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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 Speed Types, 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.


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.

WHAT PRACTICAL MEN SAY ABOUT THE "BURGESS BLUE BOOK"

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JOSEPH BRAITH, Electrician.

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,

V. E. JOHNSON, Western Union Tel. Co., Marion, Ohio.

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R. S. SWANSON,
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BURGESS ENGINEERING CO., YORKE BURGESS, Consulting Engineer
747 East 42nd Street Chicago, Illinois
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 published in the New York Evening Post Nikola Tesla, too, reminds us that he had made known to the world many years ago the fact that extra-planetary signals were recorded by his stand in the Colorado Laboratory. That was in 1899, before the world dreamt of wireless.

Every new announcement 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 Earth, on which to plant beings endowed with reason. Why should there be an exception? Life in some form or other is certain of being found on myriads of worlds throughout 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 through interstellar space, notwithstanding the absolute zero which prevails there.

In our planetary system, conditions for life, such as we know it, probably only exist 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 may also grant that it must exist 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 three years ago. We could never have received them, for we then had no means of recording them. Detectors and audions were undreamed of.

In all this warped logic, we presuppose wireless signals. But should a civilization so far ahead of ours—is to them—obsolete radio waves, which, like as not, can never hope to bridge 35 million miles? If the Martians are signaling to us, it 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 over 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 unvented. At that the Martians probably have used many methods on us. It is not even impossible that they may have used reflected 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 improvements such a system might bridge interplanetary space.

As to one planet understanding the other, that is of course child's play. Still, many humorous exponents 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? 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, one for dots, two for dashes. This, 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 they will understand each other.

That is the basis of interplanetary communication.

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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 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 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)
New York to Chicago Via the Air in Twelve Hours

"A IRLINE 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 aerial 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 E. W. 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 Aircräft Association, which held its annual aeronautical exposition at Madison Square Garden and the Sixtieth Regiment Armory from March 1 to 15, inclusive, in cooperation 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 airscrew, 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 aerial 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)
Guiding Airships With the "Radio Barrage"
Invisible Walls of the Ether

By DR. LEE de FOREST

J ust 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 under 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 the 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 Radiophone, 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 keep an eye on Cleveland," or again such warnings as, for example, it will be necessary to inform the pilot of weather changes: "Weather Warning—You 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, 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.
How Electricity Serves World’s Largest Hotels

By H. WINFIELD SECOR

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 long list of wonders? One of these is the Commodore Hotel, which has, among other new features, an electric automobile elevator, which carries the guests’ motor cars up to the grand ball room floor, so that midway in a journey do not have to wait for the chauffeur’s car 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.

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 Pennsylvania and New York Central tracks. The hotel Pennsylvania can accommodate 3,500 registered guests with rooms, not to mention several dozen tenant-floor population, which can easily entertain a large 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 of its kind. 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, I have prepared a special article for this exclusive establishment and enjoyed an afternoon off from the editorial hub-bub, amid the waving palms and the aroma of one dollar Havana perfecos arising from the “loungees” reeling luxuriously on the thousand dollar leather settees, which grace the sumptuous rooms, all of which are lavishly furnished in handsome imported marble and lighted by reflected beams passing thru a newly 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 the 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 attired in spic and span uniform. There is an elevator woman “elevator starter”—and speaking of elevators, the Hotel Pennsylvania boasts of a total of 27. In the following description of the hotel, the writer has, with due apologies, made a thorough inspection, and finds the Hotel Pennsylvania is infested, except where otherwise mentioned.

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 the disposal of the guests immediately accessible and available from the lobby are the main Dining Room, the Palm Room, used for afternoon teas, etc., the men’s cafe, the men’s bar, the grill room, and in the basement the most attractive barter shop imaginable, replete in its splendid marble and leather lounges, and adjacent to these the handsomest array of lady manicurists ever seen in this city of ours. While lounging 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 main lobby. “Red Jackson” band turns loose the jazziest jazz you ever shook a foot to. Considering for the moment that you wish to happen to pop in at the “Pennsylvania” from the water-proof subway, and that you might find at arriving in the royally appointed lobby you are subject to a large sum of 15c due perhaps to the efficient attention of an unknown pickpocket on your ride up to the hotel, you can still enjoy yourself ostensibly by repairing to the basement floor, where there is a “Quick cap, clean cut”, which will accommodate several hundreds 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 plan of the main floor and of course there are many rooms and conveniences not shown for obvious reasons, owing to their location on outer parts of the mezzanine floor. Electric power is used throughout, except in the private offices, and also there are sleeping and living quarters on these floors for the employees. On the first mezzanine floor there are exhibited mezzanine dining 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 throughout the hotel, it may be said, is one of good taste and extreme refinement. The service is carefully worked out to give this feeling at every turn.

There is a large telephonic exchange, and the capacity of 3,340 extensions, 200 trunk lines and 23 operators is connected to the various rooms and other parts of the hotel. The telephone exchange is located on the second mezzanine floor.

In the telephone exchange are also located a number of the hotel’s teletypewriters, the electric machines that write—and both of these recently opened hotels have been very lavish in their teletypewriter equipment.

The Hotel Pennsylvania has over 200 teletypewriters, and more will undoubtedly be added later as demands require them. The teletypewriter equipment at this hotel is controlled by skilled engineers, and it undoubtedly is one of the best that the writer has ever seen put into the field. The reader can rely upon the fact that 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 here, as the call is made to the outside party or a guest calls up the telephone exchange, and the operator writes down the name and address of the party, and if wanted, the following operations ensue: the telephone operator,—(and they are all good looking, take it from your Uncle Dudley) will write down the name of the person, the name of the hotel, the hotel telephone number, and the name of the person that the call is to be made to. If the name is called out by one of the bellboys on 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 prevents some poor old fellow from being visited 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 plate of her teletypewriter, and then is a teletypewriter for communications of the 23 rooms, which simultaneously the written name appears in the main dining room, grill, bar, roof garden and the office, a care of the captain’s office in the main lobby, so that when the name is called out by one of the bellboys on 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 prevents some poor old fellow from being visited 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 plate of her teletypewriter, and then is a teletypewriter for communications of the 23 rooms, which simultaneously the written name appears in the main dining room, grill, bar, roof garden and the office, a care of the captain’s office in the main lobby, so that when the name is called out by one of the bellboys on your vicinity you can rest assured that the same name is being called simultaneously in about ten other parts of the building.

