable conductor slides around one pole of the magnet and cuts the magnetic lines in a continuous manner without any reversals in the direction of the induced currents. Such machines, sometimes called 'homopolar' or 'unipolar', have a very low electromotive force or voltage. Faraday's disk machine belonged to this class."

The stream that has been supplying the ancient city of Damascus with water for forty centuries has been harnessed to provide electricity to light the city and operate a railway.

According to an Italian scientist's figures, a square mile of the earth's surface in six hours of sunshine receives heat equivalent to the combustion of more than 2,600 tons of coal.

BOOK REVIEW

A VEST-POCKET DICTIONARY OF TECHNICAL TERMS USED IN WIRELESS. Flexible cloth covers, 168 pages, indexed alphabetically, size, 3¼ x 2½ inches, price $0.75. Publisht by the Wireless Press, Ltd., London, England.

A very useful compendium of the principal wireless terms which should prove useful to all radio operators and students of the art. The various technical terms are arranged alphabetically, and the subject matter given seems to cover most of the more important terms used in radio engineering and operating. Some of the definitions are rather terse, and it seems that they could have been easily amplified without increasing the size of the book very much. For instance, we find the term "billi-condenser," and the definition of the term succinctly says—"consists of a metallic tube made to slide over an insulating tube having a metallic lining." This definition does not mean very much to any radio man, and really it is nothing but a trade definition, while as a matter of fact most of the regular text-books on wireless telegraphy describe this condenser as one having a definite electrostatic capacity of one billi-farad. This little work forms a handy, low-priced compilation of wireless terms which may prove of considerable use to radio students and others interested generally in this line of work.

HAND-BOOK OF CHEMISTRY AND PHYSICS—A READY REFERENCE POCKET-BOOK OF CHEMICAL AND PHYSICAL DATA, by Charles D. Hodgman, B.S., and Melville F. Coolbaugh, M.A. Flexible leather covers, 478 pages, size 7 x 4⅜ inches, price $2.00. Publisht by The Chemical Rubber Company, Cleveland, Ohio.

This work is something out of the ordinary and places in the hands of chemistry students and chemists in general a most excellent collection of tables and formulas worked out, which would require many hours of search thru books on chemistry and physics in order to determine these quantities. There is a large number of tables giving the complete equations for various organic compounds; physical constants of the elements; physical data of organic compounds; qualitative analysis procedure; flame and bead testing; various solutions of salts and other reagents; solubility charts, including a table giving the solubility of organic salts in water; a large number of tables giving gravimetric factors and their logarithms; tables of nitric and surfuric acids, as well as ammonium hydroxid and potassium hydroxid, giving the proportion by weight and the corresponding specific gravities for these various chemicals in solution; tables of sound and heat velocity and conduction; the various properties of saturated steam; co-efficients of thermal expansion; voltage and composition of voltaic cells; sparking potential or dielectric strength, wave length of principal lines of various elements, for spectroscopic and other work; tables giving index of refraction for gases in solution as well as metals and glass, radio-active tables, etc., etc.

This is a practical hand-book which every student of chemistry and physics should not be without. It contains an excellent glossary of technical terms with many chemical equations worked out and completed, also a large number of various physical formulas in mechanics, etc. There is given a considerable number of very useful and practical laboratory recipes, such as those for silvering glass, making of pole test paper, making cross-hairs for telescopes, etc.; various forms of photographic developing solutions for both plates and printing papers, etc. A very complete bibliography is appended at the close of the book, giving a valuable titled list of several hundred works on chemistry and physics. The volume is well indexed.

MILITARY AND NAVAL RECOGNITION BOOK, by Lieut. J. W. Bunkley, U. S. Navy. Cloth bound, 224 pages, 51 full page plates. 18 being in color, size 5 x 7 inches, price $1.00. Publisht by D. Van Nostrand Company, New York City.

This work proved of great value during the war and is one of the best ever publisht on the subject of military and naval organizations thruout the world, giving as it does not only the different insignia of rank in the various organizations of the principal countries of the world, but the customs of the service as well, such as etiquette of enlisted men and officers, etc. This book has been endorsed by the Secretary of the Navy. The treatment starts with the organization of the army bureaus and corps, the composition of the army and its various departments, how the staff is composed, and the divisions into the various arms of the service, such as cavalry, field artillery, coast artillery, infantry and engineers. Then we learn about the various coast artillery districts thruout the United States, the various ranks held in the army, and the duties of the officers holding these ranks, army etiquette and customs including salutes and courtesies in conversation, when and when not to address a lieutenant by his title; how to address a colonel, et cetera.

The succeeding chapters take up the composition of the navy and the organization of the naval force ashore, including an explanation at last, on page 41, of the duties of the Bureau of Steam Engineering, and how it comes about that the "Bureau of Steam Engineering" has to do with the installation of Radio Equipment on ships of the navy and on shore—a nice little poser that has been asked many times thru our "Oracle Department," and of the editors personally every time we meet a "Radio-bug."

Then follow interesting chapters on naval etiquette and customs, including what to do when the officer of the deck passes you, when to stand up, and when to sit down when a naval officer enters a cabin, and when an army officer enters a tent or barracks; what to say and how to say it, why a "gob" or his high superior officer must walk down Broadway in the pouring rain without an umbrella, and also you will find it prescribed in the rules and regulations on naval etiquette, that it is unbecoming an officer in uniform to carry a package of any kind. But at the close of the hum-drum of red tape, which tells you how you shall place your feet, and when you shall take off your hat, also when you can use your handkerchief, and which proves mighty interesting reading to us poor land-lubbers, we come to the most interesting announcement that—"it is customary for a committee of officers, to make the round of calls on New Year's Day on all ships in the same port," and further—"when in Washington, it is customary to call on the Secretary of the Navy and other high officials on New Year's Day, and you shall appear in your full dress uniform," rain or shine, and leave your umbrella at home.

Other chapters treat of the U. S. Marine Corps, the coast guard and the light house service. We then come to the sections dealing with the strength and organization of foreign armies and navies with the insignia of rank printed in colors.

The volume is one of the best works of this kind ever publisht, and Lieut. Bunkley should be complimented on the excellent and very interesting style in which he has compiled the work.

ELEMENTARY NAVAL ORDNANCE AND GUNNERY, by Lieut. H. C. Ramsey. Limp leather cover, size, 4¼ x 7¼ inches, illustrated and numerous drawing plates. Publisht by Little, Brown & Company, Boston, Mass., 1918, Price $3.00 net.

One of the most valuable works publisht during the war as a ready aid to the new students in the Naval Gunnery Schools and also as a guide to instructors and those trying for commissions. It has been prepared in a simple, easy and direct manner so that all classes of readers may readily acquire a correct and thoro knowledge of the fundamentals and general principles of the art of modern naval gunnery.

Most of the material has been gathered from lectures delivered at the Ensign School at Harvard University, and a number of interesting questions asked by students have been incorporated in the work with full answers.

A few titles of some of the more important chapters follow:—Naval Guns, Manufacture of Naval Guns. Gun Mounts, Breech and Firing Mechanisms, Electrical Firing Mechanisms, Turrets, Gunpowder, Projectiles, Magazines, Inspections and Tests, Spotting, Sighting, Fire Control, The Battery in Action, Care of Turrets, Automatic Machine Rifles, Battle Drills, The Gunnery Officer of a Ship, Infantry.

The chapter on Infantry has been included in order that those new to the service may understand some of the newer positions as practised in this branch of the service.

There is no doubt but that this book will fill a very distinct want amongst those who are studying this subject, besides serving to give the layman a real glimpse into what a tremendous part Gunnery plays in every battle engagement whether on land or sea. Lieut. Ramsey is to be complimented upon the excellent style in which he has covered the work in hand. The illustrations are particularly fine and show at a glance just how the breech mechanisms of the great naval cannon work as well as the small arms, including automatic rifles, machine guns, etc. Every kind of projectile is fully explained with sectional drawings, how the powder is placed and computed, calculating the range from a moving war-vessel with the compensations made for wind, speed of target, temperature of powder charge, etc., etc. A most interesting, authentic and valuable work.

Free Proof that I Can Raise Your Pay

No matter how much you are earning now, I can show you how to increase it. I have even taken failures and shown them how to make $100—$200, and in once case as high as $2,000 weekly. I am willing to prove this entirely at my risk and expense.

LET'S have a little chat about getting ahead —you and I. My name is Pelton. Lots of people call me "The Man Who Makes Men Rich." I don't deny it. I've done it for thousands of people—lifted them up from poverty to riches.

I'm no genius—far from it. I'm just a plain, everyday, unassuming sort of man. I know what poverty is. I've looked black despair in the eye—had failure stalk me around and hoodoo everything I did. I've known the bitterest kind of want.

But to-day all is different. I have money and all of the things that money will buy. I am rich also in the things that money won't buy—health, happiness and friendship. Few people have more of the blessings of the world than I.

IT was a simple thing that jumped me up from poverty to riches. As I've said, I'm no genius. But I had the good fortune to know a genius. One day this man told me a "secret." It had to do with getting ahead and growing rich. He had used it himself with remarkable results. He said that every wealthy man knew this "secret,"—that is why he was rich.

I used the "secret." It surely had a good test. At that time I was flat broke. Worse than that, for I was several thousand dollars in the hole. I had about given up hope when I put the "secret" to work.

At first I couldn't believe my sudden change in fortune. Money actually flowed in on me. I was thrilled with a new sense of power. Things I couldn't do before became as easy for me to do as opening a door. My business boomed and continued to leap ahead at a rate that startled me. Prosperity became my partner. Since that day I've never known what it is to want for money, friendship, happiness, health or any of the good things of life.

That "secret" surely made me rich in every sense of the word.

MY sudden rise to riches naturally surprised others. One by one people came to me and asked me how I did it. I told them. And it worked for them as well as it did for me.

Some of the things this "secret" has done for people are astounding. I would hardly believe them if I hadn't seen them with my own eyes. Adding ten, twenty, thirty or forty dollars a week to a man's income is a mere nothing. That's merely playing at it. In one case I took a rank failure and in a few weeks had him earning as high as $2,000.00 a week. Listen to this:

A young man in the East had an article for which there was a nation-wide demand. For twelve years he "puttered round" with it, barely eking out a living. Today this young man is worth $200,000. He is building a $25,000 home—and paying cash for it. He has three automobiles. His children go to private schools. He goes hunting, fishing, traveling whenever the mood strikes him. His income is over a thousand dollars a week.

In a little town in New York lives a man who two years ago was pitied by all who knew him. From the time he was 14 he had worked and slaved—and at sixty he was looked upon as a failure. Without work—in debt to his charitable friends, with an invalid son to support, the outlook was pitchy black.

Then he learned the "secret." In two weeks he was in business for himself. In three months his plant was working night and day to fill orders. During 1916 the profits were $20,000. During 1917 the profits ran close to $40,000. And this genial 64-year-young man is enjoying the pleasures and comforts he little dreamed would ever be his.

I COULD tell you thousands of similar instances. But there's no need to do this, as I'm willing to tell you the "secret" itself. Then you can put it to work and see what it will do for you.

A Few Examples

Personal Experiences

Among over 550,000 users of "Power of Will" are such men as Judge Ben B. Lindsey; Supreme Court Justice Parker; Wu Ting Fang, Ex. U. S. Chinese Ambassador; Assistant Postmaster General Britt; Lieut. Gov. McKelvie of Nebraska; General Manager Christeson of Wells-Fargo Express Co.; E. St. Elmo Lewis, former Vice-Pres. Art Metal Construction Co.; Gov. Ferris of Michigan, and many others of equal prominence.

$300 Profit from One Day's Reading

"The result from one day's study netted me $300 cash. I think it a great book and would not be without it for ten times the cost."—A. W. Wilke, Faulkton, So. Dakota.

Worth $15,000 and More

"The book has been worth more than $15,000 to me."—Oscar B. Sheppard, 1117 E. Locust St., Decatur, Ill.

Would Be Worth $100,000

"If I had only had it when I was 20 years old, I would be worth $100,000 today. It is worth a hundred times the price."—S. W. Taylor, The Santa Fe Ry., Milano, Tex.

Salary Jumped from $150 to $800

"Since I read Power of Will my salary has jumped from $150 to $800 a month."—J. F. Gibson, San Diego, Cal.

From $100 to $3,000 a Month

"One of our boys who read Power of Will before he came over here jumped from $100 a month to $3,000 the first month, and won a $250 prize for the best salesmanship in the State."—Private Leslie A. Still, A. E. F. France.

I don't claim I can make you rich over night. Maybe I can—maybe I can't. Sometimes I have failures—everyone has. But I do claim that I can help 90 out of every 100 people if they will let me.

The point of it all, my friend, is that you are using only about one-tenth of that wonderful brain of yours. That's why you haven't won greater success. Throw the unused nine-tenths of your brain into action and you'll be amazed at the almost instantaneous results.

The Will is the motive power of the brain. Without a highly trained, inflexible will, a man has about as much chance of attaining success in life as a railway engine has of crossing the continent without steam. The biggest ideas have no value without will-power to "put them over." Yet the will, altho heretofore entirely neglected, can be trained into wonderful power like the brain or memory and by the very same method—intelligent exercise and use.

If you held your arm in a sling for two years, it would become powerless to lift a feather from lack of use. The same is true of the Will—it becomes useless from lack of practice. Because we don't use our Wills—because we continually bow to circumstance—we become unable to assert ourselves. What our wills need is practice.

Develop your will-power and money will flow in on you. Rich opportunities will open up for you. Driving energy you never dreamed you had will manifest itself. You will thrill with a new power—a power that nothing can resist. You'll have an influence over people that you never thought possible. Success—in whatever form you want it—will come as easy as failure came before. And those are only a few of the things the "secret" will do for you. The "secret" is fully explained in the wonderful book "Power of Will."

How You Can Prove This at My Expense

I KNOW you'll think that I've claimed a lot. Perhaps you think there must be a catch somewhere. But here is my offer. You can easily make thousands—you can't lose a penny.

Send no money—no, not a cent. Merely clip the coupon and mail it to me. By return mail you'll receive not a pamphlet, but the whole "secret" told in this wonderful book, "POWER OF WILL."

Keep it five days. Look it over in your home. Apply some of its simple teachings. If it doesn't show you how you can increase your income many times over—just as it has for thousands of others—mail the book back. You will be out nothing.

But if you do feel that "POWER OF WILL" will do for you what it has done for over a quarter of a million others—if you feel as they do that it's the next greatest book to the Bible—send me only three dollars and you and I'll be square.

If you pass this offer by, I'll be out only the small profit on a three-dollar sale. But you—you may easily be out the difference between what you're making now and an income several times as great. So you see you've a lot—a whole lot—more to lose than I.

Mail the coupon or write a letter now—you may never read this offer again.

PELTON PUBLISHING COMPANY
30-H WILCOX BLOCK MERIDEN, CONN.

Pelton Publishing Company
30-H Wilcox Block, Meriden, Conn.

You may send me "Power of Will" at your risk. I agree to remit $3.00 or remail the book to you in five days.

Name .....

Address .....

The Moon's Rotation

(Continued from page 866)

festly absurd and of no bearing on the question under consideration.

In all the communications I have received, tho different in the manner of presentation, the successive changes of position in space are mistaken for axial rotation. So, for instance, a positive refutation of my arguments is found in the observation that the moon exposes all sides to other planets! It revolves, to be sure, but none of the evidences is a proof that it turns on its axis. Even the well-known experiment with the Foucault pendulum, altho exhibiting similar phenomena as on our globe, would merely demonstrate a motion of the satellite about *some* axis. The view I have advanced is NOT BASED ON A THEORY but on facts *demonstrable by experiment*. It is not a matter of *definition* as some would have it. A MASS REVOLVING ON ITS AXIS MUST BE POSEST OF MOMENTUM. If it has none, there is no axial rotation, all appearances to the contrary notwithstanding.

A few simple reflections based on well establisht mechanical principles will make this clear. Consider first the case of two equal weights w and w_1, in Fig. 1, whirled about the center O on a string s as shown. Assuming the latter to break at a both weights will fly off on tangents to their circles of gyration, and, being animated with different velocities, they will rotate around their common center of gravity o. If the weights are whirled n times per second then the speed of the outer and the inner one will be, respectively, $V = 2(R + r)n$ and $V_1 = 2\pi(R - r)n$, and the difference $V - V_1 = 4\pi rn$, will be the length of the circular path of the outer weight. Inasmuch, however, as there will be equalization of the speeds until the mean value is attained, we shall have $\frac{V - V_1}{2} = 2\pi rn = 2\pi rN$, N being the number of revolutions per second of the weights around their center of gravity. Evidently then, the weights continue to rotate at the original rate and in the same direction. I know this to be a fact from actual experiments. It also follows that a ball, as that shown in the figure, will behave in a similar manner for the two half-spherical masses can be concentrated at their centers of gravity and m and m_1, respectively, which will be at a distance from o equal to $\frac{1}{8}r$.

This being understood, imagine a number of balls M carried by as many spokes S radiating from a hub H, as illustrated in Fig. 2, and let this system be rotated n times per second around center O on frictionless bearings. A certain amount of work will be required to bring the structure to this speed, and it will be found that it equals exactly half the product of the masses with the square of the tangential velocity. Now if it be true that the moon rotates in reality on its axis *this must also hold good for EACH of the balls as it performs the same kind of movement.* Therefore, in imparting to the system a given velocity, energy must have been used up in the axial rotation of the balls. Let M be the mass of one of these and R the radius of gyration, then the rotational energy will be $E = \frac{1}{2}M(2\pi Rn)^2$. Since for one complete turn of the wheel every ball makes one revolution on its axis, according to the prevailing theory, the energy of axial rotation of each ball will be $e = \frac{1}{2}M(2\pi r_1 n)^2$, r_1 being the radius of gyration about the axis and equal to 0.6325 r. We can use as large balls as we like, and so make e a considerable percentage of E and yet, it is positively established by experiment that each of the rotating balls contain only the energy E, no power whatever being consumed in the supposed axial rotation, which is, consequently, wholly illusionary. Something even more interesting may, however, be stated. As I have shown before, a ball flying off will rotate at the rate of the wheel and in the same direction. But this whirling motion, unlike that of a projectile, neither adds to, nor detracts from, the energy of the translatory movement which is exactly equal to the work consumed in giving to the mass the observed velocity.

From the foregoing it will be seen that in order to make one physical revolution on its axis the moon should have twice its present angular velocity, and then it would contain a quantity of stored energy as given in my above letter to the *New York Tribune*, on the assumption that the radius of gyration is 2/5 that of figure. This, of course, is uncertain, as the distribution of density in the interior is unknown. But from the character of motion of the satellite it may be concluded with certitude *that it is devoid of momentum about its axis.* If it be bisected by a plane tangential to the orbit, the masses of the two halves are inversely as the distances of their centers of gravity from the earth's center and, therefore, if the latter were to disappear suddenly, no axial rotation, as in the case of a weight thrown off, would ensue.

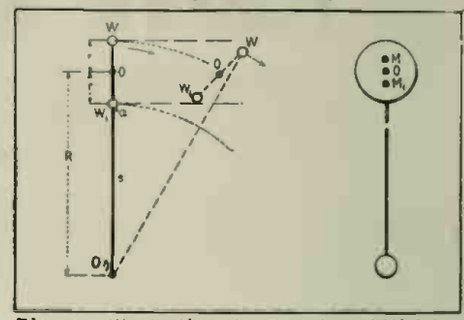


Diagram Illustrating the Rotation of Weights Thrown Off By Centrifugal Force.

WHAT IS MAN?

A man weighing 150 pounds will contain approximately 3,500 cubic feet of gas,—oxygen, hydrogen and nitrogen in his constitution, which at eighty cents per thousand cubic feet would be worth $2.80 for illuminating purposes. He also contains all the necessary fats to make a 15-pound candle, and thus, together with his 3,500 cubic feet of gases, he possesses considerable *illuminating* possibilities. His system contains 22 pounds and ten ounces of carbon, or enough to make 780 dozen, or 9,360 lead pencils. There are about fifty grains of iron in his blood and the rest of the body would supply enough of this metal to make one spike large enough to hold his weight. A healthy man contains 54 ounces of phosphorus. This deadly poison would make 800,000 matches, or enough poison to kill five hundred persons. This, with two ounces of lime, make the stiff bones and brains. No difference how *sour* a man looks, he contains about 60 lumps of sugar of the ordinary cubical dimensions, and to make the seasoning complete, there are 20 *spoonfuls of salt.* If a man were distilled into water, he would make about 38 quarts, or more than half his entire weight. He also contains a great deal of starch, chlorid of potash, magnesium, sulfur, and hydrochloric acid in his wonderful human system.

Break the shells of 1,000 eggs into a huge pan or basin, and you have the contents to make a man from his toe-nails to the most delicate tissues of his brain. And this is the scientific answer to the question, "What is Man?"

"I have watched the progress of the International Correspondence Schools almost from the very beginning. To me their rapid growth is easily understood, because I realize the practical value that is back of them and know something too of the success attained by many ambitious men throughout the country who have taken their courses.

"May your splendid institution continue to so grow and flourish that the world will come to appreciate the actual worth of the I. C. S. trained man."

—THOMAS A. EDISON.

"I am familiar with the textbooks and method of instruction used by the International Correspondence Schools in their Courses in Electrical Engineering, and I also know of a number of young men who have taken these Courses with great benefit. I believe that any young man who is interested in electricity but who cannot find an opportunity to go through an engineering college, if he will apply himself to one of these courses will find it a practical and economical way to acquire a knowledge of the profession second only to that acquired by devoting all the time for years to this study, in a regular college course."

—DR. CHARLES P. STEINMETZ.

What Would Their Advice Be Worth to You?

Suppose you have a knack for things electrical—that you realize what a wonderful opportunity for earnings and advancement the field of Electricity offers. What, then, would it be worth to *you* to have Edison and Steinmetz, the two foremost figures in the electrical world, tell you of a thorough, practical plan by which you can acquire, right at home, the training you need for success?

Well, *here* is their advice, based on years of familiarity with the instruction given by the International Correspondence Schools and on personal knowledge of I. C. S. trained men in their employ:

"I know of the success attained by men who have taken your Courses," says Edison. "It is a practical and economical way to acquire a knowledge of the profession," says Dr. Steinmetz. Read their full statements above.

For 27 years the I. C. S. have been training men at home in their spare time for success in Electricity and 280 other subjects. It is training over 100,000 men and women right now. It is ready and anxious to prepare you for advancement in Electrical Engineering or any special branch of it—or in any other line that appeals to you.

Pick the position you want in the work you like best, then put it up to us to prove how we can help you. Here is all we ask—without cost, without obligation, mark and mail this coupon.

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☐ Heavy Electric Traction	☐ RAILROADER
☐ Electrical Draftsman	☐ ILLUSTRATOR
☐ Electric Machine Designer	☐ DESIGNER
☐ Telegraph Expert	☐ BOOKKEEPER
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Canadians may send this coupon to International Correspondence Schools, Montreal, Canada

HOW BOY SCOUTS CAN GAIN "WIRELESS MERIT" BADGE.

The committee on badges, awards and scout requirements of national headquarters has just established a "wireless merit" badge which no doubt will become quite popular as soon as there is an opportunity for scouts to perfect themselves in the details. The requirements are as follows:

Be able to receive and send correctly not less than 10 words a minute.

Know the correct form for sending a message.

Be able to tell in own words the principal laws regarding radio communication.

Know at least 10 of the radiogram abbreviations (Q signals).

Be able to name two types of detectors and explain how they work.

Name five minerals used in detectors in the order of their sensitiveness.

Draw a diagram of a simple transmitting set, showing how the following instruments are connected: Source of power (dynamo or storage battery), transformer, condenser, spark gap, helix, key, and explain their function.

Draw a simple diagram showing how to connect the following instrments: Tuning coil or loose coupler, condensers, fixt or variable, detector, 'phones and ground. Tell the use of the above apparatus.

Draw a diagram of three different types of aerials and tell their advantages or faults.

Know how to properly ground a radio set and know what precautions to take during a thunderstorm.

Demonstrate how to rescue a person in contact with a live wire, and have a knowledge of the method of resuscitation of a person insensible from shock.

Write a brief essay on the development of wireless telegraphy.

ELECTRIC DRIVE FOR U. S. WARSHIPS.

America's capital fighting ships of the future will be superior to those of other nations because of their electrically driven machinery, Secretary Daniels told the House Naval Committee recently, in disclosing remarkable results attained by the new dreadnought New Mexico, equipt with the electric drive which is to be a feature of all the big ships authorized since 1916.

The New Mexico's turbo-electric machinery was designed to develop 26,500 horse-power at full speed and to give the ship a speed of twenty-one knots.

"It actually developed more than 31,000 horse-power," Mr. Daniels said, "and maintained for four hours a speed of twenty-one and one-quarter knots, and this when running at a displacement 1,000 tons greater than its design called for.

The secretary said fuel economy at cruising speed had been one of the things sought in substituting electric drive for the ordinary turbine equipment.

Practical Chemical Experiments

(*Continued from page* 880)

TO TEST FOR COAL TAR COLORING.

Experiment No. 3. See Fig. 3.

To test for coal tar colors in butter, a small sample is mixed on a porcelain plate with Fuller's earth, and if coal tars are present, there will be a red mass, while if absent the color will be only light yellow or brown.

Experiment No. 4.

Put a little butter in a test-tube, and a little oleomargarin into another. To each add one inch or so of alcoholic potash solution, and warm each in the steam of the water bath. Distinguish the one from the other by smell. Add a little sulfuric acid (dilute) to each and smell again. Notice that "olco" test tube will only smell of alcohol, but that the other will smell, besides, of butyric ether.

Radium Substitute.

We are all quite familiar with the uses of Radium in medicine and as an ingredient in luminous paint, both of which have been brought to the general public's attention within the past few years.

Luminous paint in particular offers a field whereby a substitute for Radium may be judiciously utilized. This paint played an important rôle in the war which has just terminated, having been used more particularly on the dials of instruments used on airplanes, so that they could be read at night. It has also been used for electric push buttons, door numbers, etc. The paint is permanently luminous in the dark and contains from 0.1 to 0.25 milligrams radium element to one gram of zinc sulfid. A luminous watch face usually contains from ten to twenty cents worth of radium on it.

An excellent substitute for radium for certain purposes is Meso-thorium. This is a radio-active element found in Monazite sand and other thorium minerals. When first extracted it is not satisfactory for luminous paint, and consequently must be "ripened" for several months, or even a year before it can be used. During this time the *alpha* radiation, which is required for luminous paint, becomes sufficiently strong. On the other hand the *beta* and *gamma* radiation of Meso-thorium grows rapidly and it can be used for medicinal purposes within a few days after preparation.

Radium, we are told, has a long life, half of it decaying in approximately 1800 years. Meso-thorium on the other hand possesses a short life, 5 or 6 years being its useful life for luminous purposes. For luminous paint to be used on objects which themselves have a short life, it is an excellent substitute for radium and will conserve the element radium for medicinal purposes only.

Static Electricity and Gasoline.

Static electricity, superinduced by the passage of gasoline thru chamois skin during the filtration process, was declared to be full of great danger. When this idea became prevalent, a well known automobile concern undertook a series of rigid experiments to learn what prospects there were of real danger. Their investigations resulted in their finding that the static electricity scare from the use of chamois skin was without foundation. They claim to have secured authentic data from which it was proved that a static electric charge cannot be developed with the temperature above freezing (32 deg. F.), while at zero (0 deg. F.) the conditions for producing the spark are most favorable.

Two Trade Secrets.

There are two trade secrets at least that the world at large may never know, but which it is well worth the while of inventors to study. One is the Chinese method of making the bright and brilliant color known as Vermilion, or Chinese red; and the other is a Turkish secret—the inlaying of the hardest steel with gold or silver. Among the Chinese and Turks these two secrets are guarded well. Apprentices, before they are taken for either trade, are compelled to swear an ironclad oath to reveal nothing of what passes in the workshop. They must also belong to families of high standing, must pay a large sum of money as a guaran-

(*Continued on page* 911)

INTRODUCING
Mr. R. W. DeMott

For eight months past Mr. R. W. DeMott has been advertising manager of your magazine.

You have noticed the rapid growth of "E. E." during that time. One big reason for this astounding growth and betterment of your magazine is due directly to Mr. DeMott and his "ads."

If you have the welfare of your magazine at heart, read Mr. DeMott's message. It means money to you.

The Publishers.

Advertising Talks

You, as a reader of the ELECTRICAL EXPERIMENTER, are vitally interested in every department of the magazine. There are some very strong reasons why you should be doubly interested in the advertising.

The publishers are constantly striving and planning to improve the quality of the magazine offered you each month. But it is your magazine and it is up to you as to how big it shall grow. There are a great many things that you ought to know about advertising, and how this powerful force affects you personally.

Progressive and responsible firms all over the country announce what they have to offer you through the advertising pages of the ELECTRICAL EXPERIMENTER. Not only will you help your magazine by showing an interest in its advertisers, but you will benefit yourself to an even greater degree. I will take up these points one by one each month, and hope that every reader will follow this column and offer any suggestions or ask any questions that may come to his mind regarding advertising and its relation to a big magazine.

If you have any suggestions to make regarding the advertisements that appear, if there is any information you would like regarding advertising in general, write me personally and your questions will be taken up in due course through this column.

For the next few months I will tell you about "E. E." advertising and its relation to you. Each month I will give you one reason more why the advertisements should be of vital interest to everyone of us.

You have watched the EXPERIMENTER grow from a little sixteen-page magazine to its present size. You have watched the class of articles improve, its staff of authorities who contribute each month get bigger and better, finally resulting in the wonderful announcement made in our January issue that the publishers had secured for you the services of the world's greatest inventor, Nikola Tesla, to give you exclusive feature articles in every issue for the next two years at least.

One of the principal factors in this rapid growth has been its advertising.

Next month I will show you how, by reading and answering the advertisements, you will help to still further build up and increase the size of the EXPERIMENTER.

R. W. DeMott

Advertising Manager.

AN OZONE WATER PURIFIER FOR THE HOME.

For use in homes, offices, drug stores, restaurants, hospitals and institutions, a Milwaukee concern has designed a convenient size of Ozone Water Purifier constructed as shown in the accompanying illustration. It is pointed out that in the ozonizing process employed, ozone is produced by means of an electric current and mixed thoroly with the water as drawn from the faucet, so that all water used comes into actual contact with ozone. The extra oxygen atoms of the ozone combine with organic matter of the germs in the water and burn them up. The carbon dioxid formed by this chemical action passes out into the air leaving a trace of the same effect produced in carbonated beverages, which adds to the palatability of the ozonized water. It is claimed that all tastes and odors are removed by this process while mineral elements essential to health remain, for they do not oxidize.

There are a great many cities whose water supplies are chlorinated and it is claimed that the use of this ozone water purifier will eliminate the odor and taste of chlorin from the water the same as it

New Design of Ozone Water Purifier for the Home, Office and Factory. The Ozonizer Connects With Any Lamp Receptacle. The Purifier Has a Capacity of Over 2,000 Gallons Per Day.

eliminates other objectionable odors and tastes.

As an amelioration of filtered water, or as a substitute for filtered or distilled water, it is claimed the process of ozonization stands by itself; it has no equal in efficiency; the removal of disease germs is absolute; the water resulting from such process is as perfect as one can wish, being bright and sparkling. Each of the water purifiers has a purifying capacity of over 2,000 gallons a day, and, therefore, any user is entirely independent of the condition of the water at the municipal plant in his city.

THE MAKING OF A MATCH.

Thorpe gives the following proportions for match head and for striking surface:

Head composition: Potassium chlorat, 5 parts; potassium bichromat, 2 parts; glass powder, 3 parts; gum, 2 parts. Rubbing surface: Antimony trisulfid, 5 parts; red phosphorus, 3 parts; manganese dioxid, 1½ parts; glue, 4 parts.

Tungsten is now used as an electric battery element.

Electrical goods of American manufacture are extensively sold in Porto Rico.

WHAT IS A "KILOWATT" AND "KILOWATT-HOUR".

By Frank Szabo.

THERE seems to be quite a wrong conception of the terms *kilowatt* and *kilowatt-hour*. Quite frequently one hears expressions such as "10 kilowatts per hour", but such an expression does not mean anything.

What is a kilowatt? Kilowatt is a term for power or rate of work. According to Kent and other authorities, one kilowatt is equivalent to the evaporation of 3.52 lbs. of water *per hour* from and at 212 deg. F., or 3,415 heat-units *per hour*. In this definition, *per hour* is a necessary part of it, without which the definition is incomplete.

If it takes approximately 3 lbs. of burning coal to evaporate 3.52 lbs. of water from and at 212 deg. F., then one kilowatt represents the consumption of *3 lbs. of coal per hour*, and not simply the consumption of 3 lbs. of coal. If we extend the evaporation of 3.52 lbs. of water from and at 212 deg. F. by a consumption of 3 lbs. of coal uniformly over a period of two hours, we do not have the equivalent of one kilowatt, but one-half, or ½ kilowatt, because during one hour only one-half of 3.52 lbs. = 1.76 lbs. of water have been evaporated with a consumption of one-half of 3 lbs. = 1.5 lbs. coal. Also, if we did the above performance in 30 minutes, or one-half hour, we would not have the equivalent of one kilowatt, but two kilowatts, because at the same rate we would, during one hour, evaporate 2 x 3.52 lbs. = 7.04 lbs. of water with a consumption of 2 x 3 = 6 lbs. of coal. Hence, *one kilowatt represents the consumption of 3 lbs. of coal per hour.*

Of course the quantity of 3 lbs. of coal in the above explanation is not fixt; it may take slightly more or less than 3 lbs. per hour for one kilowatt, depending on the heat value of the coal and the efficiency of the steam and current generating units, but 3 lbs. is a fair average figure.

What is a kilowatt-hour? According to Kent, it is the evaporation of 3.52 lbs. of water from and at 212 deg. F., or 3,415 heat units. In this definition, *per hour* is left out because no matter how fast or how slow the water evaporates, the actual work done in evaporating 3.52 lbs. of water from and at 212 deg. F. is equivalent to *one kilowatt-hour*. In other words, one kilowatt-hour is the equivalent of the rate of one kilowatt for a period of one hour. The rate of ½ kilowatt for a period of 2 hours is also equivalent to one kilowatt-hour. Hence:

$$\text{Kilowatts} = \frac{\text{Kilowatt-hours}}{\text{No. of hours}}$$

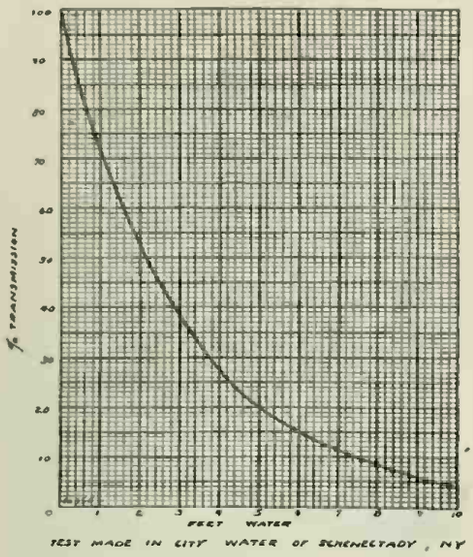
and kilowatt-hours = kilowatts x No. of hours.

Referring to the operation of electric cars, we cannot correctly say they require *four kilowatts per car mile;* we must say *four kilowatt-hours per car mile*, because the speed of the train has to be considered. Suppose we introduce a watt-meter and a watt-hour-meter into the circuit. The watt meter will indicate the *rate* of power consumed in kilowatts, whereas the watt-hour-meter sums up all the kilowatt-hours consumed during the run. At uniform speed of the car the watt-meter pointer will remain approximately steady in one position, but the watt-hour-meter will continue increasing the reading at a constant rate. If the watt-hour-meter at the end of ten miles' run at constant speed shows a reading of 40 kilowatt-hours, and it took one hour to make the run of ten miles, then the watt-meter showed a constant reading of 40 kilowatts. But if the run of 10 miles is made in say one-half hour, the reading of the watt-hour-meter will be approximately the same—40 kilowatt-hours (neglecting the difference in efficiency of the unit at different loads)—but the watt-meter

(*Continued on page 700*)

TRANSMISSION OF LIGHT THRU WATER.

The comparative transmission of light thru varying depths of water is a problem that science until recently knew but little



Showing Decrease In Transmission of Light Thru Water for Different Depths. A Problem Which All Submarine Inventors Are Interested In.

about. Now, thanks to Mr. S. L. E. Rose, of the General Electric Company's illuminating engineering laboratories, who describes his findings in the *General Electric Review*. Photometric readings were taken every six inches thruout the available range of 5½ feet of water in the cylindrical tank in which the tests were conducted. The water used was Schenectady city water, which is clear artesian well water. Sea water would transmit much less light owing to the apparent blue or greenish tint it possesses which tints bespeak a fairly considerable amount of suspended matter and consequently increased opacity.

The accompanying graphic curve shows vividly the relative transmission of light from a Mazda lamp, fitted with waterproof connections. A table of constants is given in the article, together with a formula for computing the illumination intensity for different depths of water when the initial intensity is known. The present graph shows, however, just how rapidly the illumination falls off in water for any given initial illumination. The particularly interesting feature of the results from a practical standpoint is the very considerable cut-off of light produced by a substance apparently so transparent, amounting for a single foot (0.05 m.) of water to 27.5 per cent. On this basis the transmission through 50 ft. (15.2 m.) of water would be only about one part in 10,000,000 of the incident light.

The rapid decrease in the transmission factor with increased light travel in water coincides with the well-known facts that, for a so-called transparent medium, the ocean permits the penetration of daylight to but a surprisingly short distance below its surface and that fish native to the depths are blind or carry their own illuminants.

HAMMOND RADIO CONTROLLED BOAT SUCCESSFUL.

Army and navy experts have reported the device of John Hays Hammond, Jr., for radio control of surface craft to be sent laden with explosives against enemy ships, a success, and predict similar results with submerged craft.

Secretary Baker wrote the House appropriation committee recently that the joint army and navy board was "convinced of the practicability of the control" of the surface craft, and added that there had also been demonstrations of the possibility of the control to a craft, completely submerged, except for an air in-take pipe.

Before finally deciding on the purchase of the patents for $750,000 the board desires further experiment with the submerged craft.

Construction of the submerged craft, which will be about 80 feet long by 7 feet in diameter, will take two years, according to Mr. Hammond, who told the committee, he had spent ten years and $400,000 on his invention.

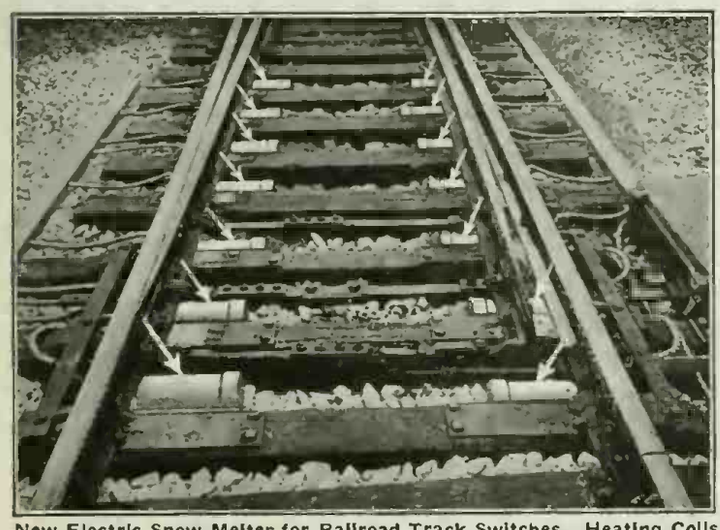
"The board considered the ability of the enemy to interfere with the control of the vessel by radio energy. Mr. Hammond's claims are that no interference can be had with the craft outside a radius of 100 to 150 yards from the source of the energy; that is, from the radio plant of a battleship, for example."

Major-General F. W. Coe said he had run the craft "all around vessels coming into the harbor at will." Mr. Hammond said an aviator after four hours' training on control, was able from a height of 9,000 feet and a distance of six or seven miles to exercise absolute control over the high-speed boat.

ELECTRIC SNOW MELTER FOR TRACK SWITCHES.

The electric snow melting device for track switches here illustrated is purely and simply an electric heater enclosed in a 3½ inch wrought iron pipe, 20 inches long. These heaters are placed between the ties, just under the rail. They are wired from a circuit as the amount and character of the supply current makes necessary, and a switch is placed in this wiring at some convenient point clear of the track. The current can be turned on as the snow storm starts by an employee as easily as an electric light. The heat generated does the rest.

The temperature in the heater rises about 100 degrees Centigrade in the first half hour and by the end of an hour is about 135 degrees Centigrade above the outside temperature. This heat is not enough to set fire to anything but is sufficient to melt the snow.



New Electric Snow Melter for Railroad Track Switches. Heating Coils Indicated By Arrows.

WHAT IS A "KILOWATT" AND "KILOWATT-HOUR?"

(*Continued from page 897*)

will give a constant reading of 80 kilowatts; in other words, for a speed twice as great the watt-meter will show a constant reading twice as high, whereas the watt-hour-meter reading will be the same for the *same distance traveled.*

Applying the formula to this example for a speed of 10 miles per hour and a power consumption of 40 kilowatt-hours, we get

$$\text{Kilowatts} = \frac{40}{1} = 40$$

Making the same run in one-half hour we get

$$\text{Kilowatts} = \frac{40}{\frac{1}{2}} = 80$$

Dividing the total power consumed by one car in kilowatt-hours by the distance in miles, we get the power consumption in *kilowatt-hours per car mile.*

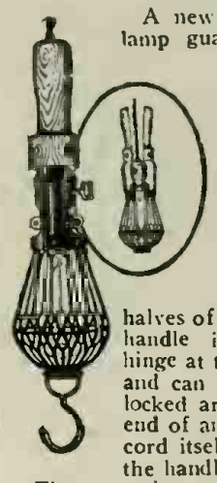
Applying the above terms to electric light, a 40-watt electric light is one that consumes electric power at the rate of 40 watts or 40 watt-hours per hour. A circuit having, say, twenty 40-watt lights in parallel will then consume electric power at the rate of $20 \times 40 = 800$ watts or 800 watt-hours per hour, or 40 watt-hours per lamp-hour. If an electric power station charges you ten cents per kilowatt-hour you can burn one 40-watt lamp

$$\frac{1{,}000}{40} = 25 \text{ hours, or twenty 40-watt lamps}$$

$$\frac{1{,}000}{20 \times 40} = 1\tfrac{1}{4} \text{ hours, for ten cents, since}$$

both conditions represent *one kilowatt-hour.*

SOMETHING NEW IN LAMP GUARDS.



A new departure in portable lamp guards is shown in the illustration of a split handle which can be quickly attached to a special expanded steel lamp guard supplied by the same concern.

This *portable* successfully fills a demand for a substantial handle guard which does not need to be wired. The halves of the guard including the handle itself, open from the hinge at the bottom of the guard and can instantly be closed and locked around the socket at the end of any extension cord. The cord itself runs thru grooves in the handle.

The convenience of this new product will be appreciated by the motorist in his garage as well as in every factory, mill or warehouse, because it permits light to be safely carried to dark corners, in stock bins, engine pits, etc. Fire danger is avoided and lamp users will readily see the advantage and economy, as the modest cost of the guard is quickly repaid thru prevention of lamp breakage.

ANOTHER "USELESS" PATENT.

A Chicago woman has patented a shoe with an electric battery in the heel to supply a mild current to a wearer's ankle as a tonic. Another "useless patnt!"

THE PHOTOELECTRIC SENSITIVITY OF VARIOUS SUBSTANCES.

SOME time ago an examination was made of various substances to determine their electrical sensitivity to light; and in view of the fact that some of the results obtained are at variance with the measurements made by Case, it seems desirable to publish a summary of these observations, which were made at the Bureau of Standards.

Two of the herein described substances were examined for change in electrical conductivity caused by the action of light upon them, and all of them were examined for *photoelectrical activity* when they were charged to a negative potential in an evacuated bulb and exposed to light, reports Messrs. Coblentz and Emerson in the *Journal of the Washington Academy of Sciences.*

When the substances were examined for an increase in electrical conductivity, a potential of 2 to 6 volts was connected thru a resistance of zero to 1,000,000 ohms into a circuit containing a d'Arsonval galvanometer and the substance under investigation. In most cases the substances were slightly conducting when not exposed to light, so that the *dark current* had to be annulled by joining a counter e.m.f. thru a resistance of 10,000 ohms to the terminals of the galvanometer. This counter e.m.f. was obtained by shunting across a resistance of 100 ohms which was in series with a cell of 2 volts and a variable resistance of zero to 70,000 ohms.

The source of light, when not otherwise

specified, was a 16-c.p. carbon incandescent lamp, placed at a distance of 10 cm. from the substance under investigation. One disappointing feature of this investigation is that no substance was found which is comparable in sensitivity with the *potassium photoelectric cell* and with the *selenium cell.*

Gallium. This metal was solid, thus differing from the impure material, which is a liquid.

The results obtained proved disappointing, this metal being quite insensitive to light. When the cell was exposed to daylight the photoelectric current produced a deflection of only 4 to 5 mm., whereas similarly exposing a *potassium photoelectric cell* the photoelectric current was sufficient to give a deflection beyond the range of the scale.

Silver Sulfide. The sample examined was a thin flexible strip, 6 by 10 mm. in area. In one test the silver sulfide formed the negative electrode of a photoelectric cell (evacuated glass bulb about 5 cm. diameter with a ring of platinum wire for the anode). It was connected thru an iron-clad Thompson galvanometer to a battery of 340 volts. When exposed to daylight a deflection of perhaps 1 to 2 mm. was observed, but no deflection resulted from exposure to the standard carbon lamp.

Selenium. A crystal of selenium, prepared by Dr. F. C. Brown and having a receiving surface of less than one sq. mm., when exposed to the standard lamp gave a deflection of more than 50 cm., which shows its *great sensitivity* as compared with other substances.

The mounting of the selenium crystal consisted of metal electrodes between which the crystal was held by compression. When operated as a photophone, by connecting the selenium crystal with an Audion amplifier, a loud musical note was obtained.

Tellurium. This metal is said to change in resistance when exposed to light. The present tests were made upon a mirror of tellurium deposited upon a glass plate by cathode disintegration. Suitable terminals were attached to a sample about 4 by 50 mm. *No change in conductivity* was observed when it was exposed to light.

Boleite. The sample of boleite [3Pb Cl (OH).Cu Cl (OH) + Ag Cl], from Boleo, Mexico, examined was a single rectangular crystal 3 by 3 by 1.5 mm. It was held by compression between copper electrodes. *No change in conductivity* was observed when the crystal was exposed to daylight or to the standard incandescent lamp.

Stibnite. The size of one sample examined was 4 by 7 by 0.5 mm. Terminals were attached to it by heating a copper wire to incandescence in a gas flame and bringing it in contact with the plate of stibnite.

The standard carbon lamp caused a deflection of 5 cm. Stibnite may be considered as sensitive as *boulangerite*, to be mentioned presently, but the deflection drifted, due to the decrease in resistance with time already noticed by other observers.

Boulangerite. The specimen of boulangerite (3PbS. Sb_2S_3, Irkutsk, Siberia), investigated was obtained from the Smithsonian collection. Several samples were examined. In one sample, 4 by 7 by 0.8 mm., the electrodes consisted of copper wires melted into the material as just described. The radiation from the standard lamp gave a deflection of 10 to 20 cm.

Another sample, 1 by 1.2 by 2 mm., held by compression between two heavy electrodes of copper, when exposed to the standard incandescent lamp produced a deflection of 2 to 3 cm., which is comparable with the preceding when one considers the size of the exposed surfaces.

Altho this substance seems fairly sensitive, it did not appear to be sufficiently so to justify an investigation of its spectral sensitivity with a view of using this mineral as a selective radiometer.

Jamesonite. ($2PbS.Sb_2S_3$; Smithsonian

collection, from Cornwall, England.) The sample examined (size 2 by 7 by 1 mm.) had the copper wire terminals attached by fusing the incandescent wire into the material. The standard lamp gave a deflection of only 1 to 2 cm., which seems to indicate that this material is not so light-sensitive as is boulangerite.

Mixtures of galena and stibnite in various proportions were melted in a crucible and poured upon a plate of metal. Several samples, 5 by 10 by 0.5 mm., were examined, but none of them gave any indication of light-sensitiveness (change in resistance) when exposed to daylight or to the standard incandescent lamp.

Bismuthinite. Bismuthinite, Bi_2S_3, was obtained from the Smithsonian collection from Jefferson County, Montana. This is the most interesting substance examined, in view of the diverse results obtained and the explanation offered therefor.

The sample of bismuthinite examined consisted of a non-homogeneous mass of acicular crystals, which was easily crushed into numerous fine needle-like crystals. The first sample examined was a small mass of crystals (size 1 by 1 by 0.7 mm.) held by compression between two heavy electrodes of copper. When the crystal was exposed to the standard carbon lamp *no change in conductivity* could be detected with certainty.

A second sample, 3 by 6 by 1 mm., had the copper wire terminals attached by fusion, as already described. The e.m.f's applied were the same as for the preceding sample. When exposed to the standard lamp no change in conductivity was observed. These results being contradictory to those published by Case, who used a three stage Audion amplifier to detect the change in conductivity of the crystals, the foregoing experiments were repeated in the manner described by him. For this purpose the light from an acetylene flame shining thru a slit 2 by 10 mm. was focused upon the crystal by means of a triple achromatic lens, 6 cm. in diameter and 18 cm. focal length. The light was interrupted by means of a sectored disk having 15 openings and operated by means of an electric motor, the speed of which could be varied. The usual speed gave 240 interruptions per second. The crystal was connected to a three stage Audion amplifier and telephone receiver. A crystal of selenium or a selenium cell produced a loud note, but the samples of boulangerite and jamesonite, which by previous tests were light-sensitive, did not give a musical sound in the telephone.

The sample of bismuthinite with electrodes sealed on produced no audible note when exposed to light.

At least a dozen samples of bismuthinite held by compression between heavy copper electrodes were examined in connection with the amplifier. Of this number only two samples appeared to be light-sensitive. One sample produced only a faint sound in the telephone receiver. The second sample produced a loud note in the telephone. The sound was the loudest when the crystal was exposed along the line of contact with the copper electrode. Covering the crystal with red glass did not reduce the loudness of the note very much, indicating that the effect is due to heating of the material. Unfortunately, this crystal was crushed while under investigation. Prolonged tests on other samples gave negative results as regards the production of sound.

In view of the fact that the tests made with a sensitive galvanometer failed to show an increase in conductivity when bismuthinite was exposed to light, it appears that the change in conductivity which was observed when a certain specimen was exposed to intermittent flashes of light (photophone or, rather, radiophone) is

the result of a *thermal change* within the crystal, or perhaps a change in the *contact resistance* at the electrodes. In this connection the following experiments on thin strips of metals are of interest.

Platinum and Gold. In conclusion it is of interest to record the results obtained when using thin blackened strips of platinum and of gold-leaf as radiophones, by connecting them thru a battery to an amplifier.

These blackened strips were warmed intermittently by exposing them thru a rotating sectored disk to the acetylene flame, as already described.

When a sensitive platinum bolometer receiver was used as a radiophone, the sound produced in the telephone was not very audible. This no doubt was due to the great heat capacity of the material which prevented the rapid alternations in resistance and hence in electric current, from being of sufficient magnitude to affect the telephone receiver.

Using a lightly smoked strip (6 by 2.5 mm.) of gold-leaf, the ends of which were clamped between thin (0.02 mm.) strips of tin, the sound produced in the telephone receiver was as loud as was observed in the photophone made of selenium.

This device was mounted in a glass bulb which could be evacuated. As was to be expected, there was no marked difference in the intensity of the sound produced when operated in air and in a vacuum.

In the gold-leaf radiophone as used, the limit of audibility was attained for a light (radiant power) intensity of 4.8×10^{-5} watts. Using a larger receiver and amplifier and a larger current (which was 0.2 amp. in the present tests) thru the receiver, the sensitivity could be greatly increased.

MENTAL TELEPATHY—A SIMPLE CONCEPTION OF PSYCHICAL ACTIVITY.

By Dr. Charles H. Merlitz

IN the September issue of the ELECTRICAL EXPERIMENTER there appeared an extremely interesting article by Dr. A. Abrams on *Thought Transference and Other Phenomena.* Altho he gave many interesting experiments he did not show the relationship of this theory to the modern physical theories. It is the author's intention in the present article to present an explanation for this remarkable phenomena.

We know very little in regard to the functioning of the human mind. We have practically no insight into the mechanism of thought and memory. We do know, however, that the brain in functioning requires nourishment. Thus it follows that any operation of the brain is accompanied by the absorption of a certain amount of energy. However, *contrary* to ordinary laws, in storing a thought and in subsequently recalling it, *energy is absorbed.* These two processes are the opposite of each other, and it would naturally be supposed that in remembering energy would be dissipated.

To commit a thought to memory we repeat it several times, each successive repetition requires the expenditure of a certain amount of energy. Thus we may say that the energy expended after a number of repetitions equals:

$1^2 + 1^2 + 1^2 + 1^2 - - - - - -$ n times

Now when we remember it the process is the reverse, which gives us $(-1)^2$ which would equal 1^2, which means the *addition of energy.* Thus the act of remembering a fact more firmly implants it in the mind.

We may easily assume that there is a certain practical limit to the amount of effect that can he produced. This limit might be called the *saturation* of the brain. It would he reasonable to suppose from this that for each repetition or act of remembering the amount of energy stored is less than that of the preceding one, decreasing in geo-

metrical progression. Each repetition, however, is accompanied by the absorption of a certain amount of energy. Thus it follows that for each succeeding repetition there is a certain amount of surplus energy to be accounted for. It is this surplus energy that gives us an explanation for the process known as *Mental Telepathy*. Our question then resolves itself into the manner of transference or transmission of this energy.

Sir William Crookes has suggested that the transmission of this energy is effected by means of *ether waves* of *smaller magnitude* and *greater frequency* than those which constitute X-rays. These rays also possess the property of neither being reflected or refracted. Prof. Flournoy suggested that these waves are undulations starting from the nervous centers in the brain. The greatest objection to this theory of telepathy is that the intensity of the received impulses is not inversely proportional to the square of the distance, no perceptible diminution in the impulses being produced by distance. In actual experiments the intensity sometimes even increased with the distance. The explanation of this curious phenomena is extremely simple, however. Pocock has suggested that the sensibility and capacity of the brain for the reception of these transmitted impulses is extremely small, so small in fact that the receiver is saturated even at the greatest distance over which telepathy has been observed. The excess energy passes on—unable to produce any effect upon the already saturated brain. This explains why the intensity is not diminished by distance.

We may postulate then that Mental Telepathy is a case of *radiant energy*. These radiations emanating from the brain when the mind is concentrated, are therefore very penetrating and traverse great distances without perceptible decrease in intensity.

The reasoning which I have heretofore pursued has been from the purely theoretical standpoint. The fact that the brain actually radiates energy has been demonstrated by several scientists. Charpentier showed that the human body emits what he has called "N-rays." He found that the phosphorescence of certain substances is increased when they are brought into the vicinity of contracting muscles or one of the nervous centers of the cerebral cortex. He demonstrated this by the use of a simple piece of apparatus. A lead tube about two inches long covered at one end by a piece of paper or silk treated with phosphorescent calcium sulfate was employed. By placing this tube near nervous centers a marked increase in phosphorescence was observed. Di Brazza showed that when a phosphorescent, platino-cyanid of barium screen faintly illuminated by a distant X-ray tube was placed near certain portions of the head, that when the subject concentrated his will the luminosity of the screen was varied in relation to the subjects *psychical activity*. From this he concluded that the brain was the seat of active radiations. When the subject's attention is not concentrated no variation in the luminosity is noticeable. Di Brazza found that the activity was greatest around the temples, the eyes and behind the ears. This experiment may be repeated by exercising great care. It must be remembered, however, that the variations in luminosity are extremely small.

There have been many experimenters in this branch of science, many of whom have recorded remarkable instances of telepathy or *action at a distance*, as it is sometimes called. Professor Henry Sidgwick has collected a great number of instances in which hallucinations directly preceded death, and which he attributed to mental telepathy. Wessermann has recorded a singularly in-

teresting incident. He wished to make the apparition of a young lady appear to a lieutenant living several miles away. At the time of the experiment a visitor happened to be with the lieutenant, who is said to have seen the apparition also. Many instances are recorded in which persons were hypnotized at some distance. All of these phenomena can be easily explained by the *brain wave* theory.

Besides the transference of thought, both sympathy and affection may be the outgrowth of these radiations from the brain. Whether our capacity for the reception of these impulses is increasing with the evolution of man, cannot be ascertained directly. It would seem probable, however, that with our increase in education and civilization that a conscious use of this *thought language* may be found. Who knows but that the man of the future may find a practical application for this radiation from the brain, and a higher and more delicately made creature may result who would effect mutual understanding by means of this marvelous and as yet but little understood *psychical activity.*

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travel at a rate of about one thousand miles an hour, impracticable by rail. The reader will smile. The plan was difficult of execution, I will admit, but not nearly so bad as that of a well-known New York professor, who wanted to pump the air from the torrid to the temperate zones, entirely forgetful of the fact that the Lord had provided a gigantic machine for this very purpose.

Still another scheme, far more important and attractive, was to derive power from the rotational energy of terrestrial bodies. I had discovered that objects on the earth's surface, owing to the diurnal rotation of the globe, are carried by the same alternately in and against the direction of translatory movement. From this results a great change in momentum which could be utilized in the simplest imaginable manner to furnish motive effort in any habitable region of the world. I cannot find words to describe my disappointment when later I realized that I was in the predicament of Archimedes, who vainly sought for a fixt point in the universe.

At the termination of my vacation I was sent to the Polytechnic School in Gratz, Styria, which my father had chosen as one of the oldest and best reputed institutions. That was the moment I had eagerly awaited and I began my studies under good auspices and firmly resolved to succeed. My previous training was above the average, due to my father's teaching and opportunities afforded. I had acquired the knowledge of a number of languages and waded thru the books of several libraries, picking up information more or less useful. Then again, for the first time, I could choose my subjects as I liked, and free-hand drawing was to bother me no more. I had made up my mind to give my parents a surprise, and during the whole first year I regularly started my work at three o'clock in the morning and continued until eleven at night, no Sundays or holidays excepted. As most of my fellow-students took things easily, naturally enough I eclipsed all records. In the course of that year I past thru nine exams and the professors thought I deserved more than the highest qualifications. Armed with their flattering certificates, I went home for a short rest, expecting a triumph, and was mortified when my father made light of these hard-won honors. That almost killed my ambition; but later, after he had died, I was pained to find a package of letters which

(*Continued on page* 907)

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(*Continued from page* 905)

the professors had written him to the effect that unless he took me away from the Institution I would be killed thru overwork. Thereafter I devoted myself chiefly to physics, mechanics and mathematical studies, spending the hours of leisure in the libraries. I had a veritable mania for finishing whatever I began, which often got me into difficulties. On one occasion I started to read the works of Voltaire when I learned, to my dismay, that there were close on one hundred large volumes in small print which that monster had written while drinking seventy-two cups of black coffee per diem. It had to be done, but when I laid aside the last book I was very glad, and said, "Never more!"