The total amount of electric power, not to mention the steam requirements of the hotel, which averages a large amount of power, is about 1,400 horse-power. Electricity is used in a general way for many purposes and important operations conductive 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 to take care of by 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 dozens of powerful electric motor driven blowers, running at the rate of from 50 to 100 horse-power each, drive gigantic blowers or fans, each of which is connected up with certain air ducts leading to various parts of the hotel, blowing clean air, pumped which promotes the proper circulation thru the hallways, and the rooms of the building. In the rooms of the Commodore hotels has a large power plant of its own.
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. Paul S. Hunter, former State Secretary of Health for Colorado, andailing from the city, stumbled on something he didn't know and doesn't know yet, in looking for something he had guessed? That is a question it may take time and development to answer, but which the writer is content only to raise by way of initiating the discussion.

There is an element of humor because the relation it represents to a serious discovery, worth thousands of dollars to society at large, the discovery will not realize until it is made public. In which it is not unlike many other important scientific discoveries. Surely Dr. Hunter was waiting for a car. He held a flashlight in his hand, and covering the ray, was attracted by the unaided glow of his flesh. He noted the dim shadows of the bones in his fingers. "Hum," he said, "the red rays come thru if the rays were more vivid, the shadow of the bone would be larger."

I can intensify them I'll bet I can photograph that," his idea took hold.

The doctor was a user of the X-ray, but he found it easier in ordinary practice to bring a patient to the table than to take the weighty apparatus with its lead aprons and coils to the patient. What a boon to the country doctor could it be if he could make a fracture diagnosis with an ordinary camera? The X-ray is applicable 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 pan-chromatic 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 whose purpose is to protect 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 the diafragram in the top of his box and fastened a plate-holder on the bottom which designed the plate beneath, into which the plate might fall the instant of its exposure, for speedy developing. He then erected a Watten F or extreme red light filter and placed it above his lensless shutter and diafrum. He placed his hand over the header, and squeezed his bulb for a half second exposure. The result was the excellent bone picture shown herewith.

This picture was made from which a filtered light—the light that passes most easily of all visible light, thru blood. The discoverer has made nothing new, but has fitted his camera, which is not essential to success. He has merely combined a stock Eastman pan-chromatic plate with a collodion with eosin solution to intensify its sensitiveness, with an F filter and a fine point of light to do simply what Röntgen earned his fame for doing in a more round-about and costly way. He has made a discovery which he prophesies every schoolboy will at once begin to borrow, and, and every doctor to use in his business. And he has given his discovery freely to the world. He does not care if anyone makes 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 the different sizes of the limbs. Whether the rays will penetrate the trunk for abdominal and intercostal examinations he does not know, but he is not of the view that the discoverer, altho from theory he contends they might be made to do so by some improved technique, such as a more intense ray of light and a more sensitive plate.

Further Dr. Hunter has to say its plate can be made to secure a box fitted out in this manner and a box of panchromatic plates a picture can be made whether a broken arm is set right before leaving the hospital and that it will undoubtedly be used all over the country.

"The machine can be improved by using a roll of film if the manufacturer can make it, and so do away with glass plates; the development tank at the bottom would be adapted to films. The whole outfit, 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 maximum effect 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 of the world with the hope that someone will further develop its usefulness and by improvements in this machine more sensitive plates be able to make pictures as well with this $2.00 outfit as with a $1,000 X-ray machine."

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

April, 1919

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 just to fit the outer contour of the body, thus giving the maximum X-raying power available in any case. The fleshly 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 blemishes which are incurable.

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 fell, 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 1,730 miles of poles on which it has strung 4,175 miles of wire. In addition about 2,000 miles of American wire has been installed on existing French systems for our use, and it has leased and operates more than 3,000 miles of French wire. Exchange lines to the extent of 12,730 miles have been built, and to operate these lines it has 244 stations, and 102 telephone 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 of Award, composed of representatives of the National Societies of Civil, Mining, Mechanical and Electrical Engineers, held their annual dinner on Friday evening, January 17, and awarded the gold medal to George W. Goethals, the builder of the Panama Canal.
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 F. B. 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 in the Engineers Club, 533 Madison Avenue, last Wednesday evening, March 5, at the Engineers 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 and the policeman putting the fare up on the door and the coloured driver ready to make a bee-line for the dock and just arriving in time to see the gang plank pulled in and make for the Lusitania 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, but in his case he will not race down to the dock but up a 30 or 40 story elevator trying to catch the Trans-Atlantic fly to, but just in time to see the big bird “take the air.”

Will the American business man of 1925 bewail his lost and remain dejected to his home? Not if he can help it! He will signal a passing flying machine 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 airship will have overtaken the big air monster and after depositing the beset passenger on the upper deck of the European bound liner—not to forget the violent language of our businessman who thinks he has been overcharged by the modern bird 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. Germsbuck suggests that the transfer of the passenger might be accomplished much easier, as shown in our illustration. The passenger would fly by a rope ladder, descend from the deck of the big flyer, in the same direction of course, and also at the same speed as that of the line. The passenger could then descend from a rope ladder and drop to the deck with ease, as well as without danger.

YOU CAN WHIT- TLE THIS IRON.

It is well known that rapid cooling of hot metal hardens them. That the opposite is true has recently been demonstrated in striking fashion by the General Electric Co. One of their scientistsanned American ingot iron surrounded by hydro-carbon gas for three hours at a temperature above 1600° 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 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 Kimberley 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 strict, as practically all of them are, before they leave the mine at the end of the day's labor.

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 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 fluoroscope 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 PRO-PULSION.

We are now able to publish a photograph of one of the most jealously guarded secrets of the British Navy. As 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 aloft 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 tunnels like an ordinary surface warship. One photo shows a British K-class submarine with a 12-inch gun, capable of giving battle to 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.
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 fickerless 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 parker stereoscopes which we have all seen and used. Of course, if we ever do get to the stage of stereoscopic movies, 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 interaction 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 Our Way, 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.

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, were found in a recent issue of Commerce Reports.

Paul L. Edwards, Commercial Attache 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 at Deurne, near Apeldoorn, some thirty-five miles from the receiving station. The sending station will consist of six steel towers, each 200 meters (about 668 feet) in height. The Radio-Nieuws says that the Kootwijk sending station will have the same range as the receiving 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 barocyclometer, which locates the center of typhoons and other storms, and also predicts their course, and from what direction, has been invented by Father Jose Alguie, director of the Manila Weather Bureau, and, according to Capt. A. W. Nelson, of the Pacific mail steamer Ecuador, is being used in safeguarding from storms numerous vessels plying in Chinese and Japanese waters.

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 Merchants, 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 Ever 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 eqipt 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 undistrubed 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 railroadling me from one class to another.

In the second year at that institution I became obsessed 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 impressed me with the boundless possibilities of a vacuum. I pressed 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 although still under the discouraging 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 aerial 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...
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 spent with him. 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 cordially to him: "Be careful, Niko, this 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 force 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.

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 sardonic request as he had been always sternly 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 Gospin 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 insidious 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 by my father 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 spher-ical 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 dismissed. 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 discard this invention public property.

Another 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)

**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 — 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 brush gear, if any, is used. On this account of all others the induction motor is used in a prepondering proportion in street cars, electric trains, factories, etc.
ELECTRICAL EXPERIMENTER
April, 1919

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 express regarding the moon's "axial rotation." These have been partly answered by my statement to the New York World on 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:

The unifying test of the spinning of a mass is, however, the existence of energy of motion. The moon is not possess of such a test. By this I mean that "axial rotation" is not simply "rotation upon an axis noncontractly 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 the velocity is a definite and positive quantity. The moon is a nearly spherical body; of a radius of about 1,087.3 miles, from which I calculate its volume to be approximately 2,899,701,000,000 cubic miles. Since its mean density is 2.77, one cubic foot of material composing it weighs close on 205 lbs. Accordingly, the total weight of the satellite is about 79,689,000,000,000,000,000 and its mass 2,899,701,000,000,000,000 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 2,360,240 seconds. If, in conformity with mathematical principles, we imagine the entire mass concentrated in a disk, 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,-471,000,000,000 tons of energy sufficient to run 1,000,000 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 planes in which the moon might turn and still exhibit the same peculiarities.

I have shown in the article that the moon rotates about an axis passing through 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 2,069 miles from the earth's center.

W E 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.

If You Still Think That the Moon Rotates on its Axis, Look at this Diagram and You'll Do It Again. 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 Shows the Moon's 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 the involving the same mechanical principle. If a metal ball, attached to a string, is whirled around the latter breaks, an axial rotation of the missile results which is definitely related in magnitude to the instant.

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 force were suddenly switched, the moon would go off in a tangent without the slightest retarding or rotating string. It would, 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 a string to be wound 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 a 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, moving successively, on the sides turned towards, and away from, the luminaries.

One of the writers imagines the earth in the center of a circular orbital plate, having fixedly attached to its periphery a disk-shaped moon, in frictional or geared engagement with another disk of the same diameter and freely rotatable on a pivot. This is 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 an exact representation 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. It might be represented by a piece of a cart-wheel to which this writer refers. But no long visits 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, it still revolves about the earth's center, but axial rotation has ceased. The writer thinks that it still exists are laboring under an illusion.

An obvious fallacy is involved in the following absurd reasoning: The orbital plate is assumed to gradually shrink, so that finally the earth would coincided with the outer edge of the plate. But as the moon revolves simultaneously about its own and the earth's axis, we may reduce the earth to a 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 manifest. (Cont. on p. 892)
PHYSICS AND THE WORLD WAR.

A fitting conclusion to this series of articles, let us consider to what extent Physics helped to beat the Huns. The bulk of the work done by all branches of science has as yet not been disclosed to the general public; but the following material disclosed by Prof. Amos of Johns Hopkins University, in his address at the University of Virginia, by Dr. Hale in addressing the New York Engineering Society, 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 before 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 share of the glory accruing from the victory of the Allies.

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 professors" were 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 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 the water would drug up any submerged invisible submarine. Another proposed generating a wind so strong that it would push away any approaching airplane, balloon, etc. Thus airplane raids were eliminated, submarine attacks were ended, and the war was over. These fool inventions were based on the fact that the War Board in self-defense determined not to consider any inventions sent in by these wonder-workers unless a "working model" accompanied the paper. It was evident that the road to a successful termination of the war lay in bringing together men possessing scientific knowledge; and equipping and armament with scientific methods. In ordinary peace time 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 fruits of their toil, we have 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, Meudenhall, Gale, Wood, 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.

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 Aerial Railways," "My Inventions"—No. 4, by Dr. Nikola Tesla; "Electricity and Dynamite—How they help the farmer irrigate land, divert rivers, build hard soil, and clear land of stumps and stones.

Recording Our Thoughts Electrically—By H. Gernonback, "New York to New Jersey Via Wagon and Auto Tunnel—A Gigantic Engineering Problem," The Latest Electric News from France, by Jacques Bouyer; Paris Correspondent of the "E. E. Spring Pansy in Electric Fans—Several dozen new wrinkles with these useful devices that will interest the whole family."

"X-Ray our Teeth—How disease and mental ailments have been actually traced to ordinary infections 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 Electrical Call of the Wild."

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

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

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. All the instruments of navigation and of signaling are perhaps very important as the airplane itself. Instruments for determining speed, direction and height, for insuring position, 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 improvements and modifications made in the 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.

The improvements have made it possible.

April, 1919

ELECTRICAL EXPERIMENTER

Experimental Physics

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

LESSON TWENTY (Conclusion)

IN THE "MAY" EXPERIMENTER

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The improvements have made it possible.

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

Tanks by the Thousand Thrust the Tides of Battle for the Allies.

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.

Portable Long Range Guns Routed the Enemy and Leveled His Cities as Well as Fortifications.
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 the 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 of good and evil that find expression in 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, 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 F, 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 gibbous 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, and E', 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, 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 toward inferior conjunction with the sun at E', 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 it is in its 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 brilliance of the earth in Martian skies at this time usually surpasses that of all other planets, Mercury and Venus, the 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, less brilliant, because of 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.

If their telescopic observation 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-laden 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, the 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 gray-green splatters, our reddish-tinted deserts, our mountains and our great level plains just as we puzzle over the earth's 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 seasonal 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 in-distinguish 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.

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 beauty of the earth's 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 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. If Venus were an object in the sky, the entire 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 five times its diameter. 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 as seen from Venus. The markings on the earth, however, might not easily be seen because of the position of Venus 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 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 toward us, its position of observation on the moon remains immovable in the heavens, and it is in 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 eye.

(Continued on page 91)

Fig. 4. The Earth As Seen from Mars. At the Time of Its Greatest Brightness, 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 Disk. Only in Crescent Form, When Entirely Illuminated By the Sun, It Is Lost In Its Rays and Is Therefore Invisible to the Martians.