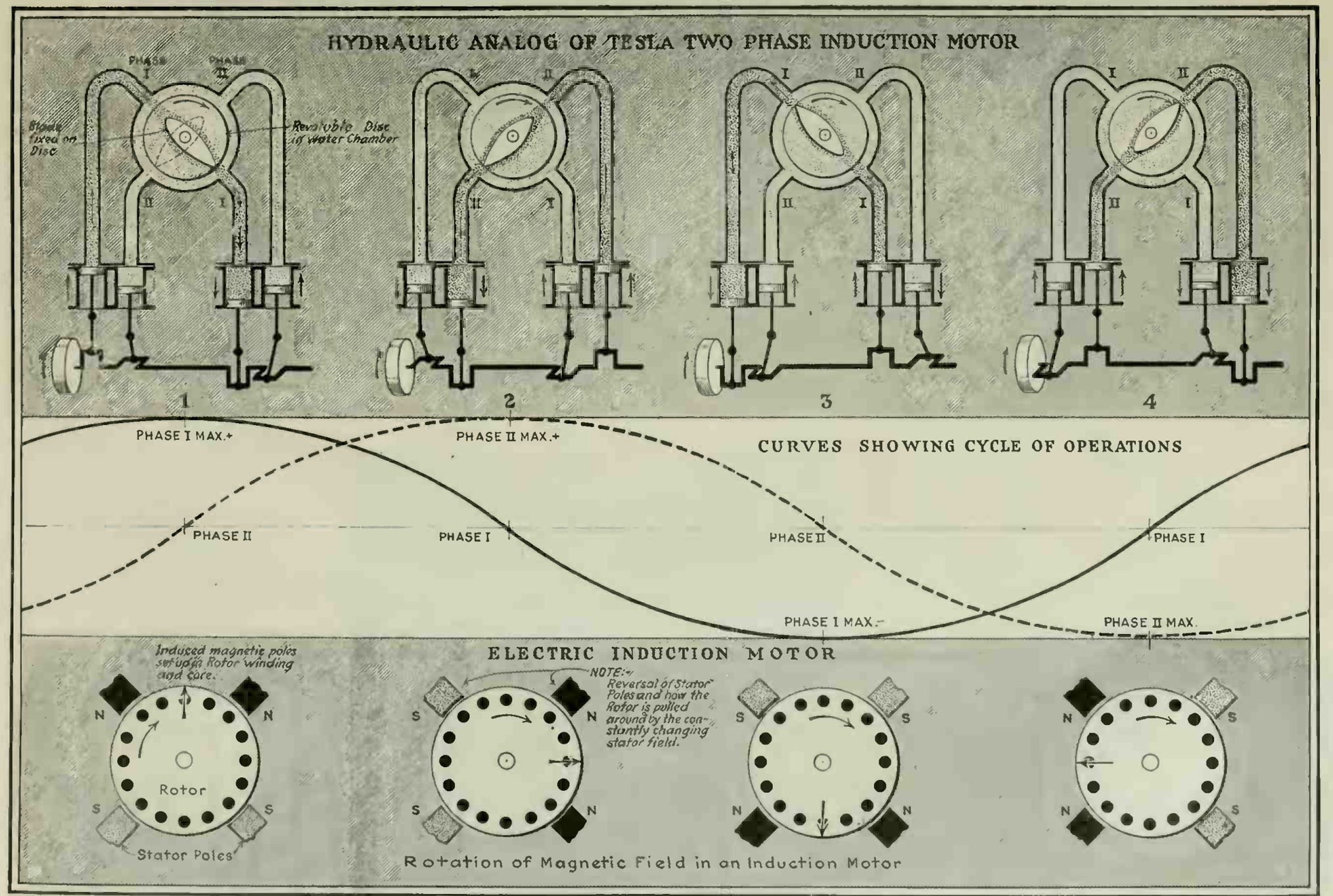
My first year's showing had won me the appreciation and friendship of several professors. Among these were Prof. Rogner, who was teaching arithmetical subjects and geometry; Prof. Poeschl, who held the chair of theoretical and experimental physics, and Dr. Allé, who taught integral calculus and specialized in differential equations. This scientist was the most brilliant lecturer to whom I ever listened. He took a special interest in my progress and would frequently remain for an hour or two in the lecture room, giving me problems to solve, in which I delighted. To him I explained a flying machine I had conceived, not an illusionary invention, but one based on sound, scientific principles, which has become realizable thru my turbine and will soon be given to the world. Both Professors Rogner and Poeschl were curious men. The former had peculiar ways of expressing himself and whenever he did so there was a riot, followed by a long and embarrassing pause. Prof. Poeschl was a methodical and thoroly grounded German. He had enormous feet and hands like the paws of a bear, but all of his experiments were skillfully performed with clock-like precision and without a miss.

It was in the second year of my studies that we received a Gramme dynamo from Paris, having the horseshoe form of a laminated field magnet, and a wire-wound armature with a commutator. It was connected up and various effects of the currents were shown. While Prof. Poeschl was making demonstrations, running the machine as a motor, the brushes gave trouble, sparking badly, and I observed that it might be possible to operate a motor without these appliances. But he declared that it could not be done and did me the honor of delivering a lecture on the subject, at the conclusion of which he remarked: "Mr. Tesla may accomplish great things, but he certainly never will do this. It would be equivalent to converting a steadily pulling force, like that of gravity, into a rotary effort. It is a perpetual motion scheme, an impossible idea." But instinct is something which transcends knowledge. We have, undoubtedly, certain finer fibers that enable us to perceive truths when logical deduction, or any other willful effort of the brain, is futile. For a time I wavered, imprest by the professor's authority, but soon became convinced I was right and undertook the task with all the fire and boundless confidence of youth.

I started by first picturing in my mind a direct-current machine, running it and following the changing flow of the currents in the armature. Then I would imagine an alternator and investigate the processes taking place in a similar manner. Next I would visualize systems comprising motors and generators and operate them in various ways. The images I saw were to me perfectly real and tangible. All my remaining term in Gratz was past in intense but fruitless efforts of this kind, and I almost came to the conclusion that the problem was insolvable. In 1880 I went to Prague, Bohemia, carrying out my father's wish to complete my education at the University there. It was in that city that I made a decided advance, which consisted in detaching the commutator from the machine and studying the phenomena in this new aspect, but still without result. In the year following there was a sudden change in my views of life. I realized that my parents had been making too great sacrifices on my account and resolved to relieve them of the burden. The wave of the American telephone had just reached the European continent and the system was to be installed in Budapest, Hungary. It appeared an ideal opportunity, all the more as a friend of our family was at the head of the enterprise. It was here that I suffered the complete breakdown of the nerves to which I have referred. What I experienced during the period of that illness surpasses all belief. My sight and hearing were always extraordinary. I could clearly discern objects in the distance when others saw no trace of them. Several times in my boyhood I saved the houses of our neighbors from fire by hearing the faint crackling sounds which did not disturb their sleep, and calling for help.

In 1899, when I was past forty and carrying on my experiments in Colorado, I could hear very distinctly thunderclaps at a distance of 550 miles. The limit of audition for my young assistants was scarcely more than 150 miles. My ear was thus over thirteen times more sensitive. Yet at that time I was, so to speak, stone deaf in comparison with the acuteness of my hearing while under the nervous strain. In Budapest I could hear the ticking of a watch with three rooms between me and the time-piece. A fly alighting on a table in the room would cause a dull thud in my ear. A carriage passing at a distance of a few miles fairly shook my whole body. The whistle of a locomotive twenty or thirty miles away made the bench or chair on which I sat vibrate so strongly that the pain was unbearable. The ground under my feet trembled continuously. I had to support my bed on rubber cushions to get any rest at all. The roaring noises from near and far often produced the effect of spoken words which would have frightened me had I not been able to resolve them into their accidental components. The sun's rays, when periodically intercepted, would cause blows of such force on my brain that they would stun me. I had to summon all my will power to pass under a bridge or other structure as I experienced a crushing pressure on the skull. In the dark I had the sense of a bat and could detect the presence of an object at a distance of twelve feet by a peculiar creepy sensation on the forehead. My pulse varied from a few to two hundred and sixty beats and all the tissues of the body with twitchings and tremors which was perhaps the hardest to bear. A renowned physician who gave me daily large doses of Bromid of Potassium pronounced my malady unique and incurable. It is my eternal regret that I was not under the observation of experts in physiology and psychology at that time. I clung desperately to life, but never expected to recover. Can anyone believe that so hopeless a physical wreck could ever be transformed into a man of astonishing strength and tenacity, able to work thirty-eight years almost without a day's interruption, and find himself still strong and fresh in body and mind? Such is my case. A powerful desire to live and to continue the work, and the assistance of a devoted friend and athlete accomplished the wonder. My health returned and with it the vigor of mind. In attacking the problem again I almost regretted that the struggle was soon to end. I had so much energy to spare. When I undertook the task it was not with a resolve such as men often make. With me it was a sacred vow, a question of life and death. I knew that I would perish if I failed. Now I felt that the battle

(*Continued on page* 909)



The Purpose of This Analog Is to Portray, As Faithfully As Possible, the Phenomena of Tesla's Rotating Magnetic Field So As to Make Them Easily Understandable to the Average Reader. The Two Alternating Fluxes Are Represented By Streams of Water Having the Same Relation As to Phase, Amplitude and Direction. The Magnetic Polarity of the Rotor Is Imitated By the Employment of a Body So Shaped As to Behave, With Respect to the Streams, Exactly As the Rotor With Respect to the Poles. Moreover, the Corresponding Rotating and Stationary Parts Are Given a Similar Appearance and Are Disposed In Like Manner. To Make the Analog Complete, It May Further Be Assumed That the Liquid Is Compressible So That There Will Be a Phase Displacement Between Pressure and Flow As That Existing Between Electro-Motive Force and Current.

MY INVENTIONS.

(*Continued from page 907*)

was won. Back in the deep recesses of the brain was the solution, but I could not yet give it outward expression. One afternoon, which is ever present in my recollection, I was enjoying a walk with my friend in the City Park and reciting poetry. At that age I knew entire books by heart, word for word. One of these was Göethe's "Faust." The sun was just setting and reminded me of the glorious passage:

"Sie rückt und weicht, der Tag ist überlebt,
Dort eilt sie hin und fördert neues Leben.
Oh, dass kein Flügel mich vom Boden hebt
*Ihr nach und immer nach zu streben!**

* * * * * * *

Ein schöner Traum indessen sie entweicht.
Ach, zu des Geistes Flügeln wird so leicht
Kein körperlicher Flügel sich gesellen!"†

As I uttered these inspiring words the idea came like a flash of lightning and in an instant the truth was revealed. I drew with a stick on the sand the diagrams shown six years later in my address before the American Institute of Electrical Engineers, and my companion understood them perfectly. The images I saw were wonderfully sharp and clear and had the solidity of metal and stone, so much so that I told him: "See my motor here; watch me reverse it." I cannot begin to describe my emotions. Pygmalion seeing his statue come to life could not have been more deeply moved. A thousand secrets of nature which I might have stumbled upon accidentally I would have given for that one which I had wrested from her against all odds and at the peril of my existence.

* "The glow retreats, done is the day of toil;
It yonder hastes, new fields of life exploring;
Ah, that no wing can lift me from the soil,
Upon its track to follow, follow soaring!"

† A glorious dream! though now the glories fade.
Alas! the wings that lift the mind no aid
Of wings to lift the body can bequeath me."

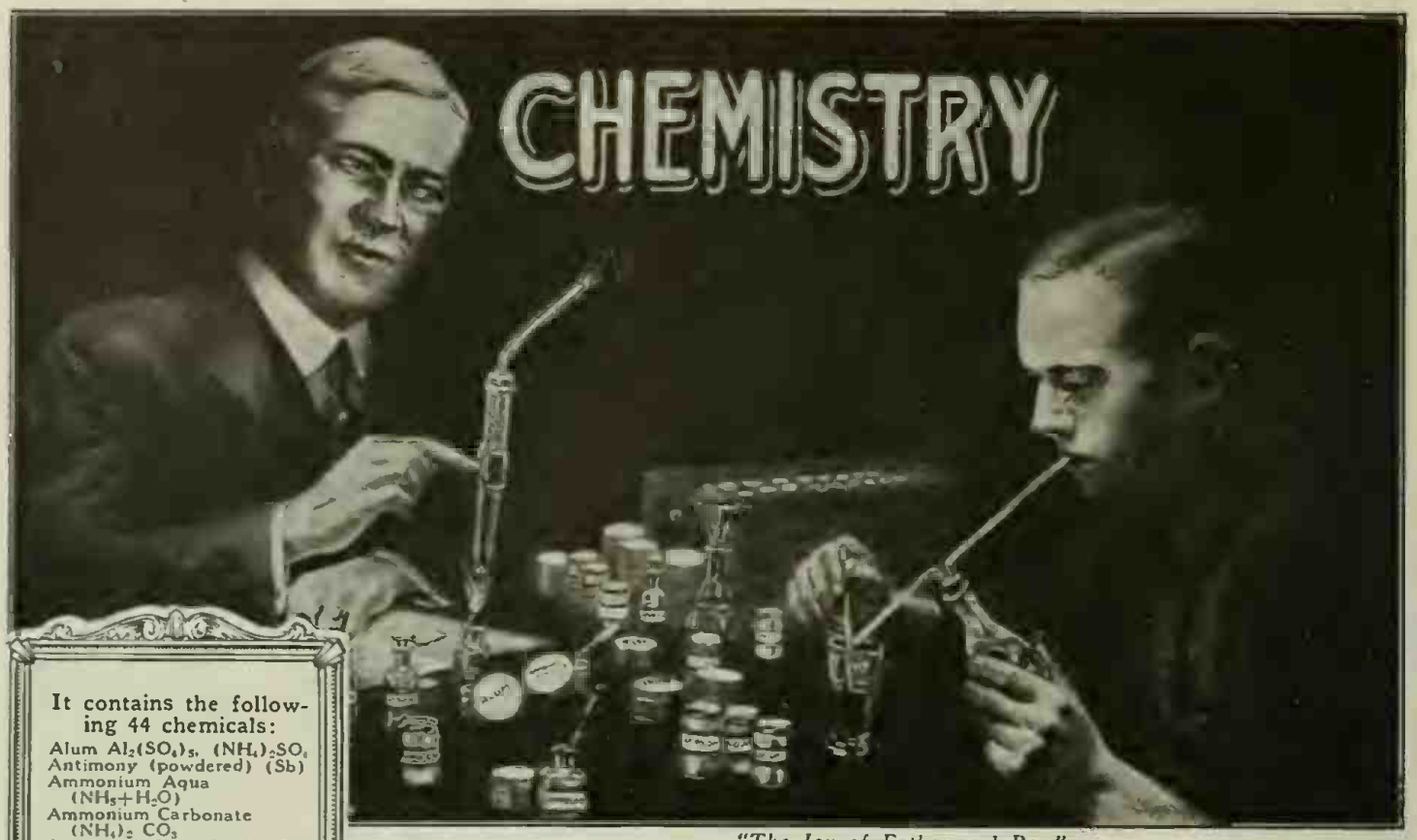
TESLA ON HIGH FREQUENCY GENERATORS.

Editor, ELECTRICAL EXPERIMENTER:

It is to be regretted that a letter addrest to me by Mr. J. Harris Rogers, in your care, was published in the march number of the ELECTRICAL EXPERIMENTER, altho the concurrence of our views in some wireless features might have made this desirable to so wide-awake and enterprising a periodical as yours.

Mr. Rogers seems to be a very appreciative gentleman and nothing would be farther from my thoughts than to detract anything from his merit, but in a separate contribution, which I expect to prepare for your next issue, I shall express myself on this subject without prejudice and in the interest of truth. However, the article by your Mr. H. Winfield Secor on "America's Greatest War Invention—The Rogers Underground Wireless" contains a reference to "a novel and original high frequency generator" of Mr. Rogers' invention. May I not —to use the President's elegant expression —call attention to the fact that this device was described by me years ago, as will be evident from the following excerpt of a communication which appeared in the *Electrical Review* of March 15, 1899. In speaking of circuit controllers, I said: "I may mention here, based on a different principle, which is incomparably more effective, more efficient, and also simpler on the whole. It comprises a fine stream of conducting fluid which is made to issue, with any desired speed, from an orifice connected with one pole of a generator, thru the primary of the induction coil, against the other terminal of the generator placed at a small distance. This device gives discharges of a remarkable suddenness, and the frequency may be

(*Continued on page 914*)



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Ammonium Carbonate $(NH_4)_2CO_3$
Ammonium Chloride (NH_4Cl)
Ammonium Sulphate $(NH_4)_2SO_4$
Barium Chloride ($BaCl_2$)
Boric Acid (H_3BO_3)
Brimstone (Sulphur) (S)
Calcium Chloride ($CaCl_2$)
Calcium Oxide (CaO)
Calcium Sulphate ($CaSO_4 2H_2O$)
Charcoal (Carbon) (C)
Chloride of Zinc ($ZnCl_2$)
Copper Sulphate ($CuSO_4$)
Ferrous Sulphate ($FeSO_4$)
Ferrous Sulphide (FeS)
Glycerol (Glycerine) $C_3H_5(OH)_3$
Hydrochloric Acid (HCl)
Iodine (I)
Iron Chloride ($FeCl_2$)
Iron Oxide (Fe_2O_3)
Lead Acetate Pb $(C_2H_3O_2)_2$
Litmus Paper
Magnesium Carbonate ($MgCO_3$)
Manganese Dioxide (MnO_2)
Mercury (Quicksilver) (Hg)
Nickel Chloride ($NiCl_2$)
Oxalic Acid ($H_2C_2O_4$)
Sodium Bicarbonate ($NaHCO_3$)
Sodium Borate ($NaBO_2$)
Sodium Carbonate (Na_2CO_3)
Sodium Chloride (NaCl)
Sodium Nitrate ($NaNO_3$)
Sodium Phosphate (Na_2HPO_4)
Sodium Sulphate (Na_2SO_4)
Sodium Sulphite (Na_2SO_3)
Stannous Chloride ($SnCl_2$)
Sulphate of Nickel ($NiSO_4$)
Sulphate of Zinc ($ZnSO_4$)
Sulphuric Acid (H_2SO_4)
Tin (Granulated) (Sn)
Zinc (Metal) (Zn)
Zinc Carbonate ($ZnCO_3$)

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One Alcohol Lamp
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PRACTICAL CHEMICAL EXPERIMENTS.

(*Continued from page* 894)

tee, and must furnish certificates of good character and honesty. These secrets have been handed down faithfully from one generation to another for hundreds of years.

QUESTIONS AND ANSWERS IN CHEMISTRY.

Standard Soap Solution.

Q. 1. Roy Munsell, Henryetta, Okla., wants to know the method of preparing the Standard Soap Solution as mentioned in the lesson on water testing of the "Experimental Chemistry" lessons.

A. A strong solution of this soap is first prepared by rubbing together in a mortar, 75 grams of the so-called "lead plaster" (which consists practically of lead oleate), which may be obtained from your druggist, and 20 grams of dry potassium carbonat. When the two are thoroly mixed a small quantity of methylated alcohol is added, and the mixture worked to the consistency of a thin smooth cream. More spirit is then added, and the contents of the mortar rinsed, using more of the spirits for this purpose. This is then collected in a bottle and the mixture placed aside to settle. The clear liquid is decanted off thru a filter, and the sediment finally washed upon the filter with more spirit. The volume of the liquid may now be made up to 200 or 250 cc., by adding a mixture of equal volumes of spirit and water.

Solvay Process.

Q. 2. C. H. Hathaway, of Peoria, Ill., desires information regarding the Solvay Process.

A. Sodium Chlorid, commonly known as table salt, is the source from which the sodium alkalies are derived. The starting point of this process is therefore salt—in the form of a good strong salt brine. If you open a bottle of ordinary smelling salts and inhale the vapor, you will immediately recognize the second fundamental of the process in the form of Ammonia, similar to the gas which is contained in the common household ammonia. The third and last fundamental is ordinary carbonic acid gas, the same as is used to make soda water fizz. For the purpose of this process it is obtained from limestone, by heating the stone to a high temperature. Thus we see that Salt, Ammonia and Carbonic acid gas are the three fundamentals upon which the process is based.

The salt brine is saturated with ammonia gas and carbonic acid gas is then blown into this solution of ammonia in the brine.

The process does not take place in one step, but the final products are Sal-ammoniac and crude bicarbonat of soda. The crude bicarbonat of soda separates out as a white powder and the sal-ammoniac remains dissolved. The Ammonia takes the place of the sodium in the salt, and the sodium combines with water and carbonic acid to form the well-known baking soda (Sodium Bicarbonat).

This is separated from the liquids by filtration. It is then necessary to prepare this for a commercial product by heating it in a furnace where it loses all its water and carbonic acid gas. The product is now known as sodium carbonat, or soda ash, the finished product of the Solvay process, and the starting point for other forms of sodium alkalies. (The liquid coming from the filtration process contains the sal-ammoniac, and this is distilled with lime to recover the ammonia to be used over again—no ammonia remains in the soda.)

Mercury Vapor

Q. 3. Gordon Jones, Jr., Cordele, Ga., wants to know how Mercury Vapor is obtained.

A. Under a pressure of 760 mm., mercury boils at 357.25 degrees C., giving off a colorless vapor. Mercury gives off vapor even at ordinary temperatures, and a gold leaf suspended over mercury in a stoppered bottle, gradually becomes white upon the surface, owing to its amalgamation with the mercurial vapor. This vapor is poisonous, giving rise to salivation, such as loosening of the teeth, etc.

Buttermilk in Butter.

Q. 4. Theodore Coughlin, Rochester, N. Y., wants to know why buttermilk is objectionable in butter.

A. Buttermilk is very objectionable as it begins to decompose almost immediately, and sets up fermentation, in the butter itself. See article at head of this month's "Chemistry Department."

BACK NUMBERS CONTAINING "EXPERIMENTAL CHEMISTRY SERIES.

The "Experimental Chemistry" series, by Albert W. Wilsdon, started in the June, 1916 issue of the ELECTRICAL EXPERIMENTER and has run continuously since that date. Prices on the back numbers containing these respective lessons, many of which have been of the greatest value to High School as well as Correspondence School and University Scholars, as has been proven by many letters which we have received from readers of all classes, will be furnisht upon receipt of stamped and addrest envelope. If you wish a first-class and clearly explained treatise on Experimental Chemistry, procure all of the lessons and bind them together. Many valuable and original tables and formulas are included in these lessons which the author has found of particular value in his commercial experience as a chemist.

SCIENCE IN SLANG.

(*Continued from page* 885)

one way only where the electrodes are of unequal temperature. With the audion, music has even been transmitted with charming effect, and over many miles. With a clever man at the adjusters, a long dash can be construed into a melody. An A flat can be made to sound like a Z sharp; in other words, you would be unable to hear it. As yet they have not got it down so pat that they can run the sound waves into the visual strata and make 'You Made Me What I Am To-day, Now Aren't You Satisfied?' evolve into a likness of Bill Hohenzollern, or "They Are Wearing Them Higher in Hawaii" into an X-ray.

"Tesla, De Forest and Marconi do not hold the whole stage in the wireless field. Prof. Fessenden has bushels of patents in the Pat. office on the stuff, and there are a lot of other guys who have earned the price of a meal from some little thing that makes

(*Continued on page* 918)

POPULAR ASTRONOMY.

(*Continued from page* 869)

eye. The play of auroral lights around the poles is plainly visible and the earth's atmosphere reflects a rim of light to the moon at the time of *new Earth*. Owing to the lack of atmosphere on the moon, there is no diffusion of light and the earth therefore stands out in sharp contrast to a sky of inky blackness in which the solar corona

(*Continued on pag* 912)

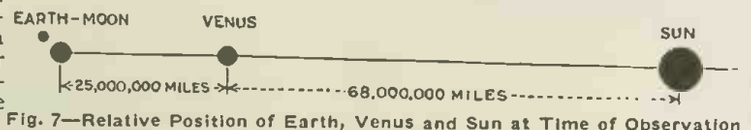

Fig. 7—Relative Position of Earth, Venus and Sun at Time of Observation at Opposition.

and the stars appear even in the lunar day.

To one equipt with an opera glass on the moon many of the wonders and beauties of our planet would be revealed: the shadows of our lofty mountain peaks would be seen falling across the adjacent plains and passing ram or snow storms would temporarily veil certain portions. Were our most powerful telescopes placed on the moon we could easily distinguish small islands and lakes and cities, as well. All objects five miles or so in diameter would be well within the reach of our great telescopes and we can imagine that the lunar inhabitants would spend a considerable portion of their time in attempting to solve the nature of many mysterious markings that come and go over the face of their nearest neighbor. It is indeed a pity that the opportunity to study a living planet at close range is granted to a world devoid of all forms of life while the great telescopes of our own planet sweep searchingly over a barren mass of lifeless rocks presenting no signs of growth or decay, a desolate and uninhabitable waste.

We have considered how our planet appears from the two other planets that are most likely to be the abode of life, Venus and Mars, and how it would appear if seen from our satellite the moon.

It will not take us long to consider how we would appear from the major planets—Jupiter, Saturn, Uranus and Neptune. The greatest possible distance the earth could depart from the sun viewed from Jupiter would be a little less than twelve degrees. Mercury, as we know, is not an easy planet to observe, yet it departs at times nearly thirty degrees from the sun. Moreover it is so near to the earth that when it is seen near its elongations it appears as a bright first magntitude star. Our planet earth on the other hand is so distant from Jupiter that it would be just barely visible to the naked eye if seen against a black sky. When we consider that it never gets more than twelve degrees from the sun under the most favorable circumstances as viewed from Jupiter and must therefore always be searched for in the light of the sun's rays we see the hopelessness of expecting to see our planet earth from the distance of Jupiter without telescopic aid and were it possible to set up our telescopes at the distance of Jupiter we would find that our little planet earth was not only a most elusive little body but also quite uninteresting when found. It would appear only as a very small half moon with a suspicion of a few dark shadings here and there. As we travel outward from Jupiter to the planets Saturn, Uranus and Neptune our interest in the little planet decreases rapidly. It appears to shrink more and more in size in the telescope until at the distance of Neptune it has become so tiny and so near to the sun that it is hardly worth a search in the telescope.

(The next Installment will appear in the May number.)

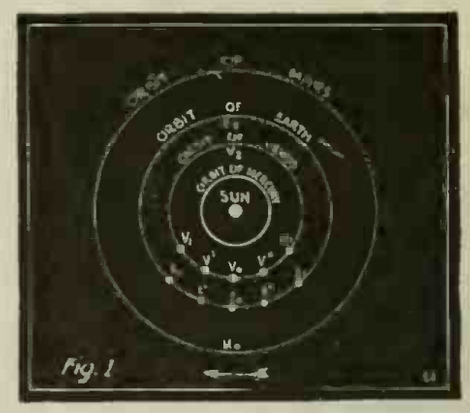

Fig 1. Diagram Showing Relative Positions of Mars and the Three Inner Planets, Earth, Venus, and Mercury, the Three Morning and Evening Stars of Mars. Assuming Mars to Be In the Position M_0 the Planets Are Best Seen When on the Near Side of Their Orbits, Positions E, E', E'' and E_3 for Earth and v, v', v'' and v_3 for Venus. At E_0 and E_3 Earth Is Invisible from Mars, Being In Inferior and Superior Conjunction with the Sun Respectively. At E, and E_2 It Is at Its Eastern and Western Elongations Respectively and at E' and E'' It is at the Greatest Brilliancy. When Venus Is at Its Greatest Brilliancy V' and V'' and the Earth Is in the Far Part of Its Orbit. Beyond E, and E_3 Venus Appears Brighter to the Martians Than Our Own Planet, but When the Earth Is Near E' and E'' It Surpasses Venus in Brightness Because It Is Then Considerably Nearer to Mars.

Experiments in Boston have shown that electric trucks deliver coal at a saving of 3.2 cents per ton mile from the expense of horse delivery and seven cents per ton mile cheaper than gasoline trucks.

Fig. 2. Changes In Size and Appearance of the Disk of the Planet Earth As Seen from Mars In Various Parts of Its Orbit. (1) At Superior Conjunction (E_2 In Fig. 1) Planet Invisible from Mars. (2) Just Before and After Superior Conjunction With the Sun. In This Position the Disk Is Quite Fully Illuminated, But It Is Comparatively Small and Indistinct Being On the Far Side of Its Orbit from Mars and Near the Sun. (3) At Times of Elongation (E, E_2 In Fig. 1). The Earth Is Now At Its Greatest Angular Distance from the Sun and Well Placed for Observation from Mars. (4) At Times of Greatest Brilliancy (E' and E'' In Fig. 1). The Planet Is Now At Its Best for Observation. (5) Just Before and After Inferior Conjunctions. The Planet Is On the Side of Its Orbit Nearest to Mars. But Is too Near the Sun for Good Observations. (6) At Inferior Conjunction (E_0 In Fig. 1) Nearest to Mars But In Line With Sun and Therefore Invisible from Mars.
The Illuminated Portion of the Planet's Disk Is Always Turned Toward the Directions of the Sun.

Ultra-violet rays are being blamed for the fading specimens in European museums, and a search is being made for a glass for cases that will cut off the rays and at the same time be colorless and inexpensive.

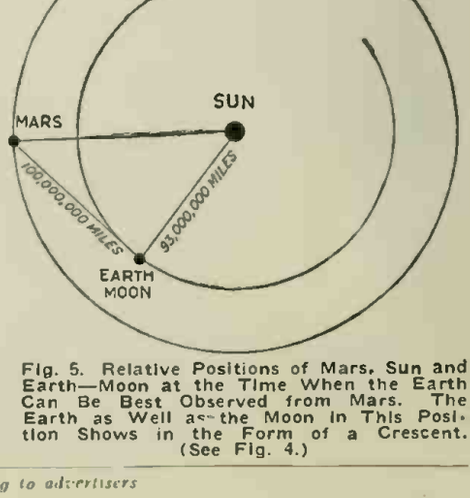

Fig. 5. Relative Positions of Mars, Sun and Earth—Moon at the Time When the Earth Can Be Best Observed from Mars. The Earth as Well as the Moon In This Position Shows in the Form of a Crescent. (See Fig. 4.)

PATENT ADVICE

Edited by H. GERNSBACK

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 address 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.

NOTICE TO CORRESPONDENTS

Questions on Patent Advice are answered in this department every month, and naturally each question must take its turn. We have received so many letters during the past months that it is absolutely impossible for us to answer them all in the "Experimenter." Thus, for instance, the answers appearing in this issue are of letters going back as far as July, 1918. We would therefore urge our correspondents to bear this in mind, and if an answer is wanted quickly, correspondents should make themselves acquainted with the rules printed above.

Angle Finder.

(305) Geo. E. Zeigler, Urbana, Ohio, submits a device which he calls an *angle-finder*. It is an instrument to show on a scale directly the degree of any angle. Such an instrument could be used in connection with drafting work, building, construction, etc. Our advice is asked.

A. In the instrument described, use is made of a spirit tube with the usual air bubble, and by displacing the apparatus, the angle can be read off in a certain manner. This device itself is not new, and a similar one has been used on autos to read the percentage of the grade, and we do not think it would be possible for this reason to obtain a patent.

Submarine Shell.

(306) J. R. Pell, Jr., Parkershurg, W. Va., has submitted an idea on a submarine shell which only explodes fifteen feet under water. Diagram submitted shows the electrical connections which are acted upon chiefly by salt water, making a contact as soon as the shell comes within about 15-ft. under the water. Our advice is asked.

A. There is nothing fundamentally new shown in this device, and there are much better ones made which have been used freely in the war.

Electric Depth Bomb.

(307) Geo. W. Curtis, Detroit, Mich., has invented a depth bomb. In this particular bomb, when it is dropt, salt water enters thru the water inlets, and being conductive, completes a circuit between certain contacts. These contacts may be regulated by a water regulator in such a way, making it possible to explode a homb at any depth.

A. Nothing new is shown in this idea, and we doubt very much if a patent can be obtained upon it. There are many patents on electrical depth bombs of this kind.