Fig. 5. The Planet Earth and Its Satellite the Moon As It Appears at Dayspring When in Opposition to the Sun, Viewed from the Planet Venus.

Fig. 6. The Earth and the Moon As Seen from Planet Venus Through 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.

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. Gilver of the Signal Corps, and Col. Rees, of the British Army Air Service. The possibility of providing airplanes with wireless telephone service was discussed, 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 been working so far 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 success. 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 headphones 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 car 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 while molten), rubberized on the inside, 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 200 horsepower gasoline engine. A brilliant line of experimentation finally resulted in a form of a telephone transmitter of microphone, which possess the remarkable quality of being insensitive to engine and
Electrical Deliver their Produce 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 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 then 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 sight 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.

The microphone and receivers used for radiophonez 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 military leader 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 100-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 operators 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 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 aerial 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.

(Continued on page 926)
The article on "Radio Around the World" is very interesting. From my own extended experience and based also on the calculations and results obtained by most of the editors and other workers in this field, I think there can be no doubt 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 phenomena associated with an horizontal antenna lying close to the surface of the earth, that is excepting but 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 comparative 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 one the terminals of a line connecting with the terminals of an A. C. generator, and sending the same wave along the axis of the earth, a radio telephone might be possible. Unfortunately, or fortunately, we cannot locate such volcanoes in the earth, and we would have to use submarine tubes.

If, as you suggest, a powerful wireless station could be operated at a sufficient distance from the ocean or sea bottom, and the earth's surface completely isolated therefrom, remarkable distances of transmission in ether might be achieved. However, the chance of a wireless wave at the moon from a tremendously powerful station would be required to transmit signals over such distance. You doubtless are aware of the remarkable distances obtainable from airplanes to the earth, by comparatively small transmitters. Just recently an airplane carried on radio communication successfully over a distance of 250 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 doubly complex. Here the ground wave is, generally, 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 a ground wave, just as it originated from an earthed antenna. See Fig. 3. There is great need for understanding the phenomena of transmission from airplanes and whoever will collect and publish such data will be rendering 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 will have a ground or ground-foot or base-penetrating short distance into the earth. I might mention a very interesting phenomenon which we have encountered in installing wireless stations in mountainous districts in the western part of the United States. Figs. 2, 4, and 5 illustrate this phenomenon. Fig. 4 shows a case which often happened in the earlier 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 combination of such a ground wave and earth waves became so stretched out or attenuated in their effect, that the waves from across this valley, that the station was only able to intercept a very weak signal, or no signals at all. Therefore it was found advisable in in- 

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

(Cont. on page 919)
Aerial 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.

Here Are the Questions the Editors Submitted

Q. 1. Do you believe that wireless transmission is effected by complex ether waves having a grounded top, these waves gliding over the surface of the earth from the antenna, and if so:
   (a) Do you think that the ground is the predominating one in energy component and amplitude?
   (b) Do you believe that the ground wave component is the predominating one in energy component, and is it propagated over long distances without the aid of the electric field (like the horizontal waves)?

Q. 2. Do you believe that underground wireless transmission is effected by means of ground waves traveling thru the earth along the line of the base of the antenna, and that the etheric space wave radiation from the antenna is merely a parasitic phenomenon, which is propagated by the earth itself at a comparatively short distance of a few hundred miles or so?

Q. 3. Can you explain the general direction of thought on the matter, that is the etheric space wave radiation from the antenna that accounts for airborne radio transmission, either plane to plane, plane to earth, or earth to plane communications?

Q. 4. How do you account for the facts obtained with the Rogers under-ground and underground radio transmission and reception? Do you believe that this is accomplished by the grounded components or "Heaviside" of the gliding etheric waves in conformity with the usual theory accepted therefore 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 underground systems, radio transmission would produce higher efficiency in the transmission of 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. Do you believe that it has been hardened to by 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 that the phenomenon is inclined to be accounted for by the results obtained with the underground system. Do you believe a ground wave to be a fact, or merely an accident?

How Do 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. (Editors' Note: This is also the case where horizontal waves play a part.)

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 be a method of receiving messages. These currents, however, represent only a small per cent of the energy of the transmitting wave. It is quite generally agreed that the wave above the surface cannot exist without the current in the surface and vice versa.


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 of the radio signal.

Q. 6. The ground losses are higher with longer wave-lengths for poorly conducting earth, in the vicinity of the antenna, which indicates that the transmission of wave-lengths in this neighborhood of the earth is affected by the currents. This greater penetration would also hold for the gliding wave. (Editors' Note: Rogers' system probably does not depend on the ground wave.)

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, 35 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 10 words per minute instead of the usual 5.

Papers covering these examinations will be in order as soon as the examination as possible but no license will be issued until five days after the station is granted operation for this purpose.

PLEASE NOTE: By taking this examination authority is not granted to operate your station. It will be necessary for the applicant to apply to the proper authorities for a license to operate your station and form all the necessary forms. The applicant must have a license to operate the station and the form 762 must be filled in and filed with the proper authorities.

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 Rotary Decreimeter.

The present time seems an opportune one for the radio student and the radio amateur to prepare for the forthcoming opening of experimental activities, 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 decreimeter. The accompanying text and illustrations on how to build a home-made wave meter which will give very satisfactory service. The dimensions given for the ordinary size of the instrument 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 circuitry which will have 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 wave meter. 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 enamelled 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 of the Laboratory. The inductances do not use any iron in building these inductances.

The next item claiming our attention is the variable condenser, and we might say a great deal concerning this part of the apparatus. We have already seen that the first place many radio experimenters would rather obtain the next wave meter that has a variable condenser of the rotary type variable condenser having the proper capacity for use in this particular wave meter, and would like to have one which will give a reading of .0006 microfarad. Of course any condenser having this capacity within a small fraction one way or the other may be used, but if the student wants 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 fixed 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 the edges flanged upon 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
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 distance of the rotary plate, as Fig. 2 indicates, should be 8-23/32 inches, and by cutting the legs 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 fix plates as to give the proper capacity.

Thus we see that the two principal parts of any wave meter are—an accurately calibrated precision variable condenser and an accurately calibrated inductance. In practically all cases the condensarcy 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, as 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 milliammeter 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's so 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 to radio transmitting sets, there is very often a sufficient 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 as 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 practical experience, is an ordinary 3-inch Geissler tube, or better yet, a small helium gas tube. It is best when 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 blacked 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 practice to connect a hot wire milliammeter 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 carbonium 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 321)
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 aerial mast is interesting as it shows a very novel construction whereby a standard fed tower structure is made of steel tubes or pipes, provided with flattened ends thru which bolts are past. The base of this 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 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 aerial conductors.

The remaining two photographs show respectively the 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 accomplished 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 also shown at the top of the instrument, while an elaborate multiplicity of control handles with graduated inductance pointers, 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 cabinets 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.

More Bunque.

By J. A. Weaver.

I often wonder how Noah made the ark 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 ever 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 books 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 withshore 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 Domiseove 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

Here's a lot in being forehanded. Mother was that way. Every Saturday night she would fish for dinner, so she wouldn't be bothered with getting up anything to serve on baking-day. That sounds like a paradox, but it wasn't. It was a shame, for the "baking" was very appetizing and savoury, while the fish was—well, not so savoury.

Now, if you had to eat 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 fuss up with cooking formulas, and would need an accompanying 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 commandeered the abode the fish abode with the grocer, it was always picking up scents like coffee and spices and matches and cigarettes, from the clerk's habit of wiping his hands on it in passing, and the butcher would have to have a horse-blanket on it often enough to give it a quaint shiny tinge. But what you'd call the basic "Tabby"—the store cat. The pile of codfish was the place where the cat slept, or a sack, or a bush, according to whether she could lick the dog or not. The result was you couldn't say the cat smelled fishy, or the fish caty, but they smelt about alike! It was a blend, like this fancy-named sailor's dough, or the biscuit a man had to have pronounced for you, can't be something or other.

If you just wanted the fish for a snacking 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 uncommon water, yellowing to heaves and casting into the air branches of assorted perfumes, like Spring-time tripping o'er the tea 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-dongosongs till the last minute, and 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 right, 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 "Peace Celebration" on Thursday, and the "Real One" on Monday, and the "Regular One" on Tuesday. I don't know how much it was, 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 be to throw some 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 rear of the Gastric Cavity thru handling the few easy objects I'd sent down to it, I envied the old copper just as it is at home—how it used to digest 3 or 4 bushels of the family wash, or boil a barrel of soft soap, or a tub or two of whitewash-stunts really exactly, you know—and get away with it year after year—Ah, me. I say, 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 ruining 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 hundred-thousand. 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 increasing 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? Not. 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 relatively short circuits—under 60 feet—will be 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 number of these cells which will give the amperage required for the service or else use more than one battery, connecting the batteries in series—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 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

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 electric 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 current. This device is often more economical and convenient if 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 Generating the Wireless Telegraph Equipment in Emergency. The Control and Charging Switch-Board Appears At the Left of the Battery. All Radio Operators Should Thoroughly Understand Storage Batteries, Both the Lead and Alkaline Types. The Smaller Cell Shows the Non-Explosive Gas Vent Fitted On the Alkaline Cell. This Cell Has A Mean Potential of 1.2 Volts.

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

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 the writer gives below a brief resume of the subject of twist drills and their grinding. Because it is very essential to follow understandably 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, c'c' is the solid part of the drill; the top of the drill nearest to us is the edge c', which unites the two edges cc, making an angle of about 55 degrees with each of them. The cylindrical surface of the drill at d, only exists for the point a, 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 is gradually lapped 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' is found, is fixt by the demand of strength in the drill. The edge c', which cuts very badly, should be 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.

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' 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 in 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 cold steel the angle α is made upon an average of about 55 degrees; with very good steel the angle can be some degrees smaller; with 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 therefore after 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 i 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.

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 α, appointed by the tangent to the spiral and by the tangent to the line of section 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 amount 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'. The diameter of the drill being D = 1 in., and the feed 1-100th in.; the inclination of the spiral line is found by:

$$\tan \beta = \frac{1}{0.00637}$$

$$\beta = 0^\circ 22'$$

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'c' with the same pitch h, Fig. 5, as a'a'; the angle of inclination γ however, is quite a different one; for the case of 1-20th in. it is:

$$\tan \gamma = \frac{50 \times \pi \times 1/10}{1}$$

$$\gamma = 3^\circ 39'$$

In Fig 5 the value of 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'a' and c'c', 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, etc., in the next installment. (To be continued)
Practical Chemical Experiments
Butter and Butter Substitutes
By ALBERT W. WILSON

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 thoroughly 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 being principally water, with some proteids and lactose from buttermilk still remaining in it, and more or less salt or salt peter, 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 stripped from the flesh, 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 wrapped up in cloths and pressed to remove the thin yellow liquid oil (deo-oil) from the solid fat (deo-stearin). To turn this liquid oil (deo-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 "Procter" butter is in general prepared as follows: Old, rancid, and unsaltable 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 of 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 thinly 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 about 60 cc. of sweet milk in a wide-mouthed bottle, which is set in a vessel of boiling water. When the milk is thoroughly 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.

(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 Editorial department, a cash prize of $5.00 will be awarded. For the best idea submitted a prize of $2.00 is awarded; for the second best idea a $2.00 prize, and for the third best prize of $1.00. The articles 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.

The plates are two twelve-inch phonograph records of the disk type. Select two which have the side blank. The tin or copper gutters are cemented to the smooth side. It is not necessary to varnish the plates. The bosses that keep the plates parallel on the sides 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 3/4 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 1/2 inch 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 hole 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 3/4 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 when the other 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 shifted 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.

SECOND PRIZE $2.00

BLINKING LIGHTS TELL YOUR FORTUNE.

A glance at the illustration will show that while the magnetic 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 pressed, 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 of itself is 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 pressed, the motor stops and one of the lamps is made, the particular lamp depending upon the position of the drum when the motor stops. 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 paper.

Contribute by

WILLIAM F. HAASE, JR.

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.

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. Each side of the lamp is right for a single dry cell. A reflector adds greatly to the efficiency of the light.

Contributed by RAYMOND WAGNER.

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 discharge arms are of brass rod of a size that will fit in the collector supporting tubes. Make a small dent in each tube to 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 3/4 inch away from the 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 3/4 to 3/4 inch.

This diagram illustrates the mechanism of the lamp. A phonograph disc is used to make a fortune teller.
A Simply Constructed Gas Generator

By IVAN CRAWFORD

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 in 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 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. A third, or 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.

The apparatus should now be assembled as is illustrated in the drawing and photograph. The solid material, such as iron sulphid, when H.S 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 sulphid, expends a flow of H.S 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 sulphid, again causing the formation of H.S. 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 bis- muth, 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 in the bladder 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 nitrate 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 Petrifications (turning into stone).—In a retort place a small quantity of powdered flour-spar and sand, and pour upon it some sulfuric acid; fluoridic acid gas will be disengaged, holding slices 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 slices 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 limestome or roll sulfur and touch the piece of steel with it. Immediately after their contact the steel will melt and drip like melted butter.