Flue Cleaner.

(308) Wm. H. Roberts, Chandler, Ind., has invented a device which he terms a "flue cleaner." In short, the idea consists of a fan arranged in the chimney in such a manner that the soot is cleaned out automatically, so that the latter will not clog the air passages of the flues. Various means are shown to carry out the idea.

A. While highly ingenious, we doubt if the device will work. Soot will he precipitated along the walls, fan or no fan, to our mind, and we do not think that the problem can be solved satisfactorily in this manner.

Steam Boat Brake.

(309) Otto I. Kirby, St. Vincent, B. W. I., submits an idea of a brake for steamers or boats. The idea in short is to have large steel vanes folded up against the body of a ship in normal position. If the boat is to be stopt, the vanes automatically open up at right angles to the boat, and the ship, thereby exposing an additional surface to the water, consequently must slow down.

A. This idea is a good one but unfortunately it has been described before, and to our mind no patent can be obtained upon it today. We do not think the device works out in practise.

Grass Cutter.

(310) John C. Reno, Spring Brook, Wis., has an idea of an arrangement to clean out grass that grows over the sidewalk. The device is to be made of sheet steel and by having a triangular nose, in our correspondent's opinion, such a tool would clean out the grass very readily in the corners between roadway and curb.

A. While no doubt this device would work satisfactorily on the ordinary concrete sidewalk, there would certainly be trouble if the road was compromised of cobblestones for instance. Otherwise, we find no trouble with the device, and think that a patent can be obtained upon it.

Fire Truck Device.

(311) M. Dunbar, Lorain, Ohio, writes: "I wish your advice about a patent on an electrical device that will immediately start the engine of a fire truck. My idea is, as soon as the alarm rings it closes the circuit which starts off the engine of the fire truck. Please advise if this idea is patentable."

A. Providing such a device can be made rugged enough, so that it conforms with the Fire Department's exacting requirements, we believe that such a device should prove of considerable benefit, altho most of the Fire Departments now have devices whereby the fire under the engines is started within a few seconds after the alarm has sounded.

Acetylene Bunsen Burner.

(312) Richard E. Mathes, Excelsior, Minn., writes: "I have devised a scheme whereby an acetylene gas plant for bunsen burners and gas in a small chemical laboratory may be installed at very low cost. This is meant especially for the amateur who does not have gas in his home. Is this practical? Could I sell a patent for it? If so, what would it be worth? Could I use an ordinary bunsen burner as part of the patent without infringement?"

A. We see nothing fundamentally new about this idea, as burners of this kind have been used for years, and such a device is well known in the art. We are quite positive that a patent could not be obtained upon it.

Double Lock.

(313) Chas. H. Morgan, Newton, Iowa, sends in an idea on a Double Hasp Lock which can be operated from both sides of the door. He wants to know if this device can be patented.

A. We see nothing fundamentally new in this, and furthermore doubt the utility of the device. We also doubt if a patent can be obtained on it.

Envelope.

(314) José Mata, San Francisco, Cal., submits a sample of an envelope. He wishes us to give him our advice if such an envelope could be patented and if it is feasible. As will be noted, a string with a knot at each end is glued into the envelope when made.

A. This is a good idea but it is not new. Similar devices have been on the market for a long time, and some years ago very many magazines used a string of this kind to open up the mailing wrapper, simply by having a thread incorporated into the magazine wrapper. This thread was pulled in a similar fashion as the string of our correspondent's envelope. We are positive no patent can be obtained on this device.

Automatic Fuse Replacer.

(315) Wm. Sambur, New York City, says: "I would like to know if an automatic fuse replacer which instantly inserts new fuses after extracting burnt out fuses would be patentable. This device could be manufactured at a cost of $3.00. Would this be a good selling article? I await anxiously the next issue of the ELECTRICAL EXPERIMENTER for my answer."

A. Without having the necessary details, it is impossible for us to give advice. Correspondents should bear in mind that merely by giving vague indications, it is extremely dangerous for us to give advice as well as for correspondents to accept it.

Smoke Stack.

(316) Walter A. Buckheim, Boulder, Colo., asks us: "Please let me know thru your magazine if the following idea is patentable. It is desired to construct a chimney or factory smoke stack with rifles or vanes which will impart a rotary motion to the escaping gases. In forced draft plants the gases can be given a rotary motion by mechanical means. In this way a miniature whirlwind will be created which will hold the gases in a narrow column and carry them to a great height, where especially, if they are poisonous, they will be out of everyone's way. The gases will in effect pass thru a chimney made of air."

A. This is a clever idea, but it has one great fault, namely, it won't work. No matter what arrangement were used and even if you were to expend 10,000 H. P. to push the gases out of the smoke stack, if a moderately strong wind was blowing the gases would positively be forced sidewise, and if the wind was blowing earthward, the gases in this case would be blown earthward too. You cannot hope to raise a gaseous column into the air and prevent its swaying sidewise by any known means. For this reason smelters and chemical industries having to do with poisonous gases build their chimneys as high as possible. There are some cases known where a chimney has actually been laid up the side of a moderate mountain in order to let the gases escape at the top as far away from human habitation as possible.

Radio Break-In System.

(317) C. E. Mitchell, Miami, Fla., submits for our advice the following idea: "I have a break-in system for use in wireless telegraphy that does away with anchor gaps and other troublesome apparatus used in break-in systems. It consists of the ordinary heavy wireless key, with an attachment at the rear, working something similar to a compound lever. When the key is raised the antenna is connected to the receiver, the detector unshorted, and circuit to power transformer opened. In this manner the receiver is always in a receptive condition at the instant the key is raised. The idea provides for an extension in length to the ordinary wireless key and may be installed in any circuit with ease and does not hamper the pressure adjustment of the key. This means of break-in will prevent considerable interference and loss of time.

A. This is not at all a new idea and the Patent Office is full of break-in systems of this kind. A great many similar ones have been described in the past volumes of the ELECTRICAL EXPERIMENTER. Many of these systems are very good, as is our correspondent's, and many are actually in use, particularly amateurs seem to like them.

NEW PULL SOCKET HAS CURRENT TAP.

In many cases it is desirable to connect an electrical appliance to a single-lamp wall bracket or ceiling fixture without interfering with the lamp. A very convenient way for doing this has been provided by means of the new pull socket current tap illustrated. It is a combination pull socket and plug receptacle built into a single compact body. It is also supplied with a ⅛", ¼", ⅜" or pendent cap. The pull chain controls the current to the lamp socket proper, whereas the terminals of the receptacle in the side of the body are continuously in circuit.

An advantage that this type of socket gives is that it eliminates the annoyance of the long cord running from side-wall outlets. By means of the new fitting, current can be supplied directly below the fixture

to operate various table appliances or other portable devices such as are in general use, without sacrificing the use of light from the lamp itself. It thus eliminates the annoyance of groping about in the dark while trying to plug into the socket.

AERONAUTICAL EXPOSITION AT NEW YORK.

Army Day at the Aeronautical Exposition in Madison Square Garden and the 69th Regiment Armory, New York City, brought several thousand uniformed spectators at the afternoon and evening sessions. Secretary of War Newton D. Baker was to have been the guest of honor, but at the last minute he notified the officials of the exposition that he had been summoned by the President for a conference. Major General Thomas Barry, Commandant of the Department of the East, accompanied by members of his staff, represented the Secretary of War.

At the wireless telephone exhibit in the 69th Regiment Armory, Lieutenant J. F. Adams entertained the spectators by reading news from a daily newspaper to ships in the harbor and places on land equipt with apparatus. The spectators, by means of a sounding horn, were able to hear the answers he received.

Brigadier General Guy Livingston, who represented the British Air Ministry in this country, was an interested spectator at the afternoon session. He said that he believed the Atlantic would be crost by airplane or dirigible within the next two or three months.

TESLA ON HIGH FREQUENCY GENERATORS.

(*Continued from page* 909)

brought within reasonable limits, almost to anything desired. I have used this device for a long time in connection with ordinary coils and in a form of my own coil with results greatly superior in every respect to those obtainable with the form of your letter, make a few statements referring to such make-and-break devices in general, and various forms based on this new principle."

I may add that a great many forms of this apparatus were constructed and employed by me for a long time, proving very convenient and useful. Water does not give particularly good results, being incapable of causing very abrupt changes, but electrolytes have the property of diminishing enormously in resistance when they are heated and the effects are much more intense. Salts of lithium are especially efficient.

NIKOLA TESLA.

New York, February 20, 1919.

NEW YORK TO CHICAGO VIA THE AIR IN 12 HOURS.

(*Continued from page* 856)

this important subject. Mr. Hawley said:

"Aërial transportation is here and here to stay," said the president of the Aero Club, speaking along general lines. Aërial transportation bears the same relation to land and water transportation that the wireless bears to the regular mail and telegraph. It is unlimited by obstacles on land and water; curves are eliminated, and there are no grades to climb after reaching your flying level.

"It has been estimated that aërial express could be carried profitably at a charge of $2 a pound for packages of a given size between New York and Chicago. A twin-motored 'plane can make the New York-Chicago trip without stopping, carrying a thousand pounds of express matter.

"The postoffice has been operating an aërial mail between New York and Washington daily since May 15, 1918, and has cut down the time of transit to two hours. Only small planes are used, which are more expensive than the large ones, when operated on the ton-a-mile basis. Yet the cost has been cut down to 40 cents a mile. It is cheaper than taxicab rates.

"British dirigible balloons, some of which are capable of carrying sixty tons of useful load at a speed of sixty miles an hour, may soon ply between Great Britain and the United States, carrying passengers, mail and express."

HOW ELECTRICITY SERVES WORLD'S LARGEST HOTEL.

(*Continued from page* 858)

own, as they obtain the required electric power and steam for heating and other purposes, from the railroad companies near the respective railroad terminals of which they are located. The Hotel Pennsylvania has a high tension transformer vault in the sub-basement as well as a large switchboard for controlling the power and light supply to the various parts of the building, and there is an auxiliary 500 K.W. steam-driven generating unit installed in the power plant.

My guide suggested that we next visit a typical "guest floor", and so we took an *express elevator* to the ninth floor, there being nineteen floors in all. On each floor there is a lady floor clerk, who has charge of everything on that particular floor, and is responsible for all the service in that particular part of the hotel. Obtaining keys for several of the rooms, we set out to look them over, and as the writer had heard of the far-famed "servidor", long before he had even thought of visiting the hotel, he asked the guide to explain this first of all. The "servidor", as its name implies, is a scheme for rendering service between the guest and the hotel attaches without introducing the objectionable personal touch, which is all right in the public rooms of the hotel, but rarely ever on the guest room floors, excepting when a waiter may have to bring in a table to serve a meal or something of that sort. The accompanying illustration includes a detail drawing of the servidor, which at the same time is also the "door" of the room, and "believe me, Xantippe", that door is one of the greatest masterpieces in all Hoteldom, and thereby hangs a tale, to wit:—In the first place the servi-"door" is made of steel, and finished in a perfect imitation of hard wood such as mahogany, or in some cases walnut, and so cleverly camouflaged that you cannot perceive the difference, unless you knock your head against it. The guide demonstrated all of the features of this most marvelous door at the request of the writer. This door swells out on both sides, giving a depth of ten inches between the inner and outer curved panels, which extend the full height of the door. These hinged steel panels are provided with an interlock, so that the outside or hall door *in the*

door cannot be opened by a servant until the inner door is shut and locked. What you can't get via the servidor—ain't! There are two shelves in the servidor which might accommodate a special order of ice cream soda or near-beer from the tap-room, but mostly, so my guide explained, the servidor is intended for clothes intended to be prest over night, or at any time by the hotel valet, and for soiled linen.

The *modus operandi* of the servidor follows:—Suppose you, the guest, have a suit of clothes which you wish prest, and have just arrived at the hotel, and wish to retire at once. You call the telephone operator via your room telephone, and inform her that you have a suit of clothes which you desire prest by the house valet. She does the rest. You go to bed and forget about it. Next morning you awake and open the inner door of the servi-"door", and "pressed-O"! there is your suit as spick and span as ever before, and perhaps if you are lucky, you might find a couple of five dollar silk shirts and a nice roll of clean collars in your servidor, but how could you be expected to be able to tell to whom they beong out of 3,500 guests! Ennerhow, as Abie Kabibble might say, the guests at this hotel are all rich anyway. At least they look it!X? But this is only the start of the tale of the servidor, for you can press one of two buttons on the inside of the door, and open or close a sound-proof ventilator. Also there is another very elaborate and clever mechanical conception incorporated in the knob and lock of the door—this takes the form of a small pin about the size of a lead pencil, placed just under the knob on the hall side of the door. If one of the attachés (in everyday English, the chambermaid), tries to enter the room while it is occupied, she will ascertain this fact without having to rattle the knob about fifteen dozen times, and chuck you into a French fit, wondering if one of the Bolshevik gentlemen is calling on you with a bomb. She simply presses her finger on the projecting pin, just under the knob. If the pin resists the pressure of the finger, then the room is occupied; if not, it is unoccupied. Simple, yes, but someone spent a lot of time to "dope" this out.

The conveniences to be found in the guests' rooms, no matter whether large or small, are all similar, and designed to give the utmost comfort and homelike atmosphere. The basin in each bath room is fitted with three spigots, the two outer ones giving hot and cold water, while the center spigot yields *ice water*, cooled in the hotel's large private refrigerating plant driven by electricity, located in the basement. The rooms as well as all of the halls are cleaned by vacuum cleaners, thus doing away with all dust, besides keeping the carpets and draperies thoroly clean and germproof.

The double rooms do have the cutest little "twin beds" you ever laid eyes on. Each one is fitted with a handsome brass reading lamp attached to the head of the bed, and provided with a silk shade and chain pull socket. Yes, you can read in bed if you want to at one of these palatial hotels. Between the beds or alongside of the single beds, there is a telephone and night lamp table, which also comes in conveniently to hold the immortal "ice water" pitcher. In some of the suites of rooms inspected, the furnishings are very attractive, including large pedestal style dresser lamps with silk shades, on the bureau for milady, and all in all the guests can really feel at home, just as much as if they were in their own residence. We should not forget the electric curling iron heater and the electric fan. Perhaps if you feel so disposed, you would like to have something piping hot made in the chafing dish. If so, one of the maids will bring you an electric chafing dish, which can be easily connected to a special electric floor outlet provided for just such a purpose.

The "Room Service", as it is called in all modern hotels, and which covers the serving of meals in rooms, is very carefully worked out, in the "Pennsylvania" and the "Commodore". At the "Pennsylvania" the system works out in this fashion: Suppose for a moment you are the guest, and that you decide to have breakfast served in your room. You call up the telephone operator and give her your order. She writes it down on her memorandum pad, and as soon as you have finished, she writes it on her telautograph *transmitting platen*. Then two important things immediately happen—*two* telautographs reproduce in writing your exact order for the meal, from coffee to cigars, one telautograph announcing your order in the "room service" kitchen in the basement,—while the second telautograph connected to the same circuit, *but situated on your room floor*, reproduces the order in writing before the "floor clerk" on your floor, and this is the first notice that she receives that you have ordered a meal. The system works out very beautifully in this way, and gives the greatest expedition possible to rapid service. Each floor has its own service pantry, which contains all ordinary things such as bread and butter, and which are supplied from this pantry. In this room there are also automatic high-speed electric dumbwaiters communicating with the "room service" kitchen in the basement, and as soon as any broiled meat, such as chops, steaks, etc., are prepared in the main kitchen, they are whisked skyward *via* the automatic dumbwaiter to your floor. As soon as the dumbwaiter reaches the floor, a buzzer starts signaling the fact, buzzing continuously until the door is opened; the victuals are removed and the door closed, after which the dumbwaiter is dispatched kitchenward. By means of a flexible cord and plug and a set of jacks, one for each of the 19 floors, the kitchen service dumbwaiters may be dispatched roof-ward *and caused to stop at any floor automatically*, simply by inserting the plug in the jack corresponding to that particular floor. When the meal is ready, one of the room service waiters stationed on your floor serves the meal in your room, and invariably of course, a table has to be provided for this purpose. Eventually, we presume, the servidor idea will be extended and amplified, so as to permit the serving of meals, altho this is questionable for the reasons already stated.

Returning toward the lower regions of the hotel, my guide piloted me down a long hallway on one of the lower floors, and we inspected the children's open-air playground, arranged in one of the large courts of which there are several, and ended up this part of our inspection trip, by looking over the large ladies' and gentlemen's "plunge", provided with large deep pools, and every convenience imaginable. The "plunge rooms" in general are provided with steam rooms, hot rooms, massage and silent rooms, drying and rubbing rooms, etc., while the women's plunge apartment contains specially fitted dressing and rest rooms, as well as a manicure and hair-dressing parlor and chiropodist.

Just as we were leaving the plunge rooms, we were surprised by seeing two nurses passing down the hall just ahead of us. Upon inquiry we found that the hotel management had not even overlooked such a possibility, and one to be conjured with when such a large number of guests are considered. Not only was it surprising that the hotel should include a "hospital," but it also developed that there is a physician always present. Thus the guests have always available hospital and medical attention for any emergency. Of course, for any protracted illness, the patient would have to be transferred to one of the regular city hospitals. One does not even have to leave the building in order to get a prescription filled, as there is a large and complete drug store on the street floor, which is accessible from the interior.

In various parts of the hotel, where the architects have found room for them, one suddenly bumps into unsuspected scenes of activity. On some of the lower floors, as well as in spare rooms on the roof, one finds carpenter shops, painters and decorators shops, an up-to-date upholstery shop, yes, even a silver-plating room (for taking care of the vast amount of silverware used in the dining rooms), employees' club rooms, plumbers shop, etc., etc.

A few words may be said here concerning the elaborate kitchen equipment at these hotels, and it is indeed a great revelation to see how cleverly the engineers who designed these departments have worked out their problems. For example, all the soiled dishes from any of the dining rooms are practically never touched by human hands, after once being removed from the dining tables. They are placed in metal carriers resembling large drip pans as soon as they pass the dining room service door. Here they are placed on continuous moving platforms, which travel along at a constantly changing angle, so as to utilize the power of gravity, and eventually the dishes reach the dish-washing department, which is quite an establishment all by itself. The dishes are washed by plunging them into large tanks filled with steam and boiling water. Every germ is thoroly killed as soon as he hits the tanks, and the dishes are then rinsed in other tanks filled with boiling water, which is so hot that the dishes are dried as soon as they emerge from the tank, due to the rapid evaporation of the water vapor remaining on them. The clean dishes are then whisked away on another continuous moving platform, which takes them back to their respective kitchens. The scenes in these great kitchens are ones that you will not readily forget, once having visited this important department of the great hotel organization. Here we see dozens of French chefs preparing the various meats and cooking them. It would be a great revelation to any housewife to see how rapidly the cooking is accomplisht. Steam, gas and electricity are used in the various ranges and stoves used for cooking the various foods, and there is a special kitchen fitted with all electric ranges and stoves, which is called the "home cooking kitchen". This kitchen is one of the features of the "Pennsylvania" and is in charge of an expert dietician. Any guest who has gastronomic trouble or for other reasons may desire to have a piece of pie "like Mother used to make" with its full quota of calories and other toothsome units, can have just what his stomach craves. When the writer visited the kitchen, it was near dinner time, and the chefs were busy cooking squabs by the hundreds in the gigantic ranges, chops by the same number, and steaks by the dozen, not to mention French-fried potatoes by the bushel. Other activities of the Culinary Department include ice-cream making, pastry and candy making, etc., etc. One of the most wonderful sights in this important section of any hotel, and particularly in this giant of all hostelries, is the storage room, where wagon-loads of vegetables are kept, not to mention several auto-truck loads of meats and fish. Large, thoroly ventilated refrigerators, kept cold by the ammonia compressor plant operated by the hotel, maintain a constant degree of cold in them.

Of course, there are the usual wine cellars, one of which extends the whole block, not to mention large rooms filled with snow white linen, shining silver and glassware and crockery, enough to stock an average department store.

SCIENCE IN SLANG.

(*Continued from page* 911)

the wireless more of a success, but who have not had the public notified that they pulled a good one.

"Old Doc. Fleming got a good one in the form of a 'valve,' which is a lot like the audion. It was a close second in the patent office and only lost first place by much wrinkles and perspiration on the part of a wise old judge who weighed the proposition like a pair of assayer's scales.

"Then suddenly just when we kiss the dear old war good-bye, in drops old man Jimmy Rogers. He steps up on the platform, puts up his hand and says, says he: 'Sh, boys, before you put up your aerial zingmagics, see me! Nix on those aerial wires!' We say: 'Thehellusay. Whazzematter with our good old aerial?'

"'Not much,' says Jimmy, 'except that aerials are all wrong. Besides you don't need 'em. Just you take a hundred feet of rubber covered auto cable and bury it three feet underground into a trench, savvy? Hook the loose end to what was once your aerial connection and, presto, in come the messages louder'n a goat on a tin roof. *And* you receive *twice* as far as before, AND the old girl static, who used to tease the life out of you, is gone for good, along with the war. Simple, if you know how!'

"I guess that is about all for to-day—now for tomorrow. We may be able to carry around in our pockets a 'phone that will enable us to talk to our colored friend in Africa—when we are in Siberia or Sing-Sing. The present wireless is a great success—so was the Roman chariot, but the Handley-Page aircraft has it over the old go-cart in more ways than altitude.

"Where are we in the art of cultivation? We thought that we had it down like a scenario until Luther Burbank showed us that cactus did not have to have their stickers and the little posies that we wear on our coat lapels could aspire to the rainbow. Way back in the old ignorant days, when a gink thought that it was no worse to marry his sister and raise a colony than we consider a divorce or Wall Street play, there lived an old bird who observed that a little hoeing and so forth would not hurt a wheat stalk and that other growths were helped thereby. I don't remember the guy's name—it was so long ago—but it seems he was an Egyptian. I would not say for sure though.

"Now look how long ago it was when we got out of the boyhood stage in the electrical game—there are a string of years ahead of us yet—perhaps some electrical Burbanks will show up. Don't get it in your head I am slighting Edison, Tesla, Steinmetz, Marconi, De Forest, Fessenden, and others who now have the WATT under the microscope and wearing their glasses at that. What would Caesar have done had he possest a machine gun or a telephone—what would Edison do with the observations and discoveries of the years to come? Men, we are moving! Moving as men have never moved before!"

PREPARED TO DELUGE GERMANS WITH GAS.

Statements that America next spring would have smothered the German front with undreamed of quantities of poison gases, that Edgewood Arsenal thru gas production would have brought about the capture of Metz, that America alone would have had ten tons of mustard gas to Germany's one, and that our chemists had surprises of which German scientists never dreamed—all these facts were recently disclosed by the War Department.

Colonel Bradley Dewey, who was in charge of gas defense production, said that a mask had been evolved which required no nose clip and no piece in the mouth. A man could wear it indefinitely and could sleep in it.

DO RADIO WAVES TRAVEL ABOVE THE EARTH OR THRU IT?

(*Continued from page* 872)

stalling later stations under such conditions, to examine very carefully the topography or rise and fall of the country over which this radio system was to operate. Fig. 5 shows a more ideal condition for the operation of a radio station in a valley, and one which has proven to be entirely successful in practise. Here the surface waves have a chance to follow the contour of the ground, as shown, and the antenna in consequence receives a full quota of energy from the waves as they pass across it. It is conceivable in the case illustrated at Fig. 4 that the etheric space-wave component at B, may become totally a space wave without a grounded foot, and this would account all the more readily for the station in this case not receiving any signals.

Some very interesting experiments were made some years ago on the relative efficiency of *ground antennae* and which were reported in the journal *"Jarbuch Für Drahtlose Telegraphie und Telefonie"*, and the essence of these tests is illustrated diagrammatically at Figs. 6 and 7. The investigator, Kiebetz, working with such antennae, utilized one form composed of insulated conductors placed in an open trench, as shown in Fig. 6, and later he covered the trench over with boards and piled soil on top of it. The more soil he placed on top of the trench, the weaker the signals became, until finally *none were received at all.* This showed apparently that if wireless signals were to be received by an ordinary ground antenna, it must be placed in close proximity to the earth's surface, as I have already described in the opening part of this article, or else in a more or less shallow trench, the top of which is open and not covered with any conductive substance or material. The diagrams, Figs. 6 and 7, show how the gliding composite waves, with their ground components, cut across the antenna wires in the open trench, while in the closed trench, the ground waves or "feet" glide over the raised contour of the soil as shown, and how the ground components, reaching but a short distance below the surface as previously explained, do not cut across the buried aerial conductors, and therefore no currents are generated in them, as the tests prove.

One way in which a submarine may pick up wireless messages is shown at Fig. 8. Here the composite radio waves glide over the water with their ground components, as shown by the dotted lines. Now, if the submarine trails a heavily insulated wire, as shown, the upper end of which is supported on two or more floats, then it naturally becomes possible for this wire to pick up energy from the radio waves travelling in the direction of the wire, and signals will be received. As mentioned above, it is also possible, that by having the floats partly weighted so as to keep the antenna wires a short distance below the surface of the water, that wireless messages can then still be picked up, due to the partial penetration of the grounded components of the waves into the water, in a readily apparent manner. It is very doubtful if the submarine will be able to pick up any radio messages, if it lies at any considerable depth in the water, say below 50 feet, with the antenna wire trailing along behind it, as the penetration of the wave base has been shown to be usually but a few feet below the surface, especially over salt water. It must be clearly understood, however, that experiment as well as theory both show that the penetration into moist earth or water *increases with increasing wave length.* Hence it is that of late, as the wave lengths

of the larger stations have been increased, these horizontal receiving antennae can be sunk deeper and deeper before effective screening is observed. Hence the periodic "rediscovery" of the astonishing efficiency of the horizontal receiving directive antenna.

So far as I have heard the first use of the horizontal receiving antennae was at Block Island in July, 1903, where we connected the receiver direct to a telephone line running across the island from the wireless station towards the Point Judith (R. I.) transmitter. Fine loud signals were thus received.

In 1905 I used a bare copper wire lying directly on the ground at New Haven, and then determined within a few degrees the direction of the transmitting station, by swinging this wire around a circle, the center of which was the receiving instrument and ground stake. The signals were loud when the wire lay in the plane of the station, in *either* direction to or from the station—practically the same for both. But when at right angles to this plane of propagation nothing at all was received.

But to return to your editorial, "Wireless Around the World", it is highly unfortunate that the esteemed advertising propensities of the Marconi interests should have made capital over this performance of their station in the year 1918, when similar performances had been on numerous occasions a matter of record for at least two years prior to that date.

I give below a news clipping sent to me back in 1916 by a wireless operator at Awarna, New Zealand, which is self-explanatory. I have received many communications from this section which, unfortunately, I have not felt authorized to publish, recounting similar "anti-podal" radio-transmission.

"In connection with Commander Cresswell's statement regarding the reception at various Australian wireless stations of messages sent out by Nauen and other places in Germany, it is stated that similar messages are received nightly at several of the New Zealand radio stations, especially Awarua, which is probably the best equipt in the Dominion. The distance from Nauen to Awarua is about 12,000 *miles, which, if it does not constitute an absolute record, is very near it. The secret of these remarkable results which in less troublous times (referring to the World War) would excite world-wide interest, lies in the De Forest ultra-audion receiver—one of the most remarkable and simple pieces of apparatus invented since Marconi's first experiments. Dr. de Forest is an American, who lives at New York. His "ultra-audion" has the power not only of receiving the far-flung waves, but can also be used as a wireless transmitter for the voice—a field as yet practically unexplored."*

In fairness to facts wherever an epoch-marking feat of this sort is accomplisht, whether in science or in any field of discovery, I am sure you will agree that it is highly important that due credit should be given to the *first* performance and not to a repetition which happens to be generously advertised years thereafter.

Perhaps your article lays unwarranted stress on the improvements which the Alexanderson alternator today enjoys over the arc transmitter. After witnessing what the big arc transmitters are doing in Europe, as well as in the United States, together with their simplicity and ruggedness and the facility with which any wave length can be instantly obtained, it is doubtful in my opinion whether the alternator will soon supplant the big arcs; at least, except in stations where one wave length only is required.

ELECTRICITY IN FAR-AWAY BOMBAY.

The great success with which the introduction of electric power from the generating station on the Ghats is being developed in Bombay is revealed by the report of the Tata Hydro-Electric Power Supply Company. The energy now being supplied to motors in Bombay amounts to 48,000 horsepower. Thirty-six mills are receiving power, and only the difficulties arising from the war prevented development being more rapid.

THE HOW AND WHY OF RADIO APPARATUS.

(*Continued from page* 875)

them in the proper manner for giving a good indication. At this point, it is well to mention that no matter which form of detector is used in conjunction with the wave meter, that the wave meter itself must be kept at a sufficient distance from the exciting circuit, no matter what its form or make-up, so that there shall be just sufficient current picked up by the wave meter oscillating circuit to give a good clear indication in the detecting or indicating device. If the wave meter is held too close to the exciting circuit, then several wave lengths or harmonics of various wave lengths may be heard, and an incorrect reading obtained.

For many purposes it is desirable and necessary to excite the wave meter so that it will radiate a wave length of known value, such as in various radio measurements, etc. Fig. 5 shows a standard method of exciting the wave meter. Here we have a high note or other form of buzzer connected with a few cells of dry battery, and a key or switch. This circuit is shunted across the variable condenser of the wave meter as the diagram indicates. This arrangement will cause oscillations to be set up in the oscillatory circuit of the wave meter, and an auxiliary inductance can be placed near the wave meter inductance so as to link the two inductively, and thus transfer the energy electro-magnetically from the wave meter circuit to the auxiliary circuit, and which energy shall have a wave length and frequency of known value.