8. Explosion Without Heat.—Take a crystal or two of nitrat of cooper 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

(1,299,080; 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 apparatus 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 the objectionable feature. The case contains a transformer, also a number of switches, by which the desired circuit 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, one of which elements grips the other. The vibrating element is connected to the frame of the diaphragm, 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 diaphragm according to the amplitude of said vibrations.

Apparatus for Locating Sunken Bodies

(1,287,007; 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 detecting device, such as a telephone receiver, and acts upon the principle of the circuit contact with some metallic body for its location. The circuit is formed thus a pair of sensitive head receivers, the base electrode, the water and the electrode, and normally of high resistance.

Recording Telephone

(1,293,621; issued to John E. Malther)
A new form of recording telephone, more or less on the style of the dictating telephone. A device for recording the 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 diaphragm constructed of the same width from end to end; approximately at the center is mounted a square solid iron disk held in place by clips, which on its underside has a holder for supporting the said point of the phonograph.

Advertising Lamp and Radiometer

Hunt

The device consists of a motor operated on the principle of the radiometer, in which the moving radiometer 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 consists of a series of vanes, preferably four or more, similarly silvered upon one side and blackened upon the other side with carbon or lamp black.

Method of Telephonic Transmission Without Return-Wire

(1,257,180; issued to A. Bardeloni) A new method of telephonic transmission without a return wire. It is sometimes necessary to use a single wire for telephonic transmission without equipment. A condition like this might exist in connection with an observation balloon or ship where the straining 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.

Radium-Applicator

(1,288,048; issued to George Knolle) A radium applicator adapted for the use of radium and other radioactive salts. The radium is properly calibrated in advance and so arranged that the prongs, using it 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 irradicates surfaces of widely variable areas, as, for instance, areas of from one millimeter to thirty-two centimeters in diameter.

Secondary Or Storage Battery

(1,356,690; issued to Bruce Ford) A new type and form of storage batteries, 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 in order to fit and be pressed into soft rubber tubing, which will make it not susceptible to leakage. The spaces between plates are filled with an electrolyte, which may be any plain liquid, or else held soaked in blotting paper or some other gelatinous formation.

Thermostat

(1,257,188; issued to Charles J. Eck) 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 fixed, alto adjustable, and the two thermostat elements generally control the single movable contact, in response to a variation in temperature. But on 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, the heat causes the thermostatic element to contract, and, thus, it has to increase upward, move a contact on the circuit which presses the face contact, thereby closing the circuit.
"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, etc. 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, cracking 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 3½ K. W. step-up transformer, condensers, spark gap, desk, summer, 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 ohms Brandes' phones, leading coil, variable and flat 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 "Hawtin's Electrical Guide," "Hawtin'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 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 books, 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 nature of some electrical experiment. This laboratory is the result of but one year and a half of earnest work and study.—J. H. England, 507 George, Greenwood, Miss.
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 practical to me, but I expect 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 of his wireless, "I 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 micro-meter spark gap or resonator. This apparatus worked on the principle that electro-magnetic waves radiate from a point of discharge. The twinkle 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 Heinrich, never having caught up with the second syllable of his first name, died a poor man. Nick Tesla hadn't been mapping either. The whole wireless dope to this bird was an unsealed book as early as 1093, when Marconi still shot down the barista in his knickers. Thus we see Nikola tweeking it nonchalantly at the Patent Office, where he grasps the first REAL wireless invention 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 boast. So the new invention snuffed at Nick's Patents, tap their foreheads significantly and made known that this wireless stuff was all loco, bungie, and then some. The same ginks today however sing a different tune and admit that in 1900 THEY were fast asleep and dealer 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 ships a 'can-you-get-it' across the Atlantic—and they got it. Soon all the first class vessels were equipped 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 doesn't have to eat macaroni for a pencil."

"The world wallows along, and the patent offices pile up the documents in the wireless department of an ardent bird, Dr. Lee de Forest. Walts on the stage of industry to the tune of 'N EVERY-THING' 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 Andoid 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 'Frisko 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 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; e, 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 Guido 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 hangs 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—of infatuation."

"The detector rectifies the oscillating current, making it fit to vibrate the diaphragm on the receiver until the 'Radio-bug' has chued to his ear."

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

"That word is Kick and not Hick. Kick is aSan Francisco slang word—it means almost anything, originating from a kick in the butt and now applying to almost anything, good, bad, and indifferent."

(Continued on page 911)
ELECTRICAL

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 published. Rules under which questions will be answered:

1. Only three questions can be submitted to be answered.
2. Only one side of sheet to be written on; matter must be typewritten or else written in ink, no penciled matter considered.
3. Correct diagrams to be submitted on separate sheets. Questions addressed to this department cannot be answered by mail free of charges. Rules under which questions will be answered:
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. & 600 K. W. rep. drive, 8 poles, compound wound, 220 volts. Even aircap 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 per

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

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 every-thing seemed 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 odd photo touched. 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 expose and preserve 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 "proofs," 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 who has the opportunity to become a reporter of the latest things in the realm of Electro-Hydro-Word and Science, but please remember—it's the "odd, novel or practical stunts" that we are interested in. Your 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, 235 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 d-c induced current occurs in the field windings, tending to prolong the magnetization, and cause not only the field 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. The fact 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 where there is any weakness in the design of the equalizing circuit between the two or more machines which may cause unequal currents to pass between the two machines. As you will readily conceive, such a current which might be caused by a mere balancing 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 brushes and commutation of one of the machines, and such a current would tend to have the effect of producing the burnt commutator bars.

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 to flow 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 and in every walk of life, 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 rooms 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 returning to their old jobs and thinking business pushing harder than ever for markets. We hear of great building operations to be undertaken, of the vast areas of Europe devastated beyond description, to be rebuilt and very largely I believe with American materials 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 making of a structure of structural work of every kind, machinery, ships, railroad buildings, etc., the vast field for men in this profession must be clearly understood.

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 and money. It was also often necessary, if a man wanted to graduate, to take 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 need no longer remain, however, for the amateur to secure instruction to give every man a chance to become an expert in any branch of draftsmanship with a little study and as quickly as his industry will let him pass from one lesson to another.

The Chicago Technical College by its method of teaching and its practical instruction in the drafting rooms of factories, architects' offices, and in many other places 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 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 the opportunities are. The calls we have to furnish good draftsmen to every industry in the country and only realize what a future there is in Draftsmanship, many a man now wondering what his future is to be would come to a quick decision.

The Chicago Technical College is proud to be the leader 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. He is 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.

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ELECTRICAL EXPERIMENTER

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 armatures are wound with either the single-parallel ring winding, the single-parallel drum winding, or the single-series drum winding. The single-parallel type 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 be reduced 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 pair 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 mechanical strains, with more or less violent sparking or flashing at the brushes, and the machine is said to be "bucking." The account of the effects of armature reactions, bucking is somewhat more liable to occur in motors than in generators. The bad effects due to unbalance can be largely prevented by providing the armature with equalizer rings as shown. By means of equally spaced leads these rings connect equal potential in the winding and allow an equalization of current between the various paths in the armature.

Sometimes errant line disturbances, motor flare-backs, defective motor control apparatus, will cause the effect you describe. The first step you should take is to 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 Tunst, 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 current or direct. For one thing, this factor would determine whether your experiment would be a success or a failure. If you are trying to operate the arc on alternating current, then you will find invariably that it will not operate well unless using a simpler resistance coil or rheostat in series with it.

For alternating current operation the proper ballast is always composed of an adjustable inductance 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 1200 C. P. arc, such as used in ordinary store lighting, etc., is employed and taking about 5 amperes on a 110-volt circuit, the inductance coil may be as large as 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 sixth layers.

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

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 built.
A. 1. We have looked over your drawings and description of what you term a direct-current commutator-less dynamo, 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 conductors, the whole principle of this type of dynamo has been known for the last forty years or more.

In considering what has been shown thus far as is simply the well-known "homopolar" dynamo, also called the "unipolar" dynamo. Faraday's first disk type dynamo belonged to this class. All modern d.c. dynamos have the disadvantage of producing a very low electromotive force or voltage and are not used practical, although 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, published in 1898.

Also you would do well to refer to Professor Thompson's complete treatise, "Dynamo Electric Machinery," where extensive work covering the complete design and calculation of the electrical as well as the mechanical circuits is given. "Unipolar" 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, distinct entirely from any of the usual commutating types, in which a coil or other movable conductor slides around one pole of the magnet to emit 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 generate 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 2,000 tons of coal.
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Our courses are simple, practical and easily understood. Everything is made clear. You do not become involved in difficult technical matter of no practical value, and which is so discouraging to the student, but you go straight into the principles of the subject and the application of these principles. Every one of our students gets personal instruction, so that his progress is steady and sure. You can tell with this course if you will simply follow our very clear directions. One of our students says: "Your course is strong for the Engineer. It gives him the vital working knowledge of the subject which makes him a competent Electrical Engineer in a very short time and at a very moderate cost." Many Electricians earn $2,500 to $7,500 a Year

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A FEW-POCKET DICTIONARY
OF TECHNICAL TERMS USED IN

A very useful compendium of the principal wireless terms which are used and presented to all radio operators and students of the art. The various technical terms are arranged alphabetically, and the subject matter is divided into the most of the important terms used in radio engineering and communication. Some of the definitions are rather terse, and it seems that they could have been explained without the use of the phraseology of the book very much. For instance, we find the term "silent"-continuous, and the term succinctly says "consists of a metallic tube made to slide over a metallic lining." This definition does not mean very much when radio operators are using not a trade definition, while as a matter of fact most of the standard textbooks on radio telegraphy describe this condenser as one having a definite electrostatic capacity of one bell-farad. This little work forms a handy, hard-bound 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 D. Hodgman, B.S., and Melville F. Coolbaugh, M.A. Flexible leather covers, 478 pages, size 7 x 4¼ inches, price $2.00. Published by The Macmillan Company, Cleveland, Ohio.

This work is something out of the ordinary and places the student and chemist in general a most excellent collection of tables and formulas which would require many hours of search thru books on chemistry and physics in order to obtain these quantities. There is a large number of tables giving the complete equations for various organic compounds; physical properties of the elements; physical data of organic compounds; qualitative analysis of various substances; flame test chart of some 95 elements; table of constants of electromagnetic waves; solutions of salts and other reagents; solubility charts, including tables giving the solubility of organic salts in water; a large number of tables giving gravimetric factors; tables of logarithms; tables of nitric and sulfuric acids, as well as numerous tables and factors, 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 solutions, the dissociation constant, decomposition, and composition of volatile compounds; specific gravity and boiling and melting points of various solutions, and so on.

This is a practical hand-book which every student of chemistry and physics should not be without. It contains a glossary of technical terms with many chemical equations worked out and computed, 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 clearing gelatine, making of pole test paper, making cross-hairs for telescopes, etc.; various formulas for making up samples for making up solutions for both plates and printing papers, etc. A very complete bibliography is appended at the close of the book, giving a valuable reference list of several hundreds works on chemistry and physics. The volume is well indexed.


This work proved of great value during the war and is one of the most important works on the subject of military and naval organizations thruout the world, giving each country only the different insignia of rank in the various organizations of the army and navy of the world, but the customs of the service as well, such as buttons, flags, colors, drums, etc. This book has been endorsed by the Secretary of the Navy. The treatment starts with the organization of the military and naval corps, the composition of the army and its various depart-
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No matter how much you are earning now, I can show you how to increase it. I have taken all the cases from which I have made $1000—$2000, and in one case as high as $2,000 a month. I am willing to prove this entirely at my risk and expense.

I've had 90% of all the men who make rich in the electrical business has made money 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 houndoo everything I did. I've known the bitter 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 pov- erty to riches. I did it without knowing it. 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 broke. Worse than that, for I was several thousand dollars in the hole. I had 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, or any of the good things of life.

Some of the things this "secret" has done for people are astounding. I would hardly believe them if I didn't see them with my own eyes. Adding ten, twenty, thirty or forty dollars a week to a man's income is a "secret" that's playing at it in one case I took a rank failure and in a few weeks had him earning as high as $2,000 a week.

Listen to this: A young man in the East had an article for which there was a worldwide demand. For two years he "puttered around" with it, barely eking out a living. Today this young man is worth $200,000. He is building a large and giving away cash for it. He has three automobiles. His children go to private schools. He goes hunting, fishing, travelling wherever 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 picked by all who knew him. From the time he was 14 he had worked and sweated—and at sixty he was looked upon as a failure. Without work—in debt to his charitable friends, with an in- volved son to support, the outlook was pitch 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 $30,000. During 1917 the profits close to $40,000. And this genius 64-year- old 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.