At this juncture, the matter of arranging the wave meter cabinet, and especially the variable condenser and its scales, etc., should be considered. In this connection we may refer to Figs. 6, 7 and 8, wherein several important and simplified methods of arranging the variable condenser scales, especially direct reading scales, are given. Fig. 6 shows a method used by the writer for several years with good satisfaction. In the scheme the variable condenser scale is specially made up on heavy bristol board or celluloid, (or else hard rubber with the graduations scratched in with a scriber and then filled with Chinese white), and instead of having simply the angular spaces marked off in degrees, and then having to refer to a calibration chart in the usual way, the corresponding wave length values for the coil are read off from the calibration chart (see Fig. 9) and marked off on the scale as shown in Fig. 6. Then as the indicator attached to the variable condenser knob is moved over the scale, and by noting which inductance coil is in use at the moment, the corresponding wave length may be read off directly as soon as the maximum resonance point is indicated by the detecting circuit. The indicator, Fig 6, comprises a piece of heavy sheet brass, soldered or otherwise secured to the shaft of the variable condenser, and the outer end of the arm is cut to the form shown, with the two side edges bent over to retain a piece of ordinary glass. With a glass cutter, a straight line is scratched across the center of the glass, and this may be darkened

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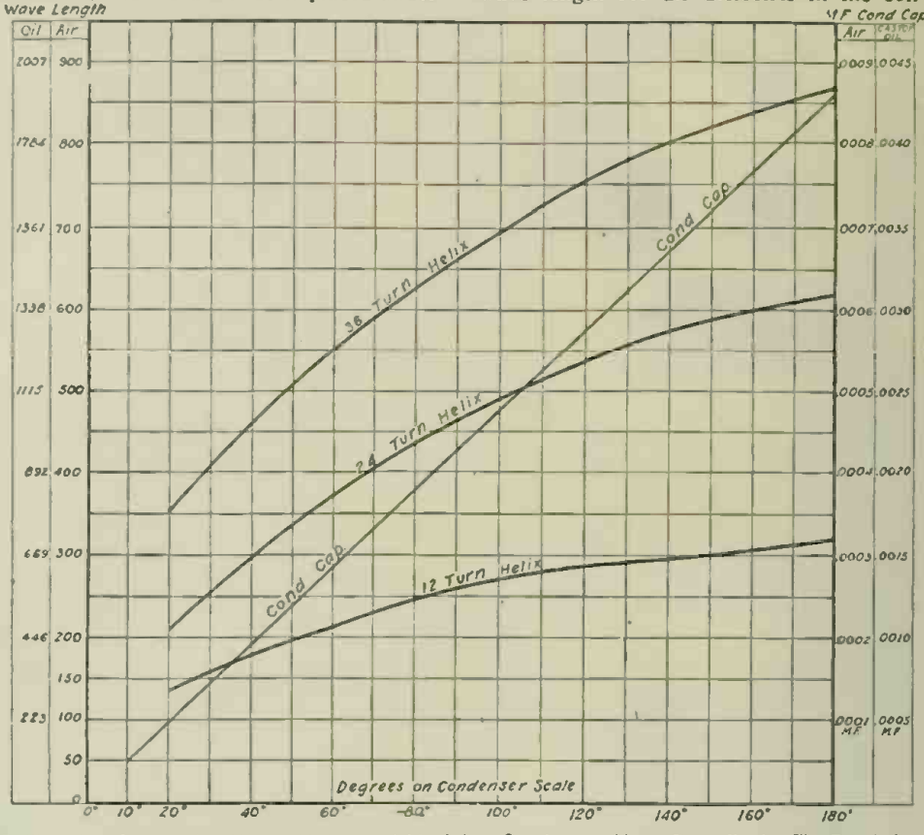
if necessary with a little black pigment. A piece of fine wire can also be drawn across the glass and soldered in place.

Fig. 7 illustrates a clever arrangement which also provides a direct-reading wave meter, and here the calibrated dial corresponding in its lay-out to that shown at Fig. 6, is secured to the variable condenser shaft *below* the shelf of the cabinet. A small oblong window is cut thru the cabinet shelf as shown, and a brass slide is placed underneath this shelf so as to be readily operated by hand, in such a way that the small window cut in the slide can be slid into any one of three positions, depending upon which scale and which inductance is being used at the moment. Fig. 8 shows an automatic arrangement, which is easily made by the radio student and whereby each of the three inductances is fitted with pin contacts, one of the pins in either case being made of a different length for each of the three coils. As each inductance is placed in the cabinet thru the spring contacts shown, the longer lug will actuate a lever system connected to the window slide shown at Fig. 7, and thus automatically move the slide to the proper position to read the corresponding wave lengths for that coil.

The calibration curves for the wave meter here described are given at Fig. 9. These values can be transposed to a special variable condenser scale if desired, of course. The variable condenser calibration curve is given as well as the wave length graph for each of the three inductances. As is well known, the capacity of a condenser may be increased by adding a liquid dielectric, such as *castor oil*, which has a coefficient K value of 5; or in other words, if the variable condenser is filled with castor oil, its capacity will be increased five times over that of air. The capacities for the condenser filled with castor oil (as well as air dielectric) are given at Fig. 9 on the right. Also in this way the student will have a greatly increased wave length range on the wave meter for any given coil, when the condenser is filled with castor oil, as the second column of wave length figures on the left indicates. The manner of using the calibration graphs is as follows: Consider that a maximum resonance point is indicated by the detecting instrument connected to the wave meter circuit, when the condenser needle stands at 105 degrees, with the 24 turn inductance in use. Glancing upward from the 105 degrees marked at the base of the chart, and noting the point where this line intersects the curve for the 24 turn helix, we find that the equivalent wave length for air dielectric in the condenser is 500 meters, and for castor oil in the condenser 1115 meters.



Calibration Curves for Wave Meter and Variable Condenser Here Described. To Read Any Wave Length Value from These Graphs, Note the Condenser Reading at Which Resonance is Indicated. Then Determine the W. L. Value Corresponding to the Intersection of the Vertical and Horizontal Lines with the Proper Inductance Graph, Fig. 9.

Direct-Reading Decremeter—The chart shown at Fig. 10 is described in a recent book entitled "Radio Instruments and Measurements," Circular No. 74, issued by the United States Bureau of Standards, and a copy of which can be obtained from the Government Printing Office, Washington, D. C., at small cost. This chart makes a *direct-reading decremeter* out of any wave meter. Fig. 10 shows how the chart may be attached to the upper rotary plate of the variable condenser; its zero graduation being set to coincide with an indicator mark or hair line thru a window in the top of the condenser case, when the rotary plates are all the way out from the fixt plates. Also it should be seen that the hair line in the window coincides with the straight edge of the semi-circular fixt plates. Full description of this arrangement is given in the work above referred to, as well as all the usual methods of measuring decrement.

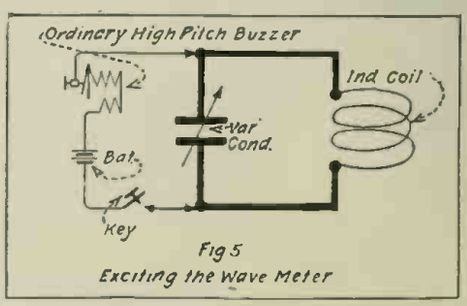


Fig 5
Exciting the Wave Meter

Hook-up for Exciting the Wave Meter so That It Will Emit Waves of Known Length.

Health In A Glass Tube

The interesting story of a man "too busy to bother" who appreciated perfect health, energy and vitality only after he lost it—and how he won it back in a startling way

By FRANK HARTLE

YOU probably know dozens of people like my friend John Brainard. Strong, robust, a human dynamo for work, a real bulldog for stamina, and a very likable fellow in spite of his entire lack of sympathy for sickness and sick people. He regarded sickness as a mild sort of crime and had such faith in his own excellent health that he had about as much sympathy for sick people as, according to Mark Twain, David had for Goliath. If you happened to mention that you didn't feel extra well Brainard would say, as courteously as was absolutely necessary, "T'bad, very sorry"—and you could almost *see* the entire matter sail out of his other ear. Sickness and suffering were foreign to John Brainard and he couldn't understand it in other people, that was all.

But as Josh Billings once said, "Health is like munny. We never hav a true idee uv its value until we lose it." And quite suddenly John Brainard realized what ill-health is. Too much overwork, inconsiderate hours, immoderate meals, and general inattention to his health finally "told on him." One day I went to his apartments and found him in bed with a severe attack of sciatica, but fuming with rage in spite of the intense pain. "Why should I have this?—I've been as healthy as a horse all my life. Why should *I* be sick?—hang it, I *won't* be sick," and he jerked himself to a sitting posture only to fall back in pain upon the pillow.

For a week John Brainard lay in bed in intense agony. Those of you who have suffered from acute sciatica or rheumatism know what it is. The doctor came and went, but Tuesday and Friday when I called, John only said, with a weak attempt at his former cheerfulness, "Nothing doing, Frank. They haven't pushed the right health button yet. Who was that fellow anyway who said something about 'a man too busy to take care of his health is like a mechanic too busy to take care of his tools.'"

Next day while at lunch with George Conrad, our mutual friend, I mentioned about John's still being so very ill. "Listen, Frank, old boy," he said, "I don't want to be presumptuous or anything like that and I certainly believe that the Doc will fix John up fine, but there's a treatment which entirely cured my wife of chronic neuralgia, and now it's bringing total cure to my cousin, another sciatic sufferer. I think if John would give it a trial it might help him some." Ten minutes further conversation with Conrad convinced me and I went right over to John's home to "spring it."

"John," I said quietly, as I tip-toed into his bedroom, "I've got the very thing. Conrad has given me some real facts about what electric violet rays are doing for people and I think—"

"Oh," he interrupted, "I don't know. I don't imagine it can help me."

"Of course you don't know. And you never *will* until you try. Now don't talk foolish, Johnny, old scout. Won't you even believe your friends? This violet ray treatment has *proved* what it is."

And then I went on to tell him all I had learned about violet ray treatment—how it had been invented by the great Tesla in 1890, how it was being used with wonderful success by eminent physicians all over the world, how he could use it on himself and it wouldn't shock him like electricity in other forms, how it would surely at least *help* his own sciatica when it had *cured* other folks' sciatica, neuralgia, hay fever, asthma, neuritis and dozens of other diseases, and finally I told him how it would bring back to him his old "pep," vigor, and "knock-'em-dead" vitality. Then John rolled over and said, "All right, if it brings me out of this blamed bed a well man I'll swear by it for life. Cart in the dynamo, or whatever it is."

"When I ran that glass tube over my 'hide'," said John, "it felt just like a local anaesthetic on a wild tooth."

"Its nothing of the sort," I insisted. "It's a handy little tube-shaped thing that attaches to that electric socket right over your head. And you can apply it yourself right to your 'hide' without feeling a bit of a shock."

Three days later I had gotten a violet ray instrument from Chicago and John used it on his legs and thighs. "Say," he cried, after the first treatment, "I thought electricity always shocked a fellow. Why, when I ran that glass tube over me and the violet rays flashed around, it just felt like a local anaesthetic on a wild tooth. If this keeps up—oh, boy!"

John Brainard got up for good three days ago for the first time in over two weeks. Five days' treatment with the violet rays put him on his feet.

"Where is your 'rheumatiz,' John," I remarked yesterday.

"Dunno, Frank, I can't find it anywhere. It just 'violet-rayed' itself away, I guess," he said, pointing to the instrument in the bathroom.

"I see you keep it attached."

"Yes, you see my wife discovered that the best beauty specialists in town used it, and she—well, my wife's a woman you know."

* * * * *

Violet rays have brought *good results* in almost every disease and Violetta, being the most advanced instrument produced and selling many thousands ahead of all others, is certain to bring you the health-giving results you have always wished. But we do not want you to take our word for it. Judge for yourself—try it for ten days in your home before you decide one way or the other.

Now, through the Violetta, you can have in your own home, the wonderful violet-ray treatments exactly as given by eminent physicians and beauty specialists throughout the country. Now you can rid yourself of Chilblains, Colds, Corns, Constipation, Dandruff, Deafness, Eczema, Eye Diseases, Hay Fever, Headache, Goitre, Insomnia, Lumbago, Nervousness, Neuritis, Obesity, Paralysis, Piles, Pimples, Pyorrhea, Rheumatism, Skin Diseases, Sore Throat, and many other ailments.

Multiply your bodily health—vitalize your nerves—double or treble your energy and vitality. Sleep better, increase your strength, improve your appetite and digestion. Soothe your nerves, reduce or increase your flesh, tone and strengthen the entire system, beautify your complexion. All with the Violetta.

Trixie Friganza, the famous actress, says, "Cheerfully will I add my praise for Violetta. It's the best 'pain chaser' and 'soother' I've ever had the good fortune to find. It's wonderful. It cured my brother of neuritis. As for myself, I use it for facial treatments and general massage. I cannot say too much for it." Frank Borzone, of Seattle, Washington, says: "I purchased the Violetta for my wife who was suffering from an acute attack of sciatica. From the very first treatment it induced peaceful rest and she is entirely well now." Scores of letters like these are received each day.

The Violetta is not a vibrator. It is not a machine that contracts the muscles—it does not shock—it does not pound the muscles—it is absolutely painless.

Eminent physicians from all over the country apply the Violetta with wonderful results. Dr. Bert H. Rice, of Vinton, Iowa, says: "I have good results with the Violetta. Almost instant relief in Facial Neuralgia." Dr. Daniels, Lisbon, North Dakota, says: "Have used the Violetta in such cases as Goitre, Bronchitis, Pleurisy, Neuritis, Neuralgia and Lumbago, and find it very beneficial. In fact, I would not be without it in my office." Dr. G. B. Duncan, Kewanee, Ill., says, "The Violetta is the finest thing I ever used to relieve congestion in any part of the body; and to relieve pain. Treatments are so pleasant that all of my patients like it."

Write today for a very interesting little booklet explaining fully about the Violetta and how you can try it for ten days before you decide. Read some of the amazing results produced in almost every disease. Read how the Violetta can be attached to any electric socket and also used where there is no electric light. Read how this little instrument, shaped somewhat like a thermos bottle with a glass tube and bulb at the end, pours electric energy and vigor into every muscle, fibre, cell, and pore of your body, read how you do not have to obligate yourself in any way until the Violetta has proven its value in your particular case.

Write for this interesting booklet now. Fill out the coupon printed below for your further convenience, *and mail at once.* Address, Bleadon-Dun Company, Dept 2C, 11 So. Desplaines St., Chicago, Ill.

BLEADON-DUN CO.,
Dept. 2C, 11 So. Desplaines St., Chicago.

Please send me your free booklet about the Violetta and ten days' trial offer.

Name.....

Address.....

.....

SEC'Y DANIELS TALKED BY RADIO TO PRESIDENT WILSON AT SEA.

Secretary Daniels transmitted a telephonic greeting to President Wilson at sea by naval radio on February 22. From his desk at the Navy Department the Secretary's voice was carried to the transport George Washington, nearly 800 miles off the Atlantic coast.

The long-distance radio telephone equipment had been set up when Mr. Daniels reached his office. With Rear-Admiral Griffin, Chief of the Bureau of Steam Engineering, and Commander Hooper, the radio expert of the bureau, supervising the experiment, the Secretary's regular desk telephone instrument was connected up thru the telegraph wires to the transmitting station at the seacoast, where his voice was projected by radio waves to the aërials of the George Washington.

The Secretary said a great welcome waited the President in Boston and again in Washington when he reached the Capitol.

Mr. Daniels repeated his sentences several times to make sure that he was understood.

"Good-bye," the Secretary said into the instrument. "I will see you Tuesday. Good-bye."

GRAND OPERA IN YOUR HOME.

(*Continued from page* 855)

microphone circuit could be loaded simultaneously with such an immense number of lines which practically constitutes a short circuit, and while the thing is possible in a limited way by means of induction coils, not more than two or three hundred subscribers could be linked up by such means. Therefore, the system heretofore was a failure.

The invention of the Audion, however, has changed this and by using audions to "boost" the circuits, it is now possible to connect a practically unlimited number of lines to one microphone transmitter and reproduce the music clearly in 50,000 homes at the same time.

The writer who interviewed high telephone officials was informed that the plan was entirely feasible and there was only one objection, which is not of a technical nature but rather a commercial consideration. Thus, the telephone engineers did not think it good business to tie up say twenty thousand to fifty thousand lines simultaneously for several hours at a time on account of the congestion that would probably ensue, but this is really only a small consideration and not of much importance if the enormous revenue that the companies will derive from this scheme is taken into consideration. While the subscribers now pay only between two and five dollars a month for service on an average, the telephone company could easily double this revenue for at least 20 per cent of all of their subscribers by installing the operatic service.

Today the man who owns a phonograph thinks nothing of spending between three to five dollars a month for records which are "dead". If he knew he could hear Caruso, Galli Curci or any of the other stars tonight in one of his favorite operas, he certainly would not object to spending 50 cents or even a dollar for the privilege, and at that he would think he was getting it cheap because he, with his entire family, would hear the music in his own home, without having to travel to and from the opera. Of course, if the system eventually comes into vogue, the opera alone will not be the only source of amusement to be drawn up by a telephone subscriber. Any of the musical shows or comedies, farces, etc., could all be heard over the telephone, altho admittedly not to such an enjoyable extent as grand opera, where it is the music that counts most.

As for the technical aspect, we now have very good sensitive microphones, which placed about the stage and orchestra transmit the sounds strongly and faithfully. The microphones are then connected thru the audion switchboard, similiar to the one shown in the lower center of our illustration, which is the identical audion switchboard now used in multiplex telephony where five conversations are held over the same wire. From here the circuit runs thru the telephone exchange shown in the upper center of the picture, whence the circuit enters the subscriber's home as shown at the left of our drawing.

Here we have a novelty suggested by the writer. In transmitting music over the telephone heretofore, it was not possible for more than one member of the family to listen to the music as there was only one telephone receiver. By means of modern loud talking telephones, however, it now becomes possible to lift off the telephone from the hook and place it over a sensitive transmitter, as here illustrated. The weak sounds picked up by this transmitter are strongly amplified and projected from the horn in great volume. Thus, it becomes possible for any one in the room to hear the music clearly and almost as loud as we do sitting in one of the further rows in the opera, where the hearing is not always good, as is well known.

As for the subscriber's amplifier as shown in our illustration, this may be made of the ordinary loud talking variety, having a simple hyper-sensitive microphone connected to a loud talking telephone, or otherwise it may be a microphone connected to an audion amplifier. The latter probably is the better of the two systems.

The amplifying cabinet can be hung near the telephone, in case of a wall set, or otherwise it can be of a different shape for table use if the telephone is of the portable type. The amplifier could be sold outright to the subscriber or otherwise rented to subscribers by the telephone companies.

We feel confident that a plan similar to the one outlined here will soon come into general use, as there is a positive demand, particularly in America, for good music and which demand as yet has not been satisfied.

But like all other large interests, the telephone companies are slow moving organizations and do not make innovations unless they know that a large part of the public actually wants them. Therefore, if you are in favor of this plan, we think it would be a good idea to write the headquarters of the telephone company, advising them what you think of this plan. If, however, you were to write to your local telephone company, not much impression would be made. If, on the other hand, you address your letter to the American Telegraph and Telephone Co., No. 12 Dey St., New York City, then there is a chance that a national movement would perhaps result from such letters. Local telephone companies cannot make a change in their present system as they are governed by the policy which originates at the New York headquarters. Perhaps your letter will help to bring the Opera into your home.

TELEPHONE GIRLS' WORK IN FRANCE.

It is difficult for us to realize the scope of the work that has been done and is still being accomplished by the telephone operators in France. To serve the needs of an army of two million men, and to connect that army up with the French by telephone was a matter that required no small amount of organization and planning on the part of the Signal Corps, says the *Telephone Review*. The distribution of the girls in the Signal Corps service asked for careful study and met with unqualified success.

HOW AIRPLANES FIND THEMSELVES BY RADIO.

(*Continued from page* 871)

"The use of directional effects of loops or coils for receiving radio signals has resulted in the development of a radio compass for airplanes which gives positive information to the aërial navigator and enables him either to locate his position by triangulation with respect to two beacon land stations or to fly at any given angle with respect to a certain beacon station.

"The apparatus consists of two principal parts—the antenna coils and the tuning and amplifying apparatus. The antenna coils are mounted in the fuselage of the Handley Page airplane, with suitable means for rotating in azimuth. The amplifier is extremely sensitive, consisting of a detector and six-stage amplifier. A novel feature of the amplifier is the use of iron-core transformers for frequencies of 100,000 cycles.

"The direction of the beacon land radio station is determined by maximum strength of signals, in a highly ingenious manner developed originally by the British. The precision of the directional effect is remarkable. In fact, the radio direction finder may well be called a radio eye."

EXPERIMENTAL PHYSICS.

(*Continued from page* 867)

to send and take messages in spite of the enemy's interference by sending out impulses of similar wave length and other distributing influences. The problem of using a non-inflammable gas for inflating balloons and dirigibles has been solved under the direction of a Physicist and a Chemist, both "fool professors".

The submarine has probably attracted as much of the attention of the scientific men as all other war inventions combined, both as to its detection and its destruction. The detection of the submarine is a definite physical problem, and it is estimated that about one-fourth of the Physicists of the Allies have devoted a considerable portion of their time to solve this problem alone. The problem had been attacked from three standpoints, light, sound, magnetism and electricity, three branches which almost comprise the entire subject of Physics. The destruction of submarines has been successfully accomplished by the use of the depth bomb.

In long range artillery work, temperature, moisture, and wind are to be carefully determined; this is done by physical apparatus. Wind direction and barometric pressure information is essential in a gas attack. This information is furnished by physical apparatus. Anti-aircraft gunnery is largely indebted to physical research and calculations for its effectiveness. The speed of the airplane must be ascertained, its direction of motion, its height above the ground, the speed of the attacking shell, and its path.

The airplane camera would be almost useless were it not for our knowledge of the branch of Physics known as *spectroscopy*. Pictures can be taken which the eye cannot see because of fog, cloud, haze or distance. By the use of the proper filters, the enemies guns camouflaged so as to be indiscernible to the eye are photographed and their positions located. The sound method of locating guns is very important. Three sounds are heard from a shell sent by the enemy. First we hear the hissing noise of the shell whizzing thru the air. Shortly afterward the boom of the gun is heard. (Since sound travels at about 1,100 feet per second and the shell's speed is greater than that). Finally we hear the sound of the exploding shell. If the time when the first of these three sounds is heard is recorded at several observing stations, from the speed of sound, and the difference in time recorded at these stations, the position of the

gun firing the shell can be calculated in a few minutes.

The Bureau of Standards, at Washington, a great national Physics institution, has certainly done its share in the war. Vacuum tubes were studied in detail, from the standpoints of sending, receiving, and amplifying wireless messages, and many important improvements were evolved. High frequency oscillographic equipment was developed. The characteristics of airplane bombs were studied, resulting in new methods of computing trajectories. New types of machine gun sights were invented. Instruments for recording the speed, altitude, direction, etc., of the airplane were perfected. Special ignition apparatus for the Liberty engine was invented. A carbureter was developed which gives a correct mixture by the simple motion of a single throttle whether the airplane is on the ground or up 3,000 feet. A fabric 25 per cent. lighter but stronger than linen, extra light but strong alloys, and non-corrosive alloys were invented. These are among the best of its accomplishments which have been made known.

Now that the war is over we shall daily hear of new, marvelous and quite astounding inventions, that have been evolved and perfected. The "fool professor" has now come before the public eye and is regarded with just and long deserved admiration and respect by it. Some, like Professor Millikan, have had exciting military times, such as quieting a "buck private" under the influence of liquor, being fed delightful sandwiches by fair white hands of Red Cross and other workers, etc., while others have suffered an existence under the S. A. T. C., and those more fortunate have spent their time in France near the front; all however have done their share nobly. In closing let us bear in mind that all that has been said of Physics and the Physicist applies equally well to the other sciences and scientists. *(Conclusion)*

EGGS PRODUCED BY ELECTRICITY.

The production of eggs by electricity may seem like an idea evolved in a madhouse, but it has been made a paying proposition at the Montana State College. By electric lighting of poultry pens, Professor W. F. Schoppe, poultryman of the state college, has created a sort of "daylight saving plan" for hens, whereby egg production has been increased more than twofold at a time when eggs were highest in price. In experiments covering the month of November last, Professor Schoppe showed a net gain of 28 cents per hen in value of eggs produced in ten lighted pens.

The experiment was tried on two pens of Leghorn hens, 160 in each pen. One pen was lighted with four 60-watt lamps, the other was left unlighted. The lights were turned on in one pen at 6 a. m. and switched off at 8.30 p. m. From the time the lights went on until they were dimmed at night, the hens in the lighted pen scratched away with all the energy of early spring or summer, showing a greater interest in the business of egg producing than ever.

The 160 hens in the unlighted pen produced during the month 443 eggs. The same number of hens in the lighted pen produced 1,306 eggs, a gain of 72 dozen. Hens in the lighted pen consumed little more food than their less active neighbors. The net gain was 28 cents per hen in egg production for the "electric" hens.

"I cannot say yet," said Professor Schoppe, "what effect this forced production will have on the hatching quality of eggs and upon the vitality of hirds, as those are problems that will require further investigation."

(See our May, 1918 issue for full details of the automatic electric lighting in hen-houses.—EDITOR.)

A TIMELY REINFORCEMENT.
A Copper Plated Stomach.

(Continued from page 877)

thanks to mother and the salt fish—*and* the cat.

You have to begin by discarding the whole idea of sheet copper. It would be all right, and any plumber could make up a good tummy in half a day—even including going back to the shop for his tools—but for the fitting of it, or inserting, or whatever you'd call it. That's a sticker; it's what's kept the invention back all these years.

But why not plate the copper on from the inside? Sure! There it was, right off the bat!

Fig. 1 shows the invention—patents pending—all worked out—perfectly simple. You procure an atomizer, A, and attach to it a long fine rubber tube, B. This tube is surrounded by a spiral wire, C, and both are covered by high-tension insulation, K.

At the further end, both the tube and the spiral wire are connected with the perforated metallic hollow sphere, E. The atomizer-bottle, F, is filled with a solution of sulfate of copper, and the spiral wire is connected with one pole of the spark-coil secondary, H. Around the patient's waist is then buckled the belt I, containing a strip of wire netting J, connected with the other pole of the spark-coil.

All being ready, the patient "swallows" the perforated ball, E, with enough of the tube to maintain communication with the outer world. The ball is then resting nice and cozy within the tummy. Mark the patient closely; a really delightful surprise is about to be handed to him? × ! Pressure on the bulb, G, projects a spray of copper sulfate from the perforations of the sphere, E, while at the same time a touch of the key, L, causes a shower of sparks to be thrown from the ball toward the metallic belt without. The sparks pass easily thru the patient's tissues, but not so the sulfate. This is decomposed by the electric current, and metallic copper is *deposited* on the gastric lining, forming a dense and highly polished surface, ready to tackle any food product short of Bangor red-eye and Irish confetti—brick-bats.

Perhaps you wondered why, before the operation, the patient took a few magnesia tablets, together with a peppermint "life-saver". This was to take care of the other product of the reaction, sulfuric acid—otherwise the patient might as well be fed to death as the way he is. The magnesia neutralizes the acid, producing a pleasant effervescence, which, being flavored by the peppermint, becomes the exact equivalent of an ice-cream "sody" fresh from the fountain.

So behold! at the end of the operation, when the patient finishes his cigarette and lets go the nurse's hand, there he is,—equipt with a perfectly-fitting copper stomach, enclosing a temperance-drink as a hint to guide him in the selection of future contents for it—like a new tin bank for little Willie, with a dime in it.

No, no, put aside that medal. Really I—well, if you must, you must. But I refuse to patent the idea in Germany. Absolutely. It's going to be dedicated to the free use of all free and civilized countries. "That's me all over—liberal, Mabel."

Note—The editor tried "Tom's" latest stunt. After he was dismist from the hospital, and was at last equipt with his copper "insides", he felt pretty weak! So he promptly swallowed a few pounds of zinc dust with his next meal. The copper tummy, the gastric juice—(an excellent electrolyte) —plus the zinc dust, makes a really excellent battery. It strengthened and revived the editor at once. It works so well that he has given up all food in preference to zinc dust. A slight change in diet is had with magnesium dust—it tastes better, and gives a much higher voltage. Iron filings were tried, but they made the editor "rusty"!

JOHNSON SMITH & CO.'S Annual Condensed PRICE LIST of FINEST FLOWER, GARDEN & VEGETABLE SEEDS

All prices postpaid to any address in the world.

Calabash or Pipe Gourds

A luxuriant and rapid growing climber; thrives anywhere. Produces the ornamental gourds from which the famous African calabash pipes are made. Grow this interesting vine and dry and prepare your own. Seeds, with instructions, 15c pkt., 3 for 40c.

Japanese Nest Egg Gourd

Very curious. Produces fruit same size & shape and color of nest eggs. Matured fruit does not crack. Will serve for years as a nest egg, stocking darner, or ornamental purposes, etc.

Seeds 15c pkt., 3 pkts. for 40c.

DEVIL'S CLAW

An ornamental plant, bearing beautiful flowers which are succeeded by large seed pods that, when young, are fine for pickling. They are delicious in soups, stews, etc., and make fine pickles. Pkt. 10c, 3 for 25c

Johnson Smith & Co., Chicago

Butterfly's Own Bush

This plant is a veritable refuge or haven for butterflies, and it attracts all the most beautiful types of butterflies to the neighborhood. Bees, too, are very fond of it. It is a pretty plant bearing pretty double flowers, ranging from white to rich crimson, deep red and pink, lilac and other delicate shades.

10 cents, 3 for 25 cents postpaid.

Shoo Fly Plant

A very remarkable Botanical curiosity you should have. Though quite odorless, flies will not remain in a room where it is grown.

Bears very pretty blossoms; blooms summer and winter. Grows rapidly from seed.

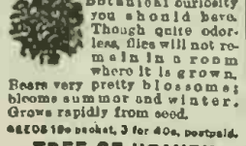
SEEDS 15c packet, 3 for 40c, postpaid.

CROWN OF THORNS

A very curious and remarkable window plant, can be trained over any desired form. Bright scarlet flowers. An object of rare and striking beauty, easily grown. It grows wild in Judea, and it is said that it was from this plant that the crown of thorns was made which was worn by our Saviour.

Packet 10 cents, 3 packets for 25 cents

TREE OF HEAVEN



This splendid ornamental tree is a native of China, and is called the Tree of Heaven, on account of its great beauty. Very hardy, thrives in any soil, no matter how poor and grows from 6 to 10 feet high from seed the first summer. The leaves are from 8 to 5 feet in any length, giving it a grand appearance. Nothing outside the tropics will fit for lawn decoration. Large panicles of bloom, followed in season by great clusters of colored seed pods, make the tree a continual thing of beauty. Packet, 15c, 3 packets for 40c, postpaid. Johnson, Smith & Co.

The Trembling Vine

A beautiful annual climber with lovely feathery foliage, that trembles in the breeze, showing masses of tubular flowers of scarlet, pink and white. The effect in most charming, the tubular flowers contrasting effectively against the bright, delicate, fern-like leaves. For training upon a light trellis the Trembling Vine cannot be excelled. For window decoration, or ornamental work of every description it is very pretty indeed.

Packet, 15c, 3 pkts for 40c, postpaid.

PORTULACA

Very popular for edgings, rock work, &c. Flowers are large and double, colors very brilliant red, orange, white, maroon, yellow, and various other shades. A bed of Portulacas makes a truly magnificent sight. Blooms very profusely.

Packet 10 cents, 3 for 25 cents

The Fountain Plant (Amaranthus Salicifolius)

Finest of all Decorative Plants. It is quite a curiosity either for lawn or home decoration on account of its rapid and very vigorous growth. Bears long wavy racemes of curious drooping branches, tipped with orange, bronze and crimson. Grows very readily, succeeds anywhere. Greatly admired for table or window decoration. 15 cents per package.

CATCHFLY PLANT

An Effective and Efficient Substitute for Fly Paper

A great curiosity. Flowers are a beautiful white, red or pink that makes them very desirable as house plants, or may be cultivated in open garden. The surface of the bladder underneath the flower is covered with a sticky material. This is where it gets its name. Catchfly, and small insects and ants that climb up become entangled and lose their lives in the fruitless effort to get at the sweets. By picking the flowers, that bloom very profusely, and placing them in a vase in a room, you have a fly catcher that is more effective and pleasanter than fly paper. The flies are attracted to the plant, and thus it is a simple matter, by having flowers in each room, to keep the house rid of the pests. The plant seems to be endowed with remarkable intelligence, for it does not harm winged insects such as butterflies, because it is necessary to have the pollen of the flower carried from one flower to another, in order to cross-fertilize, as this cross-fertilization is what makes the flower "set its seed." SEEDS, 15c packet, 3 pkts for 40c, postpaid.

GROUND ALMONDS

Amazingly Prolific—Easily Grown From Seed

The Ground Almond has a flavor that is MOST EXCELLENT, resembling the cocoanut. The meat is snow white, covered with a dull ar skin of brown color. It grows close to the surface and anything from 200 to 300 Almonds may be expected from a single nut. There is no trouble whatever in growing anywhere and in any kind of soil. May be planted any time, and in eight or ten weeks after time of planting you will have an ENORMOUS CROP of the MOST DELICIOUS ALMONDS YOU EVER TASTED. Seeds 15c Pkt.

Perfume Plant

Blooms only at night, giving forth the most delightful scented fragrance for quite a distance. Causes much comment. For house or garden. Also valuable for use of perfume made from it. SEEDS, 10c pkt., 3 for 25c.

SENSITIVE PLANT

Marvel of the Philippines. Leaves curl, fronds droop when touched. Apparently resents interference.

A handsome shrub for house or garden; very curious and interesting. Seeds, 15c a pkt., 3 for 40c.

Chinese Fragrant Tree Fern

Just introduced. Noted for its rapid growth. An exceptionally pretty ornamental plant. Foliage is rich dark green. Form a grand pyramidal bushes about 6 feet high. Handsome; very desirable for decorative purposes, wreaths, etc. Seeds 15c pkt., 3 for 40c.

Weather Plant

NATURE'S WEATHER PROPHET

By mysterious changes that take place, this remarkable plant accurately forecasts the weather many hours in advance. Will grow anywhere all the year around. An interesting house plant. Bears large, fragrant, pink, butterfly shape flowers.

Seeds, 15c packet, 3 for 40c, postpaid

Tom Thumb Calliopsis

Very showy, low-growing, compact bush, covered with golden yellow flowers with deep crimson centers growing to a height of six inches. Seeds, 10 cents pkt, 3 pkts for 25 cents, postpaid.

FOXGLOVE

Produces long spikes of richly colored flowers, excellent for cutting. Particularly showy and desirable for use among shrubbery and in partly shaded spots. However, it will grow just as well in the open. Easy to cultivate, requires little attention, produces mass of flowers throughout the season. 10c pkt.

Early Blooming Mammoth Carnations

A wonderful strain, producing flowers two weeks from seed, at least 80 per cent of the flowers being double. All of the beautiful shades of Carnations will be found in this assortment. 10c pkt, 3 pkts for 25c, postpaid.

Electric Light Plant

Remarkable curiosity, grows to the height of four feet, covered with large spikes of flowers six to eight inches long, in lovely shades, pure white at base and rose to bright red at top of flower. 10c pkt.

BRUSSELS SPROUTS

Miniature cabbages formed on the stalk of the plant. Delicious eating when cooked. Boiled like cabbage or cooked in cream same as cauliflower. The plants are grown in rows two feet apart and 18 inches in the row. Packet, 10 cents, three packets for 25 cts, postpaid.

CANARY BIRD VINE

Highly ornamental creeper with beautiful cut leaves and pretty, delicate flowers of a canary yellow, bearing a striking resemblance to a canary bird with wings half expanded. Makes a desirable window decoration. Grows up to twenty feet high.

Packet, 10 cents, three for 25 cents.

BALLOON VINE

"Love in a Puff." Ornamental, rapid growing, climbing vine, producing pretty white flowers, followed by remarkable seed vessels or inflated membranous capsules that look like small balloons. Packet, 10 cents, three for 25 cts.

BRILLIANT POPPY MIXTURE

Collection is made up of all varieties that will give a constant bloom from early until late in the season.

One of the easiest flowers to grow, and for a variety of colors nothing can compare with the delicate form and color of these blooms. Packet, 10 cts, three packets for 25 cents, postpaid.

Giant Climbing Nasturtiums

For covering trellises, fences, arbors, &c., and other places to be hidden. Very strong and vigorous, with large, dark green foliage, producing great quantities of giant flowers of all colors. Packet, 10 cents, three packets for 25 cents, postpaid.

ORANGE KING MARIGOLD

Fine type of Marigold, bearing dense double flowers of a rich, deep golden-orange color. Very desirable for cut flowers. Grow anywhere, blooming profusely and continuously.

Pkt, 10c, three pkts for 25c, postpaid.

The Great Japanese Umbrella Palm

A Graceful House or Conservatory Plant

Easily Grown From Seed Winter or Summer

The Japanese Umbrella Palm is a semi-aquatic plant. It is easily grown from seed either in a bowl of water or in very damp soil. Probably the most usual, as well as the most interesting method, is to cultivate the plant in a bowl or jardiniere filled with water, with two or three inches of good garden soil at the bottom. The seeds soon commence to germinate, and the plant shoots up stems two to three feet high and rapidly assumes a most pretty palm-like appearance, as shown in the engraving. The tops of the stems are surmounted by a whorl of umbrella-shaped leaves, of a waxy appearance. We will send a package of this seed, with full instructions for culture, for only 15c or three packets for 40c postpaid.

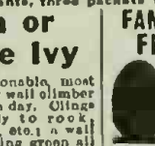
VINE PEACH VEGETABLE ORANGE OR MANOO MELON

One of the best of all vegetables. Resembles oranges in color, shape and size; grows on vines. Presents a most tempting appearance when canned; makes delicious preserves and sweet pickles, and fine for pies. Nothing like them; grows from seed in 80 days; enormously productive; can be used in every way as the peach, but not quite as sweet and not used raw. Packet, 10 cents, three packets for 25 cents, postpaid.

Boston or Japanese Ivy

Fashionable, most hardy wall climber of the day. Clings tightly to rock, brick, etc., a wall of living green all summer, turning in autumn, to a flaming, gorgeous crimson. SEEDS, 10 cents packet, three packets for 25 cents, postpaid. J. S. & Co.

FAMOUS MEXICAN FIREFLY PLANT



Beautiful hedge plant, grows 8 to 10 feet high and resembles a closely clipped ornamental evergreen. The globe-shaped or pyramidal bushes are close and compact, and of a pleasing light green color. May be grown singly or in the form of a hedge or background. In early autumn the whole bush becomes carmine or blood red, hence its name of Mexican Fire Plant, or "Burning Bush," as it is sometimes called. Selected seeds, 10c packet, three packets for 25 cents.

The Matchless Dwarf Giant Tomato

A magnificent variety. Grows about two feet high, very strong and produces large sized fruit; larger than any other dwarf tomato. The fruits grow in large clusters and weigh from 9 to 12 ozs. each. Flesh is firm and solid, no core, delicious flavor; almost seedless. Pkt., 10c, 3 packets for 25c, postpaid.

Grand Rapids Lettuce

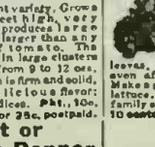
Easiest variety of all to grow the finest flavored on the market. Produces an abundant crop of green leaves, which retain their sweet flavor even after it has become quite old. Makes a practical substitute for lettuce. A single packet will keep your family supplied the whole season.

10 cents packet, 3 packets for 25 cents

Bouquet or Red Cluster Pepper

The Peppers are a very pretty coral red color, formed in clusters of from 12 to 30 on the upright fruits to each cluster. Very hot and pungent. Unusually prolific, the small but compact bush being literally covered with cone shaped fruit. An enormous crop produced; still keep for use all through winter. Elegant for borders or with pot herbs. SEEDS, 10c pkt., three packets for 25 cents, postpaid.

Salsify or Oyster Plant

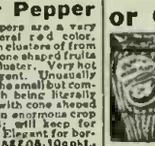


One of the most delicious vegetables; gets its name from the similarity of its flavor to oysters, frequently hard to tell the difference. Exceptionally wholesome, nutritious, satisfying. A very hardy plant that can be left in ground all winter and dug as needed when ground thaws. 10 cents packet, three packets for 25 cents, postpaid.

The Giant Spider Plant

A very remarkable and curious plant. Derives name from peculiar shape, the long, curving stamens suggesting spiders. Flowers are a deep, purplish pink when they first open, but fade to light pink. Seeds, 10c packet, 3 pkts. for 25c.

Mixed Squash Seeds



You will get all the different shapes, freaks, colors and sizes imaginable. A dozen different varieties included, early and late; you will derive much pleasure from their cultivation.

Mixed Seed, 10c, 3 packets for 25c.

Giant Crookneck Summer Squash

Selected strain of this delicious vegetable. Produces fruit nearly double the size of the old standard "Crookneck." Plants are bushy and compact. Fresh, rich, golden yellow; quality and flavor is unsurpassed. Grow readily in almost any soil.

Packet, 10c, 3 packets for 25c, postpd.

White Velvet Okra

Most delicious vegetable that is very fashionable and popular. Is easily grown. The pods are used for soups and stews. Noted for its fine flavor and tenderness.

Pkt., 10c, 3 for 25c, postpd.

New Japanese Giant Radish

The great Sakurijime Radish from Japan. The largest radish grown, often attaining the enormous weight of 15 pounds, and sometimes 20 or 30 pounds. Not merely a curiosity, but a radish of extraordinary quality. The flesh is solid, firm and brittle, and of most excellent flavor. Will grow or thrive in any soil or climate.

Packet, 10c, 3 pkts. for 25c, postpaid.

New Garden Huckleberry

Grows from seed first year. A new fruit that can not be excelled for Pies. Very prolific, yielding an immense crop of fruit. Grows and thrives in all climates and on all kinds of soil. The fruits grow larger than the common Huckleberry or Blueberry. If cooked with apples, lemon or anything sour, they make the very finest jelly.

Pkt. 10c, 3 for 25c. p.pd.

APPLE PIE MELON

A wonderful novelty that you will find a delight in cultivating. Vine and fruit are similar to a watermelon. Has a most delicious flavor, resembling the flavor of apples. Each vine produces 6 to 18 bushels of melons, producing on an average about 900 pounds of fruit. One melon will make as many pies as a half bushel of apples. Flesh is white and solid and of excellent quality for making pies, sauces, preserves, etc. They keep fresh and solid all winter, so can be used when wanted, and, owing to their value as stock food, any surplus not used for home cooking can be fed all winter to stock; in fact, it will pay to raise them for this purpose alone. Packet, 10 cents, three packets for 25 cents, postpaid.

Japanese Pop Corn

Nothing delights the children more. When well popped it becomes nearly twenty times its natural size. In the long winter evenings it keeps the children amused for hours watching the kernels burst into white balls, that are as light as a feather. Every family will enjoy planting it and caring for it and watching it grow.

Packet, 10c, 3 packets for 25c.

Banana Musk Melon

Quite a curiosity. Looks and smells like a banana. Peculiar shape and its delicious flavor make it well worth your while cultivating. Flesh is deep and of exquisite flavor. Very high prices are obtained in choice city markets, as high as a dollar sometimes being demanded for one single specimen.

Packet, 10c, 3 pkts. for 25c.

LUCCULAS SUMMER SPINACH

Two distinct vegetables from the same plant at the same time. The leaf portion of the foliage is cooked and served in the same manner as spinach; the stalks are delicious when cooked and should be served in the same manner as asparagus.

Packet, 10c, 3 packets for 25c.

Giant Asparagus

A few stalks of this rich and delightful vegetable on toast, or served with drawn butter, will make the greatest epicure punctuate each bite with a smack of satisfaction. One of the grandest table luxuries that you can buy. Has delicately tender stalks with exquisitely delicious flavor.

Packet, 10c, 3 pkts. for 25c.

Early Chantenay Carrots

Very tender and delicious, one of the best early Carrots in existence. Grow about 6 in. long, are stump-rooted, very smooth, deep red fine grained sweet and sugary and not apt to crack open while growing. Unsurpassed for table use.

Packet 10c, 3 pkts. for 25c, postpd.

Chicago Pickling Cucumber

Undoubtedly the best cucumber for pickles. It meets the most exacting requirements of the most critical pickle makers, who supply fancy and highest priced goods to the market. The vines set fruit when young and continue bearing longer than other varieties.

Packet 10c, 3 pkts. for 25c postpaid.

Giant Pascal Celery

Stalks are very large and solid, crisp and of rich, nutty flavor. Blanches easily and quickly. The heart is golden yellow and has a very attractive appearance.

Packet, 10c, 3 packets for 25c.

Chinese Giant Pepper

Very prolific for so large a pepper. Flesh is unusually thick, mild flavor and makes a very fine salad, sliced and served like tomatoes. Glossy scarlet.

Packet, 10c, 3 pkts. for 25c.

Jerusalem Cherry

A miniature tree that bears red and green berries continually in winter and summer. Foliage is always green. The fruit, however, is not edible. Especially fine for ornamental purposes.

Packet, 10c, 3 for 25c postpaid

Garden Lemon

An enormous yielder, cultivated much the same as Musk Melon. Has a most desirable acid flavor, thus dispensing with sliced lemon. Unexcelled for general canning purposes.

Packet, 10c, 3 packets, 25c.

Snake Cucumber

Curious as well as useful. Elegant for slicing when quite young. Coils like a serpent up to 7 feet in length. A novelty well worth cultivating.

Packet, 10c, 3 packets for 25c.

Dusty Miller

One of the prettiest of ornamental leaved plants. The leaves are white and are beautiful for vases, edgings, ribbons, or mixed with cut flowers.

Packet, 10c, 3 pkts. for 25c.

A few other reliable seed novelties you should cultivate. *All 10c per packet, p.pd.*

FLOWER SEEDS

Imperial Sweet Sultan
Forget-Me-Not
Ornamental Cotton
Scarlet Runner Bean
Evening Primrose
Mixed Tall Nasturtiums
Passion Flower Vine
Fuchsias
Little Blue Star
Wall Flower
Sweet Alyssum
Grandiflora
Harvest Moon Vine
Candytuft
Armeria
Cosmos (Mixed)
Pulse Dragon Head
Sunflower
Cardinal Climber
Columbine
African Marigold
Baby Golden Glow
Dianthus
Hybrida Superba Calliopsis
Carnation Poppy
Gruwelia
Dwarf Nasturtiums
Sundial Flower
Canterbury Bells
Satin Flower
Angel's Breath
Large Flowering Verbena
Everlastings
Joseph's Coat (Amaranthus)
Everlasting Sweet Pea
Giant Sweet Pea
Butterfly Pea
Bouquet Stocks
Lobelia
Heliotrope
Prize Balsams
Sweet William
Four O'clock
Hibiscus (Marsh Mallow)
Tobacco Plant

VEGETABLE SEEDS

Georgia Collards
Whitleaf Chicory (or French Endive)
Corn Salad
Kohl Rabi
Emerald Isle Kale
Tom Thumb Pepper
Moss Parsley
Enormous Peas
Snowball Cauliflower
Kentucky Wonder Climbing Bean
Giant Crimson Rhubarb
Golden Bantam Sweet Corn
English Vegetable Marrow
Large Red Wethersfield Onion
Emerald Gem Musk Melon
Tree Egg Plant
Marrow Fat Parsnips
Swiss Chard
Turnip Rooted Celery
Mammoth Pumpkin
Italian Leek
Breakfast Radish
Long Scarlet Radish
Oyster Endive
Mammoth Prize Tomato
Red Peach Tomato
Water Cress
Curled Garden Cress
Grape or Cluster Tomato
Prize Radish
Mixed Table Carrots
Extra Early Pea
Coffee Berry
Earliest Watermelon
Luscious Table Beet
Egyptian Winter or Tree Onion

Nitto's Plant & Flower Food changes ill-nourished plants into Luxuriant Beauties, producing masses of blooms that will equal any. Causes plants to bloom early and ahead of others. Friends marvel at Success. Brings out New Foliage and Flowers, and causes a Marvelous Transformation. Pkge. 15c, 3 for 40c.

JOHNSON SMITH & CO., Dept. E5, 3224 N. Halsted Street, CHICAGO

JAPANESE ROSE BUSHES

The Wonder of the World

Japanese Rose Bushes **bloom all the year round.** Just think of it. Six weeks after planting the seed, the plants will be in **full bloom.** It may not seem possible, but we positively **guarantee it to be so.** They will **bloom every ten weeks,** Summer or Winter, and when three years old the bush will be a **mass of roses,** bearing from 5ve hundred to a thousand roses on each bush. The flowers are in three shades — white pink, and crimson. The plants will do well both in and out doors We guarantee at least three bushes to grow from each packet of seed. **Price, 10c** packet, 3 pkts. for **25c** postpaid.

10 Cts.

SCARLET FLAX

Showy annual for flower beds and masses, brilliant crimson scarlet flowers, great profusion. Blooms very quickly.

Packet, 10 cents, 3 packets for 25c p.pd. Johnson Smith & Co.

PYRENTHRUM

Large, very bright and showy, very much like daisies and asters. Colors range from white, light pink, to deep red, with bright yellow centers. Flowers are 3 or 4 inches across. One of the best plants for edgings, or for cut flowers, on account of its beautiful yellow foliage. **Packet, 10c, 3 for 25c. Johnson Smith & Co.**

GIANT ZINNIA

A very showy annual. Flowers retain their beauty for weeks, and a profusion will be produced until frost. As double and as brilliant as Dahlias.

Packet, 10c, 3 pkts. for 25c, postpaid.

ICE PLANT

Very fine, effective basket plant. Foliage is very ornamental, being covered with ice-like globulies, prized for garnishing. Valuable plant for dry, sunny situations on banks, rockwork, old walls and ruins, etc., also for sunny borders. Peculiarly brilliant in sunshine.

Packet, 10c, 3 pkts. for 25c, postpaid.

CIGAR PLANT

A very fine genus of plants, remarkable for their beauty, freely blossoming ornamental appearance. bears large numbers of tube-shaped flowers of a bright scarlet color with white and purple ends. Always in bloom, cultivated indoors or outdoors. Good for bedding and hanging baskets; very desirable pot plants. **Packet, 10 cents 3 pkts. for 25c p.pd. Johnson Smith & Co.**

Torch Lily or Flame Flower

Has quite a variety of names, the most common of them being "Torch Lily," "Red Hot Poker," "Flame Flower," etc. Flowers are borne in compact form on stout 3 and 4 foot stems, having the appearance at a distance of orange and scarlet tinted cacti.

Pkt. 10c, 3 pkts. for 25c, p.pd.

NICOTIANA

Beautiful annual with sweet scented, large, star-shaped flowers. Blooms very profusely throughout the summer, affording a continuous display of brilliant flowers, flowers are nearly as large as a Petunia, and many are delightfully scented

Packet, 10c, 3 packets for 25c, postpaid

MIXED GERANIUMS

Have no rivals; when a show of colors is desired none can surpass them. Grow readily from seed and their foliage makes them the most desirable plants for house or pleasure ground. Nothing better for baskets, bouquets, vases, etc. Colors include various shades of crimson, scarlet, pink, rose, salmon, blush, white, etc. **Pkt., 10c, 3 pkts. for 25c, p.pd.**

Giant Empress Cockscomb

Very handsome either for pot plants or specimens in beds, where they excite the curiosity of visitors more than almost any plant that can be grown. Very desirable for growing indoors; grow in pots practically all winter Colors, brilliant scarlet, crimson, rose, orange, bright yellow and lemon. **Packets, 10 cents, three packets for 25 cents, postpaid.**

RAINBOW CORN

A charming grass that forms an object of great beauty in mixed beds and borders or planted in groups on lawns. Leaves are striped yellow, green, pink and rose. Not unlike maize or corn in growth. **Packet, 10c, three for 25c.**

PAMPAS GRASS

Comes from South America; very pretty ornamental grass, producing the most beautiful silvery plumes. Very tall and stately, and can be cultivated in this country; a very pretty table decoration, and can be cultivated in pots. **Packet 10c, three packets for 25 cents, postpaid.**

Celosia Spicata

Very pretty and unique variety of Cockscomb family. Introduced from India; bears countless blooms of silver white, with rich carmine tip. Easily cultivated; grown in or outdoors. Blooms practically the antire year if properly cared for **Packet, 10 cents, three packets for 25 cts. postpaid. J.S. & Co.**

THE REMARKABLE FIREFLY PLANT Blooms at Night

Fills the Atmosphere with Fragrant Aroma

One of the most rapid growing vines known. Under favorable conditions this vine has been known to grow OVER 26 FEET IN A SINGLE WEEK. In a very short space of time indeed the Vine has climbed to a great height, and is covered with IMMENSE FLOWERS, from 6 to 7 inches in diameter It is, indeed, a great novelty, for, unlike other plants, the flowers OPEN IN THE EVENING, and remain open until about noon the following day. In dull weather they will remain open all day. It is a most INTERESTING SIGHT to watch the opening and closing of the flowers as the clouds appear and disperse. As the flowers open they give forth the most DELIGHTFUL AROMA and the whole atmosphere around is full of scented fragrance. It is always the object of favorable comment, and much curiosity is aroused by people passing at night time as to the cause of the charming aroma, frequently stopping in an endeavor to satisfy their curiosity **PRICE, 10 CENTS packet, two packets for 25 CENTS, POSTPAID.**

Mammoth Peanuts

Peanuts can be easily cultivated. Their culture is very simple and exceedingly interesting. Mammoth Peanuts grow to an astonishing size. It is a good producer, very prolific, and the giant nuts have a thick, heavily ribbed protecting shell. The plant is very attractive, the leaves being of odd shape and a handsome green shade, tinted through the center with white. You will derive much pleasure cultivating this interesting species. **Seeds 10c skt., 3 pkts. for 25c**

Monster Mixed Petunias

No flower garden is complete without a bed of Petunias. Few plants can compare with them for beauty. Bright yellow centers, Flowers are 5 or 6 inches across. One of the best plants for edgings, or for cut flowers, on account of its beautiful yellow foliage. **Packet, 10c, 3 for 25c. Johnson Smith & Co.**

DAHLIA

One of the most beautiful of all flowers. If seeds sown early in the spring will bloom the first year. Our seed is of the finest strain, and produces large flowers of the richest shades. **Packet, 10c, 3 packets for 25c, postpaid.**

Johnson Smith & Co., Chicago

LARKSPUR

Remarkable for beauty, diversity of shades and decorative qualities. Blossoms are of immense size, single, double and semi-double. The colors range from white and lavender through every shade of blue, some having several shades on stem. Very effective in borders and planted among shrubs. The graceful spikes of bloom are much valued for vases. **Packet, 10c, 3 pkts. for 25c p.pd.**

SNAP DRAGON

Charming old fashioned flower. They have dark and glossy leaves and curiously shaped flowers, with finely marked throats. Bloom the first season. Splendid for borders, bedding, pot culture for house decoration, and are largely forced during the winter for cut flowers. Their delicious fragrance renders them extremely well adapted for cut flowers. **Packet, 10c, 3 pkts. for 25c, postpaid**

California Poppy

The state flower of California. A very attractive annual for beds, edgings or masses. Flowers profusely, foliage fine cut and of bluish color. The flowers are very large, measuring about three inches across, of a canary yellow color with a blotch of golden orange at the base of each petal. Valuable for bedding; from seeds sown in the spring they flower profusely until late in the autumn. **10 cents packet, 3 pkts. for 25c, postpaid. Johnson Smith & Co.**

Periwinkle or Old Maid Flower

Does well in bright sunshine; the drier and hotter the summer is the more the plants flower. A handsome bushy plant with glossy foliage. Blooms the first season. As bedding plants for the garden they rival the Geranium. They make very attractive pot plants. White, pink and mixed.

Packet, 10c, 3 pkts. for 25c postpaid.

COLEUS

For indoor decoration, for the adornment of the greenhouse or sitting-room, the Coleus plants are in the greatest demand. Will grow indoors all through the winter. You can grow them outside, and by taking a few slips, you can start them in pots and they will grow without the slightest trouble. Some of the combinations are very gorgeous. **Pkt., 10 cts, three pkts. for 40 cts, postpaid.**

STOKESIA, or CORNFLOWER

Very handsome, resembling Asters in appearance. Flowers are rich blue, like a giant cornflower, while others include charming shades of lavender, violet, white, and a new pink variety. **Packet, 10 cents, three packets for 25 cents, postpaid.**

Angel's Trumpet

Lovely garden plant, bearing enormous lily-like blossoms on five seven in. across and a foot in length, like a tremendous trumpet, some white as snow, others purple, some golden, others white bordered with lilac. Exceptionally fragrant; a single plant in bloom will scent up a whole lawn or garden. **Packet, 10c, three packets for 25c, postpaid.**

African Daisy

Remarkably handsome annual; forms bushes two feet high Foliage is of a soft downy, of whitish color; flowers, borne on long stems, rising well above foliage, large and showy. Flowers last for over a week when cut. **Packet, 10 cents, three packets for 25 cents, postpaid.**

"Tiger" Flower

Handsome and showy plant, easily cultivated; flowers are large, reddish brown, with golden yellow tiger-like markings, hence its name. Produces an abundance of bloom, in fact the plant is never out of bloom.

Packet, 10c, 3 packets for 25c.

Moss Verbena

Spreads over the ground, forming a carpet of lovely moss green, above which the delicate clusters of purple-blue or pure white blossoms are borne in great profusion. Delicate fragrance when cut.

Packet, 10c, 3 pkts. for 25c.

SURPRISE FLOWER GARDEN Over Hundred Varieties of Mixed Flower Seeds

MANY RARE AND CURIOUS NOVELTIES

An Abundance of Flowers Assured Throughout the Season

A mixture of easily grown annuals that bloom very soon after sowing the seed; others vary in their time of blooming. Those who cannot give the constant care necessary for finely arranged flower beds will be delighted with the Surprise Wild Flower Garden. Will prove a continual surprise and pleasure, as new varieties and the old garden favorites flower successively throughout the season. There are over a hundred varieties of seeds. Many of the plants may be taken inside as house plants and will bloom during the winter. Fine for children, also teachers for school gardens. **Packet, 10 cents, three packets for 40 cents, postpaid. J. S. & CO.**

JOHNSON SMITH & CO., Dept. E5, 3224 N. Halsted St., CHICAGO (OVER)

TEXAN PRIDE PHLOX

Charming, hardy annual. Colors are very rich, bloom of very long duration, rendering them a most desirable acquisition. Very beautiful for bouquets. Colors vary from pure white to deep crimson. Once planted require no further attention for several years. **Packet, 10 cents, three packets for 25 cents, postpaid.**

LOVE IN A MIST

Borrounded with beautiful webbing, feathery foliage. The flowers are very curious looking, having pods in the center. The charming pods in the center. The charming combined effect, no doubt, accounts for name. **Pkt., 10c, 3 pkts. for 25c, postpaid.**

White Gem Feverfew

A fine, old-fashioned bedding or border plant, always in flower. Blooms quickly. Grown outdoors in summer and indoors in winter. A fine pot plant. Grows a foot and a half high. Stems are literally covered with very double, pure, snow-white and golden-yellow flowers. *All the year round* **Packet, 10c, 3 pkts. for 25c, postpaid.**

Chinese Wistaria

For trellis, porches, arbors, trees or buildings, is magnificent when in bloom, bearing long clusters of purple flowers. Luxuriant and rapid growth. Flowers early in long, drooping racemes, resembling a bunch of grapes.

Packet, 10c, 3 pkts. for 25c, postpaid

SCARLET SAGE

A bed or border of Scarlet Sage is always a complete attention. Nothing can equal the gorgeous effect of a bed of Scarlet Sage when in full bloom. The large, flaming masses of scarlet bloom against green surroundings of lovely foliage is matchless. Grown in almost any position; flower on the walk or in borders. Also add to the attractiveness of a shrubbery if planted in clumps in the vacant spaces. The various shades of green and the blending scarlet have a most pleasing effect. Fine pot plants. **Pkt., 10c, 3 pkts. for 25c, p.pd.**

LANTANA

Showy and shrubby bedding and basket plant with Verbena-like flowers in shades of white, red and yellow. Very agreeable aromatic perfume. Rapid-growing, constant-blooming, excellent for growing in pots or for garden decoration. **Packet, 10c, 3 packets for 25c, postpaid.**

Bachelor's Button

Everlasting flower, globe shaped, useful for dried winter bouquets. Retain their color the whole winter. Also good for fresh cut flowers. Endures drought well; succeeds in any soil.

Pkt., 10c, 3 pkts., for 25c pp.d.

Black Eyed Susan

Beautiful trailing plant for hanging baskets, large vases, low fences, verandas, rustic work or green-house decoration. Flowers are orange, white, buff, etc. Height, 6 ft.

Packet 10c, 3 pkts. for 25c, postpaid

Wild Cucumber Vine

Rapid climbing vine reaches height of 30 feet in a season. Clusters of white scented flowers followed by an abundance of ornamental, prickly seed pods that are most interesting to children who like to see them burst. Left on the vine the seeds burst of their own accord and falling to the ground come up the following season. Ideal for trellises or places where a dense shade is desired. **Pkt, 10c, 3 pkts. 25c.**

Jap Virgin's Bower

Most beautiful of all flowering vines. Flowers are white, 5 to 6 inches across, are borne in great wreaths and clusters. The colors are rich royal purple, white or and pearly-white.

Packet, 10c, 3 pkts. for 25c, postpaid

Gorgeous Giant Pansies

These lovely flowers are favorites, not only for their brilliancy and variety, but for the durability of their bloom and the wonderful range of color and marking. A great diversity of all the very best giant and gorgeous varieties. Colors range through all the shades known in Pansies. Wonderful combinations; many of them are rare and new. **Packet, 15c, 3 pkts. 40c, postpaid.**

Asparagus Sprengeri

The best plant for hanging baskets. Masses of lush, gleaming foliage drooping in a very graceful manner. The foliage when cut for decorative purposes will last for weeks in water. The seed pods are very pretty red berries adding to its beauty. **Packet, 10c, 3 pkts. for 25c, postpaid**

Fire on the Mountain

A magnificent plant after the Poinsettia variety. Called "Fire on the Mountain," on account of deep fiery scarlet leaves. The plant presents a darling ray of green and scarlet leaves; effect is very startling. Very showy in the garden, or mixed with cut-flowers for bouquets. **Packet, 10c, 3 pkts. for 25c, postpaid.**

Snow on the Mountain

Beautiful plant for borders or beds. Beautiful leaves, veined and margined with white; pretty white flowers and has appearance of snow from a short distance. **Pkt., 10c, 3 pkts. 25c, postpaid**

Japanese Climbing Cucumber

Unpeelably strong and vigorous growing vine; grows twice the size of ordinary varieties, growing readily on fences, poles, trellises, etc. One hill will keep an entire family supplied all summer.

Seeds 10c, 3 pkts. for 25c.

Ostrich Plume Cockscomb

Unique variety of Cockscomb. Develops great, feathery plumes early in the season; grows like a pyramid, about 2½ ft. high. Can be cultivated in pots. Will bloom practically through the winter.

Packet, 10c, 3 packets for 25c, postpaid.

The Great Wonderberry

A luscious berry that may be grown and ripened from seed in any soil or climate in 3 months. The flavor is fine and unsurpassed for eating raw, cooked, canned or preserved in any form. The fruit is blue-black in color, and tastes like a luscious, rich blueberry. One bush will produce an enormous amount of fruit, yielding great masses of rich fruit all Summer and Fall.

Packet, 10c, 3 pkts. for 25c, postpaid.

Bush Musk Melon

A vineless Musk Melon, grows in bushes, and thus can be cultivated in the smallest garden. The fruit, is of the popular "Jenny Lind" type, but larger, averaging 6 inches in diameter. The flesh is very deep, edible almost to the rind and is colored light green, flushed with salmon toward the center. The quality is superb, luscious, sweet and juicy. Packet of seeds, with full directions for culture, **15 cents, 3 packets for 40 cents, p.pd.**

SUNBEAM GLADIOLUS

Makes a magnificent show in the flower garden or on the lawn. Bears 20 to 60 grand flowers to each stalk. Flowers beautiful beyond description; the colors are gorgeous and markings marvelous. Lend themselves to artistic decoration; from a decorative standpoint are simply exquisite. Bloom early and profusely. **Pkt., 10c, three pkts. for 25 cents, postpaid.**

MIGNONETTE

Mignonette is French for "Little Darling," that typically describes this dainty little flower. Very sweet scented; fragrance makes it indispensable for bouquet and cutting. **Pkt., 10 cts, 3 pkts. for 25 cts, postpaid.**

CACTUS FROM SEED

Very curious, odd looking, strange species of plants; will grow anywhere with little or no care. Flowers are of exquisite beauty and delightfully fragrant. You will be astonished at the odd looks of the Cacti just sprouting. **Packet, 10 cents, three packets for 25 cents, postpaid.**

APPLE BALSAM

Ornamental, quick growing climber, is grown mostly for the effect of the fruit, which is yellow; looks not unlike an apple, hence its name. When ripe stop seeds and shows the seeds and blood-red interior. **Pkt., 10c, three packets for 25 cents, postpaid.**

PANSY-VIOLETS

Produces beautiful Pansy-like blossoms of the most delightful colors, including blue, black, rose, purple, lavender, maroon, all-yellow, gray, crimson, orange, white, lemon, etc., while some are striped, edged and spotted. Many are very fragrant. It is hardier than the pansy and blooms for a longer period. Planted in masses they form perfect mats covered with myriads of flowers.

Packet, 10 cts, 3 for 25 cts. J. S. & CO.

WIND FLOWER

Beautiful Irish Poppy-flowered varieties produce in abundance large single, semi-double and double flowers in an endless variety of colors. Some are mottled, striped, fringed, etc. For cutting they are fine. **Packet, 10 cents, three packets for 25 cents, postpaid.**

Allegheny Vine or Mountain Fringe

Very graceful and hardy climbing vine. Feathery foliage is like the Maidenhair Fern. Bears pretty rose-pink and white tubular-shaped flowers. Nothing better for covering fences, trees, tree stumps, etc.

Pkt., 10c, 3 pkts. for 25c, p.pd.

Japanese Morning Glory

A new mammoth class of noble flowers. Grows 20 ft. by midsummer. Rich, dark green leaves, marbled a silvery white and yellow. Giant size flower, and continues in bloom until destroyed by frosts. The colors are exceptionally rich and flowers as large as teacups.

Pkt., 10c, three packets for 25c, postpaid.

Enormous Prize-Medal Cabbage

Enormous "Prize Medal" Cabbage grows to enormous size and quality any other variety on the market. Grown for us by a specialist in cabbages. Has been known to reach the enormous wt. of 60 to 90 pounds per head, with a diameter equal to that of a bushel basket, while 30 lbs. per head is by no means rare. If you wish to have the finest tasting as well as largest in the whole neighborhood, try a package, and you will not be disappointed.

SEEDS, 10c packet, 3 packets for 25c.

"Wong-Bok" Chinese Cabbage

Novelty from China and should be be grown in every garden. Seems to be a cross between Celery and Cos Lettuce. Flavor is more mild than any other cabbage. **Can be served** on the table and eaten raw or cooked like cabbage, spinach or lettuce or made into salad. Grows very rapidly, easy to cultivate. You can create quite a sensation by cultivating this remarkable novelty. Seeds, 15c packet, 3 pkts. for 40c.

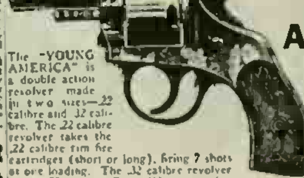
Butterfly Flower

Sometimes called Poor Man's Orchard. Forms compact plants literally covered with countless beautiful orchid-like flowers, all delicately fringed and curiously marked with crimson, lilac, purple and yellow, resembling butterflies in their bewildering range of color. **SEEDS, 10 cents, three packets for 25 cents, postpaid.**

Ever Blooming Hollyhock

Hardy garden flower, blooms from seed the first season; flowers often measure five inches across, with a great variety of beautiful shades and tints. They bear pyramid-shape spikes of large flowers somewhat like rosettes. Continuously covered with large flowers. **10 cents, three packets for 25 cents, postpaid.**

JOHNSON SMITH & CO., Dept. E5, 3224 N. Halsted St., CHICAGO (OVER)



The Alkaline Storage Battery

(*Continued from page 878*)

Consequently the engine would have to be operated at various rates and at all times. This is uneconomical. By using a storage battery one may arrange to run the engine at its most economical (full load) rate and thus effect a saving to offset more or less completely any loss of current resulting from the use of a storage battery between the generator and the lights. Further, the storage battery tends to improve the character (the steadiness) of the light. With a small installation where the current passes directly from the dynamo to the wires supplying current to the lights, the latter are apt to manifest undesirable fluctuations in brilliancy because of irregularities in the running of the engine. By using a storage battery, one is able to use this fluctuating current in charging and then to get an even current from the battery.

A shunt-wound dynamo is the thing to use—else, when the voltage of the battery rises too high, it may "back up" and operate the dynamo (series type) as a motor, causing considerable damage. If a compound dynamo is already installed, or if it is desired to use such a machine for charging storage batteries, it can be done simply by disconnecting the series windings on the field coils, thus converting the machine into a shunt dynamo.

The dynamo which is used to charge a battery should always have an excess voltage capacity. Thus, if we are going to use a battery of 30-32 volts rating, it is good practise to employ a 45-volt dynamo for charging. In fact, we may largely consult convenience when charging a battery, provided we use a high voltage rather than a low one. A 110-volt dynamo may be employed, at times, for charging a 30-32-volt battery, thru a suitable resistance; tho perhaps it will not be the best thing to do.

The alkaline battery with which we are concerned is made up in a variety of sizes, of which that known as "A" is quite popular for electric automboiles and trucks. A numeral used along with the letter indicates the number of positive plates used in the cell. These numbers furnish a rough gage by means of which the comparative capacities of this type of cell may be determined. The reason underlying this is that amperage is determined by the total area of plate surface exposed to the action of the electrolyte. An A4 cell will have about half the capacity of an A8 cell, etc.

Charging.

The *positive terminal* of the battery is conected with the *positive line* of the supply current; and the *negative terminal* with the *negative line*. The positive pole of this type of cell is indicated by a *red bushing* and also by a + mark stamped in the metal of the container. A black bushing is used for the negative pole. A further means of determining the positive and negative poles is by means of the *form* of the little containers in the plates. The round tubes belong to the positive plates, and the flat pockets to the negative plates. If substantial heating is noticed at or near a cell pole during the charging operation, it is to be taken as indicative of an imperfect connection. If, however, all the connections are tight, then disconnect and determine whether there is dirt present and whether the metallic contacts are flat and rigidly clamped.

If there is any doubt as to which is the positive wire of the dynamo and which is the negative wire, the following simple test is recommended:—Connect one wire of the generator with some form of resistance. The free end of the unconnected wire of the resistance and the free end of the unconnected wire from the generator may now be brought close together in a cup of salt water. In a moment one wire-end will begin to turn bright. Bubbles will form at this wire. This is the *negative* one. The other is, naturally, the *positive* wire.

Normal Amount of Electrolyte.

The proper amount of electrolyte is such that plates will be ½ inch below the surface. During the charging operation the attendant evolution of gas will be likely to create a transient level. Tests for the level are to be made after the charging is all completed and the liquid has settled down. As it may not be easy to see conditions inside the cell, a good way to determine the depth of liquid over the plate tops is to use a piece of straight glass tubing with a bore of, say 3/16 inch or more. Introduce one end of the tube, holding it vertical, until the bottom of the tube is on top of a plate. Then close the top of the tube with the forefinger and withdraw the whole. At the bottom will be found a column of electrolyte whose height will be the depth of liquid over the plate top. When the right amount of electrolyte is in the container, this column will measure ½ inch. Simply a glass tube is required. No rubber cap or tube is needed in addition and the tube of an ordinary fountain-pen filler may be used. The rubber bulb is removed and the larger end of the tube is inserted into the electrolyte. The operation of charging, as already intimated, involves the production of gas. Some, at least, of this gas comes from the decomposition of water in the electrolyte into its constituent gases. These gases will naturally be lost, and the result will be a slight reduction in the total volume of the electrolyte in the container. Consequently, a very proper time to examine for height of solution is *subsequent to charging*. The remedy for this loss and any other loss due to withdrawal of water (as, for example, by natural evaporation) is the addition of pure water.

Adding Water.

When water is to be added to the contained electrolyte to bring the surface to the required height or to correct a solution that has become too strong, a special appliance—the "electric filling outfit"—may advantageously be employed. Only *distilled water* is to be used, whatever the method of introducing it. Of course, do not add water during charging, for the reason that the level can not be exactly determined at that time, as already explained. The addition of water will not, ordinarily, be required every time the battery is used. Usually, once or twice a week will be sufficient, unless the operation of the battery is very considerable. Other things being equal, water will be necessary oftener when the *constant current* method of charging is used instead of the *tapering current* method.

Two Methods of Charging.

To charge by what is known as the constant current method the rheostat is set a few amperes higher than the current it is proposed to deliver. The amperage will fall off as the charging goes on, but by readjusting the rheostat every 30 minutes or so to a point somewhat higher than the average desired, a fairly even flow may be maintained. To charge by what is known as the tapering current method, the rheostat is set a considerable amount above the desired average, say 50 per cent, and the current delivered without further adjustment. At the end it is proper that the current should be considerably below the average. An advantage of this method is the relief from attention during the charge.

Opportunity Ad-lets

YOU will find many remarkable opportunities and real bargains in these columns. It will pay you to read and investigate the offerings made every month by reliable firms, dealers and amateurs from all over the country. No matter what you may be seeking, whether supplies, automobile accessories, the opportunity to make money, or anything else, you will find listed here the best and most attractive specials of the month.

Advertisements in this section seven cents a word for each insertion. No advertisement for less than 50c accepted. Name and address must be included at the above rate. Cash should accompany all classified advertisements unless placed by an accredited advertising agency. Ten per cent discount for 6 issues, 20 per cent discount for 12 issues. Objectionable or misleading advertisements not accepted. Advertisements for the May issue must reach us not later than March 22.

The Circulation of the Experimenter is over 100,000 and climbing every month

EXPERIMENTER PUBLISHING CO., INC., 233 Fulton Street, New York, N. Y.

Automobile Accessories.

More Power, Less Fuel, No Carbon. No mystery, plain facts, results guaranteed. Write for booklet S. O. No-Leak-O Piston Ring Co., Baltimore, Md.

Fords Start Easy in Cold Weather with our new 1919 carburetors. 34 miles per gallon. Use cheapest gasoline or half kerosene. Increased power. Styles for any motor. Very slow on high. Attach it yourself. Big profits to agents. Money back guarantee. Thirty days' trial. Air-Friction Carburetor Co., 270 Madison, Dayton, Ohio.

Repair parts for all make cars, also engines. Carburetors, magnetos, bucket seats for racing cars. We also carry a large stock of slightly used tires and tubes at very lowest prices. Write for list. Haviland Supply Co., 2306 Seventh Ave., New York City.

Ford Car Repair Book sent free. This valuable, complete, well illustrated, book explains in a simple way the Causes and Cures of Overheating; Repairing Ford Timer; Curing Piston Ring Troubles; Carburetor Adjustment and Repairs; Connecting Rods; Transmission Troubles; Care and Repair of Rear Axle; Stopping Axle Grease Leaks; also covers practically every other phase of Ford Car repairing. Another feature is a chart showing exactly how much to pay for work done by rapair men. Send 25c coin for three month's trial subscription and get the valuable repair book free. Ford Owners' Magazine, 417 Montgomery Bldg., Milwaukee, Wisconsin.

Simplex Belt Power Transmitter for Fords, $12.50. Write for circular. Frank R. Weisgerber, Salina, Kans.

Agents Wanted.

Easy, Pleasant Work for mechanics, shop men, clerks, during spare hours, will add many dollars to their salaries. Also want persons who can give full time. Big wages assured. Novelty Cutlery Co., 308 Bar St., Canton, Ohio.

$10 Daily refinishing chandeliers, brass beds, automobiles by new method, without capital or experience. Free particulars and proofs. Write today. Gunmetal Co., Ave. D, Decatur, Ill.

Insyde Tyres, inner armor for automobile tires, double mileage and prevent punctures and blow-outs. Quickly applied. Costs little. Demand tremendous. Profits unlimited. Details free. American Automobile Accessories Co., Dept. 54, Cincinnati, O.

American Inkless Pen—new invention. Everybody wants it. Sells $1. Agent's sample 60c. Agents. District Managers wanted. Attractive proposition. Buckeye Distributing Co., 1822 Noble Rd., E. Cleveland, O.

Agents! Get busy sell Wax O Polish direct to car owners. Resists dust and mud. Makes the car look new and glossy. Requires no rubbing, dries instantly. Good profits given to agents. Send for sample now. Price postpaid $1.00. Wax O Polish Co., 119 No. 1st St., Alberquerque, New Mexico.

Agents—Exciting fun flying a Yankee Aeroplane, flies like a real machine. Sample and money making plan, 25c. Yankee Mfg. Co., Milwaukee, Wis.

Make your own toothpowder and retail it. Great profits, receipt 25c. Mason's, Petaluma, Cal.

Agents—New invention puzzles world; wonderful chemical cloth; one rub over rain, snow blurred auto windshield, street car or engine window, presto! glass stays clear 24 hours; can't blur; agents making $120 weekly. Security Mfg. Co., Dept. 106, Toledo, Ohio.

Telegraphy.

Telegraphy, Wire and Wireless, and Railway Accounting taught thoroughly. Unprecedented demand for both sexes. Big Salaries. Oldest and Largest School—Est. 45 years. Catalog free. Dodges Institute, Seventh St., Valparaiso, Ind.

Postcards.

Everything in Postcards. Live-wire list free. Worth-while samples 25c. Mention subjects preferred. Mutual Supply Co., Bradford, Pa.

Help Wanted.

Nikola Tesla Correctly Chose his life work. I can help you to choose as intelligently as he chose. Complete character reading showing what natural abilities you possess. Tried and true method based on photos and handwriting. No magic guesses. Particulars free. Lowell P. Hoyt, Presque Isle, Me.

U. S. Government Positions. Men—women. $80 to $135 month. Paid vacations. Short hours. Pleasant work. Common education sufficient. Write immediately for list positions now open. Franklin Institute, Dept. D26, Rochester, N. Y.

Raise White Mice, big profits let me start you. Ray Boyle, Watertown, S. Dak.

Make Die-Castings. Sketch, Sample, Booklet, and Proposition, 12c. Byrd & Blair, Box 227 F. Erie, Pa.

Motion Pictures.

Motion Picture Film for home machines 200 feet $2.00, parcel post prepaid. Charles Gunby, 145 West 45th Street, New York.

For Sale Cheap, Motion Picture Films. Send 10c for sample and list. William Halstead, 88 Mamaroneck Ave., White Plains, N. Y.

February 24, 1919.

Mr. R. W. DeMott,
Advertising Manager,
THE ELECTRICAL EXPERIMENTER,
233 Fulton Street,
New York City, New York.

Dear Sir:

We take great pleasure in stating that our advertising in your classified department has been very successful.

To tell the truth, we have received more returns and at a lower cost than any medium that we are using.

Sincerely yours,

NATIONAL AERO INSTITUTE,
(Signed) John A. Tenney,
President.

Exchange Ads.

For Sale—Two loose coupler receiving sets, commercial type, best construction, and phones. Splendid condition. Low price. Unusual opportunity for amateur station. Call Saturday evening, 354 Convent Ave., near West 145th Street, New York City.

For Sale—Train, Camera, and other small stuff. Mahan Smith, Jefferson City, Mo.

For Sale—Telephone generators, $1.50; Battery telephone, 75c; Electrolytic interrupter, $2.00; $35.00 Chemistry Laboratory, $25.00; Brandes Superiors, $4.25; Telephone transmitter, 50c; Audion, $3.00; Double Barreled shot-gun, 12 gage, $7.00; 17 jewel Waltham, silverine case, $9.00; etc. Want—Typewriter. Welton, 708 Marion, Mattoon, Ill.

$300.00 Tent, 40 x 80, cheap, $30.00 takes it. 4-20 ft. center poles 9 ft. wall. Also twin cylinder motorcycle engine with magneto $10.00. V. G. Gustafson, 1402 N. Hickory St., Joliet, Ill.

Exchange—Thorough Bred Shetland Pony for 8 inch spark coil or $125.00. Deb. Cummins, Wilmot, S. D.

Write immediately for large list of electrical and chemical apparatus. Mr. Keogh, 328 Lorel, Chicago.

For Sale—Electrical Apparatus. Send stamp for list. Alfred Embovitz, Washington Depot, Conn.

Brand new 15 dial Omnigraph with 15 extra dials, $15. Write J. F. Maurer, Jr., 682 Broadway, West New York, N. J.

Sell—Loose Coupler, $4.00; Detector, 30c. List of Wireless apparatus 3c. Kenneth Tooker, Coshocten, O.

Will Sell or Trade a Fuller Johnson, overhauled, gasoline engine, 1½ H.P. Fred Sheel, 174 Martin Street, Milwaukee, Wis.

For Sale—One 50 amps.—110-125 volts—2 wire—D. C.—Duncan Integrating Wattmeter in first class condition. J. Paternoster, 511 West 160th St., N. Y. C., Phone 9651 Audubon.

Exchange Ads.—Continued.

For Sale—Blueprints of motor windings, see add under Blueprints, etc., this issue. Charles L. Chittenden, 811 W. 18th St., Kansas City, Mo.

Wanted—Mignon Receiving Cabinet RLC 5 or RLC 6. Cash. J. H. Newton, Suffolk, Va.

For Sale—1, 2, 3, 8, 9 Hawkin's Guides, cheap. Joseph Saltry, 319 Oak St., Scranton, Pa.

Wanted—Omnigraph and Records. State price and condition. J. A. Burgess, Provost, Va.

Sale—High tension magneto $5. Austin Randall, Bradford, Me.

For Sale—Small Climax talking machine and 20 records in A1 condition for $10.00. Also Telescope, Magazines, Electrical Apparatus. Emil Feldman, Manning, Iowa.

Sell—Omnigraph No. 2 Jr. Make me an offer. Myrl Priest, St. James, Minn.

For Sale—National Automatic Telegraph Transmitter with 25 records in continental code, practically new, $12.50. Leonard Ulstrip, Freewater, Ore.

For Sale—Complete sending and receiving set. Absolutely new. K. Jennings, Newton, Mass.

Wanted—Bound Volumes, 3 and 4 of Electrical Experimenter. Printing Outfit or Wireless Receiving Set. Everett Fritzberg, 727 Washington St., Northeast, Minneapolis, Minn.

For Sale—1 H.P. D. C. Electric motor; 1 motorcycle engine; also other things. George Coulin, 851 Columbus Ave., New York City, N. Y.

Sell—Complete Chemical Outfit, Wireless and Electrical Goods. Charles McLaughlin, Cadiz, Ohio.

For Sale—½ K.W. Open Core Transformer, unmounted, cost $6.50, $2.50; ¼ K.W. Closed Core Transformer, $7.50, $4; Pancake Oscillation Transformer, $3.75, $2; Jove Detector, 70c; 2500 meter Loose Coupler, $8, $4; .22 H. & R. 7 shot revolver, $8.50, $5; .22 Automatic Rifle, $17.00, $8.50; 3000 meter home made Loose Coupler, $5; all in fine condition. Guns' bores are perfect. Henry Cole, M-2 Box 380. Indianapolis, Ind.

Will Swap—No. 2 Folding Autographic Brownie and fishing rod and reel for wireless apparatus. Max Feldner, 1444 W. 13th St., Chicago, Ill.

Wanted—Parts type 400-500 Edison Primary Batteries, Michael Boland, Forest Avenue, Englewood, N. J.

2 K.W. Wireless Outfit. Full particulars by mail. Best offer or exchange for marine engine. W. Monroe Whaley, Maple Road, Linthicum Heights, Md.

For Sale—New 5 record Omnigraph, buzzer, key, 20 records, $15.00. Margaret Ewing, Norwichtown, Conn.

For Sale—Hytone Rotary Gap ½ K.W. Transformer, Pancake Type Oscillation Transformer. Unusually fine glass plate condenser NAA Coupler. All new, low price. V. Van Zandt, 1663 Winfield St., Los Angeles.

Sell—Good Remington Typewriter, $30. C. Gillespie, 72 Woodward, Buffalo, N. Y.

For Sale—Nonpareil printing press, number 22; eight fonts type and ornaments $25. Donald Peglow, LaPorte, Ind.

For Sale—Curtiss Biplane, 3 ft. Model $10.00. Miami bicycle $12.00. Post card projector electric, $4.00. Edw. Webb, New London, O.

Electrical Photographic and Chemical Apparatus, motors, fans, switches, spark plugs. Advise what you want or have for sale. H. C. Hancock, Bogota, N. J.

Exchange—$8.00 Omnigraph and dials for variable condensers or motor. W. T. Gravely, Danville, Va.

Sell—Twelve complete wrestling lessons, $5.00. Harry Schulte, 2460 Buchanan St., Baltimore, Md.

For Sale—No. 5 (No. S) Omnigraph worth $7 perfect condition. **Wanted**— perfect Thordarsen 1 K.W. sending transformer, state price. Wallace Heckman, Windermere Rd., Auburndale, Mass.

Wanted—Telegraph Apparatus. Write Gowan, 343 George, Peterboro, Can.

For Sale—Audion Bulb, Tuner, Condenser and double receiving phones. Cahn, 182 Pulaski St., Brooklyn, N. Y.

For Men.

Shave Yourself? Send ten cents to Mecntzen, Beaumont, Texas, for blood stopping styptic pencil.

Business Opportunities.

Victory—Mechanical Toy Soldier window attraction. 30 inches high. Salutes, turns head, points with finger, etc., as set. Well made, nicely dressed officers, privates, Uncle Sam, etc. Electrically operated. Does some stunt every half minute or oftener as set and will salute soldier and pay no attention to other if desired. Representative wanted in each city and town. Write for prices. The John M. Biggs Co., Box 324, Chattanooga, Tenn.

Dollars Yearly in Your Back Yard. No ginseng, mushroom dope. New ideas. Investigate. Particulars free. Metz, 313 East 89, New York.

Build up an Income in Oil—Others are doing it—Why not you? Today is the opportunity. Join our easy monthly payment plan NOW—it may mean hundreds in profits. Write for information. National Oil Drilling Co., Dept. K, Houston, Texas.

Incorporate your business under the common law. No organization tax; no franchise tax; no federal corporation tax; certificates not taxable; stockholders exempt from company debts; do business anywhere; directors reside where you wish; lowest cost organization possible. Common Law Organization Co., 4 Randolph, Detroit, Mich.

Patents For Sales: To buy or sell patents address Patent News-H, Washington, D. C. Only inventor's newspaper published.

Start a profitable business manufacturing "Puffed Crisp." Delicious confection. Whirlwind money-maker. Machine, instructions complete $6.50. Samples 10 cents. Bestever Products Co., 2526—E4, Polk St., Chicago.

We will start you in the cleaning and dyeing business, little capital needed, big profits. Write for booklet. Ben-Vonde System, Dept. H, Charlotte, N. C.

Why Sell Perfumes and Toilet Goods for others? make your own; get all the profits. Particulars, Laboratory Box 1316—X— Memphis, Tenn.

Hurry: Our First Issue. Plans and specifications for building National Advertising Weather Service. Sales talk picture of finished machine, etc. Profit $150.00 for manufacturer. Protected territory. Descriptive literature, terms and picture 25 cents. None free. National Sales Co., Box 421, Lima, Ohio.

If Interested in profitable money making plan send quarter. Coffer, 104 Main St., Flushing, L. I.

"Quick-Action Advertising—How it is Building Business for the Progressive Advertisers of America"; A little story of RESULTS, told by the advertisers themselves—not the publisher. You will be interested in reading this little booklet, which we have prepared for prospective advertisers, a copy of which will be gladly mailed to you upon request. It tells you how to talk business with 1,000,000 intelligent, interested and responsive Americans every month—men who know what they want and who have the money to buy it. Write for particulars and rates today. Douglas Wakefield Coutlee, 225 West 39th Street, New York.

Enter a New Business. Earn $3,000 to $6,000 yearly in professional fees making and fitting a foot specialty, openings everywhere with all the trade you can attend to; easily learned by anyone at home in a few weeks, at small expense; no further capital required; no goods to buy, job hunting, soliciting or agency. Address Stephenson Laboratory, 18 Back Bay, Boston.

Make Die-Castings. Sketch, Sample, Booklet, and Proposition, 12c. R. Byrd, Box 227, Erie, Pa.

$30.00 a week evenings. I made it with a small mail order business; continued my regular job daytime. Free Booklet tells how, 2 cents postage. Albert W. Scott, Cohoes, N. Y.

Gold and Silver Plating without costly electrical apparatus. Wonderful example of scientific achievement. Unparalleled opportunity to establish yourself in dignified lucrative business. Experience and capital unnecessary. Complete detailed instructions in both processes. One Dollar. Electroless Plating Co., 1646 Echo Park Ave., Los Angeles.

Branch Manager Wanted for old established Chicago Concern. We furnish full stock of goods, advertising matter, and equip store completely, in good location, all at our expense and pay you $40.00 a week salary, in addition to liberal share of the profits your store earns. Work can be started in spare time. No investment or previous experience necessary to secure this position. If you are a hustler and want an opportunity to make $5,000 to $15,000 a year we want you and will pay you well from the start. Send me your application today. S. Levy, Mgr., Department 784 Como Bldg., Chicago, Ill.

Experimenters: Would you like to earn $100.00 a month in your spare time at home. Send 25 cents (Coin) for instructions. Lloyd Stultz, Middletown, Maryland.

Business Opportunities—Continued.

Make Big Money opening safes and setting combinations. Wayne Strong, P. O. Box 1430, Los Angeles, Cal.

Men, get into the wonderful tailoring agency business, big profits taking orders and your own clothes free. We furnish fine sample outfit and everything free. No experience needed. Write today. Banner Tailoring Co., Dept. 186, Chicago.

Attention manufacturers—What have you to offer for Mail Order House? Must be easy mailing. Can use large quantities. Address, Guarantee Sales Co., 468 E. 117th St., Cleveland, Ohio.

Miscellaneous.

Luminous Paint makes watches, clocks, anything visible at night, 25c bottle. Luminous Paint Co., 2426-X Polk St., Chicago.

Your Opportunity—Used correspondence courses bought and sold. Dollars saved. Write now. Enclose stamp. MacMichael Educational Bureau, Dept. 44, Victor, N. Y.

Japanese Incense produces fragrant odour. Sample 10c. Box Yama, Postal Box, 281 Sta. C., Los Angeles, Cal.

Be Healthy! Know the surest way to success. Read "Sincere Words," 1919 wonder. 20c postpaid. Success, 1943 Patten St., Philadelphia, Pa.

Cats crave catnip. Send 10c for a "catnip mouse" (a lifelike cloth mouse, stuffed with catnip). More fun than a "barrel of monkeys," and your "kitty" will like it. Address: Percy Ewing, Decatur, Ill.

You Can Be a Winner. Gain Power and Individuality and become what you wish to be, through our system of Self-Development. Practical, positive benefits. Send 10c and birth-date for interesting Personality Sketch and first lesson in Efficiency. Thomson-Heywood Co., Dept. 350, Chronicle Bldg., San Francisco, Cal.

Catch Fish. Descriptive folder containing valuable information mailed for stamp. George Julian, Albany Building, Boston.

Blacksmith, Listen! Prepare for big wages in Navy and Arsenal with Toy's Modern Methods doing hard jobs easy. Forging and making solid welds, hardening and tempering to a standard, with colored tempering charts. All for one dollar. Sample free. W. M. Toy, Sidney, Ohio.

Wanted—Small Gasoline and Steam Engines. Cash paid for 1 to 4 cylinder light weight Motors. ¼ to 10 H.P. Johnston, West End, Pittsburgh, Pa.

Snow Plow. Removes snow from sidewalks, etc. Easy to raise or lower. Thoroughly tested. Can also be used as toy. A. H. Tallyn, Benson, Ill.

"Opportunity Adlets" bring quick results. Our 100,000 circulation, net. Other firms are making money—so can you. For proof address Classified Department, Electrical Experimenter, 233 Fulton St., New York City.

Wireless.

Amateur Radio will be Prohibited in Five Years unless amateurs organize for beneficial protection! Will amateurs be organized body able to protect themselves from this impending calamity? Write us for absolutely latest particulars concerning this latest question. Future amateur radio depends on you—the loyal amateur! Only a slacker will hesitate. You write immediately! American Institute of Radio Engineering. Omaha.

Complete receiving sets $8.50, $9.50 and up. Instruments, parts, minerals. Circular for stamp. Inquiries invited. Jenkins, 923 Purchase Street, New Bedford, Mass.

Mineral Detectors are not one hundred per cent efficient without a sterling silver catwhisker. Better than gold, 15c each. Gooding and Layton, 1604 Broome Street, Wilmington, Delaware.

DeForest Ship's Set Complete. Loose coupler, detector stand, reversing switch, variable condenser, etc., all mounted on hard rubber base and mahogany cabinet—very fine. Price $30. W. M. Ronan, 172 Front St., New York.

Better stock up now on switches and switch points for that new set. Circular describing the most perfect on the market sent free. Eureka Secondary Co., 6939 S. May St., Chicago, Ill.

Learn Wireless Telegraphy at Home Cheap—Through home course outlined which will not exceed $5.00 including the entire outlay. Don't waste time and money learning elsewhere. Use your spare time for this purpose. I tell you how to obtain this complete course and answer all questions free thereafter. Complete instructions and details, $1.00. Investigate. Satisfaction guaranteed. E. Jones, 818 Roosevelt, New Orleans, La.

Switch Points, Binding Posts. Switch levers, and small parts, send 2c for catalogue describing these and other goods. A. W. Bowman & Co., 23 Church St., (Harvard Square), Cambridge, Mass.

Amateurs, Complete Set of Blue Prints and Instructions for construction of (RA6) Regenerative Receiver, amplification 100, range 180-580 meters. Easy to construct. Just revised. Price $1.50 postpaid. Radio Research Laboratories, 2148 Fifth Avenue, Troy, New York.

Formulas.

500 Formulas, resilvering mirrors, renewing dry batteries, luminous paints, mechanics' soap, 25c, lists 2c. "Bestovall," 3311-E Belleplaine, Chicago.

Chemicals.

"Chemical Analysis honestly and correctly done" by Leland E. Tenney, Chemist, Colton, N. Y.

If you are in need of Chemicals you will be wise if you send your orders here. We handle the Chemicals that are most rare and most difficult to obtain. Send 5c for sample price list. Ziegler Experimental Laboratory, 47 Judson Street, Rochester, N. Y.

Electrical Supplies & Appliances.

Motor Winders: See ad under blueprints, etc., this issue. Charles L. Chittenden, 811 W. 18 St., Kansas City, Mo.

One Service Station Storage Battery Generator; High tension magnetos; S. D. Motor starter; D. C. Motors 110 v.; Motorcycle engines and parts. Telephone parts of all kinds, belt, pulleys, spark coils, 2 cylinder Thor Engine carburetor and magneto complete. Going to sell dirt cheap while they last. P. A. Paul, Lewisburg, Ohio.

For Sale: 250 Penlites exact representation of fountain pens complete with 2 cell guaranteed battery only 65c each, postage 4c extra. Extra batteries 20c. Also 50 2-cell fiber tubular flashlights 90c, and 15 3-cell flashlights $1.05. Postage 7c extra on either. J. A. McLardie, 424 Edgewater, Dayton, Ohio.

$2.00 75-ohm double pole watch case receivers—NEW—permanent magnet type, fine for wireless, prepaid, $1.25. Electro Sales Co., 1844 Cleveland Ave., Chicago, Ill.

Electrical Tattooing Machine and Supplies—Catalogue Stamp, Prof. Temke, Exp., 1019 Vine St., Cincinnati, Ohio.

Recharge 25 Dry Cells for Five Cents. Directions 10c. Gilbert, 28 Chestnut, Binghamton, N.Y.

All sizes of refillable fuses. Send 25c for sample plug fuse and 10 refills. State Amperage. Knoll and Palmer, 7076 Jenkins Arcade, Pittsburgh, Pa.

For Sale—Electrolytic rectifiers. glass jars, Knapp motor, 19, 21, 23, 25 and 35 D. C. C. magnet wire, 24 and 31 S. C. German silver wire, transformer iron, switchboard complete, miniature sockets, battery binding posts, spark gap, electric heater. J. L. Lange, 9 Roosevelt Ave., Jersey City, N. J.

For Sale—Electrical apparatus all kinds. List for purple stamp. Wm. Doty, 207 John St., Portland, Oregon.

Personal.

Are you self conscious—embarrassed in company—lacking in self control? These troubles overcome. C. E. Veritas, 1400 Broadway, New York.

Letter Specialists.

Letters That Land Orders and Money Orders—written for $4.00; three for $10.00. Guaranteed. Criterion Service, Dept. 3, West New York, New Jersey.

Real Estate for Sale.

Is This Your Idea of Florida? A little piece of land near the water, a boat, a garden, some strawberry plants, and perhaps a few chickens; a vine-covered cottage, pleasant neighbors; fish and oysters in abundance. plenty of quail and game—a simple, natural, wholesome life in the open the year round—Home, Health and Contentment. All this is within your reach at modest outlay in this beautiful land of sunshine and roses. We are on the Gulf and a navigable river; also on the Dixie Highway. Here we have the freedom, comfort and economy of country life, yet are only two hours by motor bus from big cities and resort centers like Tampa and St. Petersburg. Our community is new, but is one of the fastest growing in the State. Prices have not gone sky-high and living expenses are moderate. 100 Northern families already here. They like it—perhaps you will. May we send complete information? Board of Trade, Box 298, New Port Richey, Fla.

Motorcycles.

Motorcycles from $25 up—New and second-hand. Easy terms. large list to choose from. all makes. Send 4c stamps for Bulletin "A." Peerless Motorcycle Co., Watertown, Mass.

Song Poems Wanted.

Write the Words for a Song. We write music and guarantee publisher's acceptance. Submit poems on war, love, or any subject. Chester Music Co., 538 S. Dearborn St., Suite 265, Chicago.

Continued on page 934

Patent Attorneys.

Inventions Patented. Trade-marks Registered, Labels, Prints and Publications Copyrighted, reasonable fees; correspondence solicited; detailed information free; booklets. Jaynes & Jaynes, 702 Kellogg, Washington, D. C.

Patents Procured—Trade Marks Registered—A comprehensive, experienced, prompt service for the protection and development of your ideas. Preliminary advice gladly furnished without charge. Booklet of information and form for disclosing idea free on request. Richard B. Owen, 130 Owen Bldg., Washington, D. C., or 2278-T Woolworth Bldg., New York.

M. F. Miller, Ouray Building, Washington, D. C. Patent Attorney, Mechanical and Electrical Expert. Best quality of work and results. Moderate charges. Advice free.

Millions spent annually for ideas! Hundreds now wanted! Patent yours and profit! Write today for free books—tell how to protect yourself, how to invent, ideas wanted, how we help you sell, etc. American Industries, Inc., 212 Patent Dept., Washington, D. C.

John M. McLachlen, Atty. at Law, Patents, Trade Marks, Copyrights, 410 McLachlen Bldg., Washington, D. C.

Patents—My fee payable in monthly installments. Send sketch for advice. Booklet free. Frank Fuller, Washington, D. C.

Patent Your Own Inventions. Save attorney's fees; we prepare applications; furnish full instructions and give satisfaction. Free information. Carl Larsen Co., Park Row Building, New York City.

Patent Attorney, Electrical Engineer, Mechanical Expert; Thorough Personal Service. Frank Ledermann, 21 Park Row, New York.

Patents. My fee payable in installments. Full particulars return mail. John Patten Duffie, Patent Attorney, Washington, D. C.

For Inventors.

We Have A Proposition that will probably interest you. Inquiries invited. The Wakefield Engineering Co., 922C—F St., N. W., Washington, D. C.

600 Mechanical Movements, also illustrations and explanations of 50 perpetual motions. My book, Inventors' Universal Educator, 4th edition, tells how to procure and sell a patent for your new invention. Government and other costs. Covers the matter from A to Z. 140 pages elegantly bound. Contains noted Court decisions on Patent cases. Mechanical Movements greatly assist inventors—suggest new ideas that might prove of great aid in perfecting inventions. Tells how to select an attorney. Has valuable information regarding Patent Sharks, Selling Agents and Brokers. Price $1. Postage free. Fred G. Dieterich. 603 Ouray Building, Washington, D. C.

Inventors. Protect your idea before exposing it. Advice Free. Inventor's Patent Service, Park Row Building, New York City.

Inventions Commercialized. Cash or royalty. Adam Fisher Mfg. Co., 205 St. Louis, Mo.

Inventors join National Institute of Inventors, World Building, New York City; membership society 1,900 strong; will help protect, develop, finance and market your invention. Absolutely no charge. Write for booklet.

Patents for Sale.

Patent—Cork float oil gauge for Ford cars. Price right. L. A. Randall, Conimicut, R. I.

News Correspondents.

Earn $25 Weekly, spare time, writing for newspapers, magazines. Experience unnecessary; details free. Press Syndicate, 566 St. Louis, Mo.

Scenery for Hire.

Collapsible Scenery for all Plays. Amelia Grain, Philadelphia, Pennsylvania.

Cameras, Supplies—Photo Developing.

Send us your next film for developing and printing. No charge unless you are satisfied with our work. The Photolo Co., 36 Garrison Road, Claredon, Virginia.

Mail Us 15c with any size Film for development and 6 velvet prints. Or send 6 negatives any size and 15c for 6 prints, 8 x 10" mounted enlargements 35c. Prompt, perfect service. Roanoke Photo Finishing Co., 255 Bell Ave., Roanoke, Va.

Camera bargain list free. Durso, Dept. 41, 25 Mulberry, N. Y. City.

Clean, Neat, Perfect Kodak Finishing at the lowest prices. Work returned the same day received. Send film for sample print and copy of Catalog on Developing, Printing, Enlarging and Hand Coloring, also copy for Photo Craft Magazine which will help you make better pictures. Photo Craft Co., Box 69, Ann Arbor, Mich.

Books.

What Every Draftsman Should Know. Very useful booklet. Price 12c postpaid. Wack Booklet Co., 1943 Patten St., Philadelphia, Pa.

Dear Reader—If Occult, New-Thought and Scientific books appeal to you, send for my catalog, it's free. I have books on Personal Magnetism, Concentration, Spiritualism, Clairvoyance, Seership, Will, Mind, Hypnotism, Mesmerism, Character Reading, Healing, Mysticism, Success, Salesmanship, Mechanics, Entertainment, etc. A. W. Martens, J-49. Burlington, Iowa.

World-Romic System, Masterkey to All Languages. Six Textbooks, $1.44. French Chart, 37c; Spanish, 37c; Aviation Dictionary, $1.50. French-English Aviation Dictionary, 61c. Languages, 143 West 47th, New York.

Books on Sex—Catalogue free. United Sales Co., Springfield, Ill.

Books for Real Live People. Lists free. J. E. Sheridan, 417 E. 151st, New York.

20,000 Formulas, Recipes and Trade Secrets in double-column, 530-page book, only $1. Postpaid. Clifford Camp Co., 32 Prospect St., Claremont, N. H.

To Get Better Pictures: Read the Amateur Photographer's Weekly; illustrated; weekly prize competitions; print criticisms; many unique features; $1.50 per year; three months' trial subscription 25c. Abel Publishing Company, 401 Caxton Bldg., Cleveland, Ohio.

Old E. E. Back Numbers: We have some valuable old E. E. back numbers on hand as follows: 1915—Jan., March, April, May, June, July, Aug., Sept., Oct., Nov., Dec., price each 35c. 1916—Jan., Feb., March, May, June, Sept., Dec., price each 35c. 1917—Jan., April, May, Aug., Nov., Dec., each 35c. 1918—Jan., Mar., 35c; 1918—May, June, July, Aug., Sept., Oct., Nov., Dec., each 20c. 1919—Jan., Feb., Mar., 20c. We can fill orders at once upon receipt of your remittance, and if you have not these numbers already, now is your chance to get them, as they probably will be snapped up very quickly. Experimenter Publishing Co., 233 Fulton St., New York City.

Sexual Knowledge—By Dr. Faulkner. Plain facts about sex matters. Over 100 pages valuable information for men and women, married or single. Price 25c, in plain wrapper. United Sales Co., Springfield, Ill.

Leading Magical Magazine. You'll like it! All magicians do! Why? The value is there. Sample 10c; three months, 25c; year $1.00. The Eagle Magician, Dept. E, Minneapolis, Minn.

"Nature Book" facts every married and engaged person should know. 35c. Central Company, 599 Ninth Avenue, New York.

Blue Prints.

Blue Prints: ½ H.P. Gas Engine 30c, ¼ H.P. Steam Engine 50c, ⅛ H.P. Boiler and Engine 70c, all 3 $1.00. Circulars for stamp. Universal Gas Motor Co., 364 Monadnock, Chicago.

Blue Prints of Motor windings. 108 A.C. connections, 132 D.C. armature windings, complete 240 diagrams $5.00 cash. Send 25c for 12 samples or write for particulars. Charles L. Chittenden, 811 West 18th Street, Kansas City, Mo.

Make volt and ammeters. Simple practical instruction and blue print 25c. D. R. Hansell, 2328 N. Carlisle Street, Philadelphia, Pa.

Health.

Enjoy Vigorous Health. My new book "Muscular Development" tells how. Send for it today—10c. Earle Liederman, Dept. A, 203 Broadway, New York.

Tobacco or Snuff Habit Cured or no pay; $1.00 if cured. Remedy sent on trial. Superba Co., SA, Baltimore, Md.

Pyorrhea—H. E. Kelty, D. D. S., M. D., pyorrhea specialist for 15 years, has developed a successful home treatment for pyorrhea. Purifying, healing, preventative. Full month's treatment and booklet $1.00. Circular free. Dr. H. E. Kelty, 106 Gladwin Ave., Leonia, N. J.

Cigarette, pipe or chewing habit conquered. Nature's method. Guaranteed. Write for free brochure. Edw. J. Woods, TA-300, Station F, New York.

Stammering.

St-Stu-t-t-tering and Stammering cured at home. Instructive booklet free. Walter McDonnell, 105 Potomac Bank Building, Washington, D. C.

For the Hair.

I was Bald. Obtained hair growth by an Indian's ointment containing genuine bear oil and rare plant juices. Many others have good hair-growing results. Will send box, postpaid, with recipe, 10c. John Hart Brittain, 150 E 32nd St., BA-300. New York.

Tricks, Puzzles and Games.

Tricks, Puzzles, Jokes, Toys, Games, Novelties, Doll and Cane Racks, Plays, Wigs, Stage Supplies, Escapes and Illusions. Large 1917 catalog free. Oakes Magical Co., Dept. 549, Oshkosh, Wis.

1000 Stage Tricks with 500 illustrations. Catalogue 10c, small catalogue free. Hornmann Magic Co., Sta. 6, 170 Eighth Avenue, New York.

Black Art Hindoo Experiments, 1919 Edition, 25c. Invisible Ink. Free Trick. Catalogue each order. Linhorst Magic X Shop, St. Louis.

Ventriloquism taught almost anyone at home. Small cost. Send today 3c stamp for particulars and proof. O. A. Smith, Room R-605, 801 Bigelow Street, Peoria, Ill.

100 Kinds Wire and Steel Puzzles. Catalog and leader 10c postpaid. Western Puzzle Works, St. Paul, Minn.

Phonographs, Needles and Supplies

Build Your Own Phonographs and manufacture them for profit. Drawing instructions, Parts, Price List, Blue Prints, etc., complete, sent free upon request. Write today. Associated Phonograph Co., Dept. E-1, Cincinnati, Ohio.

Build Your Phonograph. "Perfection" high-quality spring and electric Motors, Tone Arms, Reproducers. Wonderful results. Big saving. New catalog and building instructions mailed for ten cents. Indiana Phonograph Supply Co., Indianapolis, Indiana.

Phonograph Owners: Test our wonderful, new Ring Point needles. Buy at wholesale prices and make money selling to your friends who hear how they improve tone. Scientific method, important discovery, very interesting. Single needle plays 100 records. Send 25c for samples and special offer. K. Kenyon Company, 31 Union Square, New York.

Wonderful $75 Phonograph. 42 inches high, 12-records album, needles, $45. Stamp. 631 Newhall, Milwaukee, Wis.

Motors, Engines and Dynamos.

Small Motors and Generators: 1000 New Motors and Generators from Bankruptcy Stock, ¼ H. P. A. C., $18.50 each; ½ H. P., $30.00. Battery Charging Sets—Robbins & Myers new outfits, all sizes, $30.00 each and up. Charging, Lighting and Moving Picture Arc Generators, $10.00 each and up. Motors for all phases of current. Immediate delivery Less than ½ regular prices. Write for late bulletin. Johnston, West End, Pittsburgh, Penna.

For Sale—The following 60 cycles, single-phase motors, 1800 r.p.m., new. 25-⅛-110 volts, 3½ h.p., 220 volts, 2¼ h.p. 220 volts, 2-1 h.p. 220 volts, 1-1½ h.p. 220 volts, 2-2 h.p. 220 volts. Electric Machinery Equipment Co., 714 W. Van Buren St., Chicago.

Wanted for Cash—Marine, rowboat, stationary, automobile, motorcycle engines or bicycle attachment motors. State condition, price, etc. Write, A. J. Temps, 305 Broadway, New York City.

Printing.

100 Bond Noteheads, 4 lines and 100 envelopes, prepaid, $1.00 Southwestern, 1413-H Berendo, Los Angeles.

100 Engraved Style Visiting Cards 50c; 100 Emblem Cards 70c. H. Gregory, Warwick, N. Y.

Stamps and Coins.

500 Finely Mixed United States or Foreign Stamps, 12c. Philatelic Star, Madison, N. Y.

California Gold, Quarter size, 27c; Half-dollar size, 53c; Dollar size, $1.10; Large cent, 1820, and catalogue, 10c. Norman Shultz, Kings City, Mo.

Stamps—61 all different free. Postage, 3c. Mention paper. Quaker Stamp Co., Toledo, Ohio.

Free—Packet Valuable Stamps to applicants 50% approvals. Benj. Forbes, 160 Devilliers, Pittsburgh, Pa.

Free packet of stamps to approval applicants. Laskaris, Union City, Pa.

Stamps 100 different, 8c; 200, 23c. Approvals. Michaels, 5600 Prairie, Chicago.

Acme Stamp Co.—Send stamp for pocket list. 494 12th St., Brooklyn, N. Y.

For Advertisers.

"Quick-Action Advertising—How it is Building Business for the Progressive Advertisers of America"; A little story of results told by the advertisers themselves—not the publisher. You will be interested in reading this little booklet which we have prepared for prospective advertisers, a copy of which will be gladly mailed to you upon request. It tells you how to talk business with 1,000,000 intelligent, interested and responsive Americans every month—men who know what they want and who have the money to buy it. Write for particulars and rates today. Douglas Wakefield Coutlee, 225 West 39th St., New York.

SKINDERVIKEN TRANSMITTER BUTTON

$1.00 ppd.

YOU can easily make a highly sensitive detectophone by using a Skinderviken Transmitter Button to collect the sound waves. You can build your own outfit without buying expensive equipment. Think of the fun you would have with such an instrument! It's very simple, too, and inexpensive.

You can install an outfit in your home and hear the conversation being held all over the house. You can connect up different rooms of a hotel. *Our outfit was used by secret service operatives during the War. It is being used on the stage.* So much for its commercial adaptations! *You* can procure apparatus of the same type.

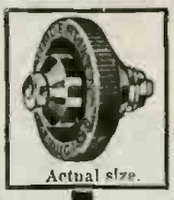


Fig. 3

Fig. 6

One of the main advantages of the Skinderviken Transmitter Button lies in its ultra-sensitiveness. You can place it in any position you like. It is the greatest invention in micro-phones and has won recommendations from men of high standing in the scientific world. It is being used all over the world. You can mount it most anywhere. In figures 3, 4 and 5 are shown some unusual and practical methods. Card board boxes, stove pipes, stiff calendars and hundreds of other places will suggest themselves to you. The buttons cannot be seen by any one in the room as they are so small and light. Only a small brass nut is exposed to the view.

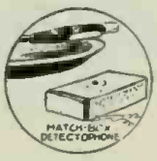


Fig. 4

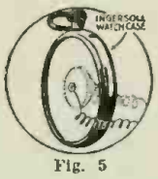


Fig. 5

BARGAINS

These prices are very low

All equipment is GUARANTEED. The apparatus is the same as sold by us to large telephone companies. 110 volt telephone generators.

3 bar	$1.75	Weight	6½ lbs.
4 bar	2.25	"	8 lbs.
5 bar	2.75	"	10 lbs.
Ringers 80 ohm	.35	"	1 lb.
" 1000 ohm	.75	"	1 lb.
Silk cords, 6 ft. 3 cond.	.20	"	3 oz.
" " 6 ft. 4 cond.	.20	"	3 oz.
" " 3 ft. 2 cond.	.10	"	1 oz.
Transmitters complete with Steco transmitter button	$1.50		12 oz.
Induction coils	.35		6 oz.

Full directions for connecting up the button for use as a detectophone are given in booklet No. 4 which is sent with each button. Figures 1 and 2 of this advertisement, two of the many illustrations in booklet No. 4, show the circuit connections of the detectophone.

The only instruments needed to complete a detectophone outfit, in addition to a Skinderviken Transmitter Button are a receiver, battery, and, if desired, an induction coil.

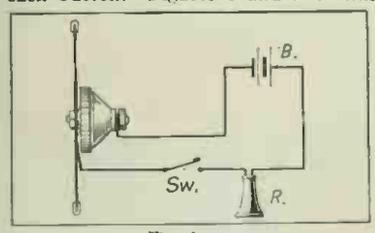


Fig. 1
Transmitter Button mounted on Diaphram. Simplest circuit.

AMONG electrical experimenters the button has created a sensation. It is not uncommon to receive unsolicited letters like these: "I received transmitter button today and I wish to inform you that it works great and is *the best I have ever seen or heard of for the price.* I will certainly recommend it to my friends. I wish to thank you for your good service."

$1.00 ppd.

"I have been using one of your transmitter buttons, and it has proved to be worth more than its value in my experimenting." "I received one (Transmitter Button) some time ago, and they are just O. K. for experimentary." "I bave been using one of your transmitter buttons for experimental work and it certainly lives up to all you say for it *and then some.*"

Fig. 7

Mr. H. Gernsback, editor of this magazine, who is the dean of electrical experimenters, said: "In writer's opinion, obtained by actual elaborate tests, your Transmitter Button is probably most efficient device of its kind on market today, due to its simplicity and other outstanding features. Should have a great future."

Figures 6, 7 and 8 suggest some very interesting experiments. That of reproducing music at a point far removed from the phonograph is very popular with experimenters. The Skinderviken Transmitter Button is mounted in a very small hole in the under side of the sound arm. (Note: This hole will not injure the quality of the music.) When the phonograph is being played, the sounds produced are transformed by the Skinderviken Transmitter Button into a varying electrical current. The receiver, which is located in another room, reproduces the music at that point.

Fig. 8

Figures 7 and 8 illustrate the methods of transmitting sound by means of the vibrations in a body while speaking. Speech will be reproduced by the receiver just the same as if the experimenter had spoken into a transmitter. In these experiments the Skinderviken Transmitter Button is mounted on a small iron disc.

The same circuit connections apply to all experiments, regardless of how the transmitter button is mounted.

The Skinderviken Transmitter Button operates on one or two dry cells. It often happens that two cells produce too much current and the sounds are deafening. We recommend either one fresh cell or two worn out cells.

We have the utmost faith in our transmitter button. We guarantee satisfactory service or we will refund the purchase price. Boys — Young and old—send in a dollar bill RIGHT NOW! You can't lose. If you're not satisfied, you receive your dollar back. Isn't that fair?

Send a 3c stamp for a copy of Booklet No. 4.

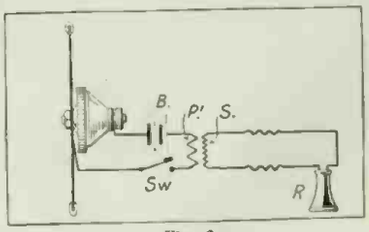


Fig. 2
Transmitter Button mounted the same but with Induction Coil.

USE THIS COUPON

STECO, 2134 North Clark St., Chicago, Illinois. E. E. 4-19
Gentlemen:—Please enter an order for (Use Pencil)
Enclose sufficient postage for mailing.

[ ] Skinderviken transmitter buttons	@ $1.00	prepaid	
[ ] 110 volt generators.....bars	@	Wt.....lbs.	
[ ] Ringers.....ohms	@	Wt.....lbs.	
[ ] Cords.....conductor.....ft.	@	Wt.....lbs.	
[ ] Induction coils	@ .35	Wt.....lbs.	
[ ] Transmitters with T. Button	@ 1.50	Wt.....lbs.	

Ship to.....

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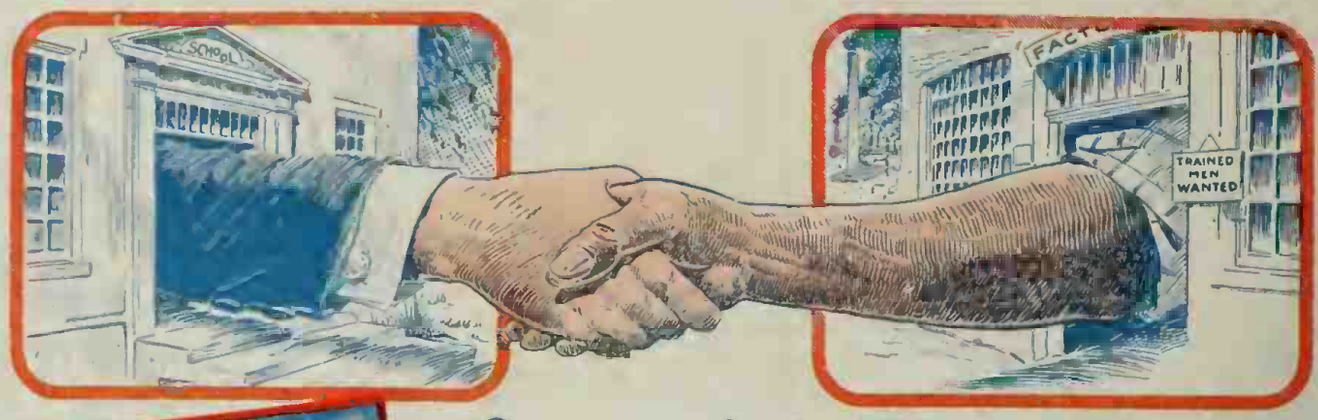
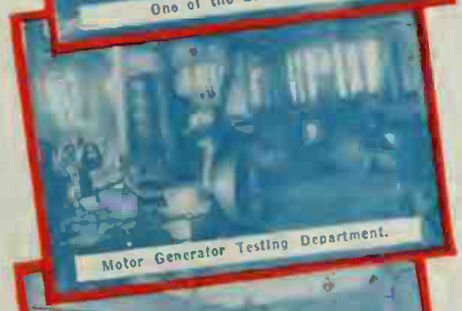
Send Booklet No. 4. [ ]




One of the Lecture Rooms.


Motor Generator Testing Department.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Do you realize that this country, and practically all of the civilized world as well, is today facing a period of unparalleled demand for electrical engineers and trained electrical school graduates? Has it occurred to you that thousands upon thousands of engineers and electrical men are going to be needed soon, both here and abroad, to rebuild Europe's industries and restore her war-shattered commercial life? Have you heard what President Wilson says about after-the-war engineering? "It is of first consequence to the country that there be an adequate supply of engineers for the period of reconstruction which must follow the war."—Woodrow Wilson.

Prepare Now for This Extraordinary Opportunity—Learn the Electrical Profession as it Is Taught in America's Most Practical Electrical Institute.

Whether you take up Electrical Engineering, Expert Electrical Technique, or one of the Electrical Trades, your course in this school will be a complete, practical training for a definite kind of position. Under this institution's combined shop, drafting-room and recitation-room curriculum—with our high grade faculty of practical engineers, with our large splendidly-equipped shops and laboratories in which students learn to know electrical apparatus by actual, daily contact—an "S. O. E." Diploma has become a known badge of merit in the electrical industry.

B. S. Degree in 3 Years—Electrical Technician Diploma 1½ to 3 Years—Six Months' and One-Year Electrical Trade Courses.

Recognized "Bachelor of Science" degree given graduates of the Electrical Engineering Department, under laws of Wisconsin, in 3 years. Electrical Technician diploma given in 1½ to 3 years, according to whether student is only Grammar School graduate, or has some High School credits. (Diploma qualifies student for expert technical positions, such as Government Technician, Electro-Mechanical Draftsman, Power Plant Superintendent, Technical Salesman of Electro-Motive Power Installations, etc.) 1-year and 6-months' Trade Courses qualify students as Draftsmen, Linemen, Metermen, Motor Repairmen, Wiremen, Telephone Trouble and Repairmen, Armature Winders.

Two Reserve Officers' Training Corps Units Just Authorized in This School by United States Government.

The War Department has just authorized Junior and Senior R.O.T.C. units in this school. Students joining one of these units will be issued free uniforms and given a free six weeks' summer training camp trip each year. Members of Junior or Signal Corps Unit will receive free instruction in Wireless Telegraphy. **And after a period of 2 years' enrollment, all R.O.T.C. students recommended for same will receive a Government allowance of $12.00 per month.** Requires 3 hours' military training per week. Membership cancelled on leaving school. Mail coupon for full particulars. **New Term every 3 months.**

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Mail this coupon for full details of this school's splendid part-time employment plan, which enables students, to earn living expenses while pursuing studies.

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83-373 Broadway, Milwaukee, Wis.

Tell me all about your "Earn-While-You-Learn" plan, and your

- ☐ Electrical Engineering Course—3 years
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