I do claim I can make you rich over night. Maybe I can—maybe I can't. Sometimes I do make failures—everyone has. But I do claim that I can help 99 out of every 100 people in the world be making profits—every man, woman and child. I have to do with the point of all my friends, is that you are up against almost insuperable obstacles to the development of your brain of yours. That's why you haven't won greater success until now.

Throw the ordinary nine-tenths of your brain into action and you'll be amazed at the almost miraculous results.

The Will is the motive power of the brain. Without a highly trained, indefatigable 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 "do them over." Yet the will, although heretofore entirely neglected, can be trained into wonderful power like the human brain to action and you'll be amazed at the almost miraculous results.

Your Will is your Power to Win.

The Will is the motive power of the brain. Without a highly trained, indefatigable 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 "do them over." Yet the will, although heretofore entirely neglected, can be trained into wonderful power like the human brain to action and you'll be amazed at the almost miraculous results.

But if you hold 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 Will—we because we continually bow to circumstances—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.

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The Moon's Rotation

(Continued from page 866)

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

In all the communications I have received, the different in the manner of presentation of the successive changes of position in space are mistaken for axial rotation. So, for instance, a positive refutation of my argument is found in the common notion that the moon exposes all sides to other planets! It revolves, to be sure, but none of the evidences is a proof of its axis. Even the well-known experiment with the Foucault pendulum, altho exhibiting similar phenomena, our globe would merely demonstrate a motion of the satellite about some axis. The view I have advanced is NOT BASED ON A THEOR. 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 established mechanical principles will make this clear. Consider first the case of two equal weights, w and w, as shown in Fig. 1, whirled about the center O on a string s as shown. Assuming the latter to be at a height 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. It is obvious that the speeds must be the same, since the velocity of the outer and the inner one will be, respectively, $v = \sqrt{\frac{w}{r}}$ and $v' = \sqrt{\frac{w}{r'}}$, and the difference of the speeds will be $v - v' = \sqrt{\frac{w}{r} - \frac{w}{r'}} = \sqrt{\frac{w(r' - r)}{rr'}}$ will be the length of the circular path of the outer weight. Inasmuch, however, as there will be equalization of the speeds at the mean value, $v = \frac{v + v'}{2} = \sqrt{\frac{w}{r} \frac{1}{2}} =$

$2\pi r = 2\pi \sqrt{\frac{w}{r}}$, 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, must also be in a similar manner for the two half-spherical masses can be concentrated at their centers of gravity and rotate respectively, which will be at a distance from O equal to $\frac{1}{2} r'$. 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. times per second, or 9000AD 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 about an axis, it must also hold good for each of the balls as it performed 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 $E = \frac{1}{2} M R^2$. Since for one complete turn of the wheel every ball makes one revolution, according to the prevailing theory, the energy of axial rotation of each ball will be $e = \frac{1}{2} M R'^2$. For, since one complete turn of the wheel every ball makes one revolution, according to the prevailing theory, the energy of axial rotation of each ball will be $e = \frac{1}{2} M R'^2$. We can use as large balls as we like, and so make e a considerable percentage of E and yet, it is unlikely, at first sight, that each of the rotating balls contains 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 taken. If J. J. Abrams 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 the mass the observed velocity.

From the foregoing it will be seen that every turn of the wheel is accompanied by a rotation of 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 certainty that the moon is deprived of momentum about its axis. If it be bisected by a plane tangential to the orbit, the masses of the two halves are in equilibrium as the distance 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.

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 cubic foot, would be worth $280 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 a fair match for 3,500 cubic feet of gas five hundred persons. This, with two ounces of lime, make the stiff bones and brains. Notwithstanding how sore a man looks, he contains about 60 lumps of sugar of the ordinary cubical dimensions, and to make the seasoning complete, there are 20 spoonsful of salt. If a man were distilled into water, he would make about 35 quarts, or more than half his entire weight. He also contains about 10 pounds of potatoes, 6 of magnesium, 9 of salt, 60 of sugar, 6 of 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 spherical portion of his body. 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 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 F. 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.

You benefit by mentioning the "Electrical Experimenter" when writing to advertisers.
HOW BOY SCOUTS CAN GAIN "WIRELESS MERIT" BADGE.

The committee on badges, awards, and scout requirements of the national headquarters has just established a "wireless merit" badge which no doubt will become quite popular as soon as the public is made aware of the opportunity for scouts to perfect themselves in the details. The requirements are as follows: be able to receive and correctly spell less than 10 words a minute. Know the correct form for sending a message. Be able to use your own words in the principal laws regarding radio communication. Know at least 10 of the radiogram abbreviations. Be able to use the Morse code. Know all types of detectors and explain how they work. Name five minerals used in detectors in the order of their suitability. 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 instruments: tuning coil or loose coupling, condensers, fixed or variable, detectors, transmitter, 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.

In wartime the boy can 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. WAR-SHIPS.

American capital fighting ships of the future will be superior to those of other nations because of their electrically driven machinery, Secretary Daniels told the Naval Commerce club. The closing remarkable results attained by the new dreadnought New Mexico, equipped 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 give her a horsepower 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 explained. "The ship maintained for four hours a speed of twenty-one and one-quarter knots, and this when running with a displacement of 10,000 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 COLOR.

Experiment No. 3. See Fig. 3.

To test for coal tar colors in water, a small sample is mixed on a porcelain plate with Fuller’s earth and water. If 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 water in a test-tube, and a little oleomargarine 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 1 part). Notice that “oleo” 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 use 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 an important role in the work which has just been completed, 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 ten to twenty cents worth of radium on it.

An excellent substitute for radium for certain purposes is Meso-thorium. This is a radioactive element found in Monazite and other minerals. When first extracted it is not satisfactory for luminous paint, and consequently must be “aged” for several months, or even a year before it can be used. During this time the beta and gamma radiations of Meso-thorium grow rapidly, and it can be used for most of the 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 very 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 much more economic than the amount of radium used in the field of medicine for pharmaceutical 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. 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.) as low as 0.1 (0.1 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 while the inventors to study. One is the Chinese method of making the bright and brilliant color known as "tahara" or Chinese red; and the other is a Turkish secret—the inflaying of the hardest steel with gold or silver. Among the Chinese and Turks these two secrets are highly valued. Apparatus is 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 guaranty.

(Continued on page 911)
Earn $125 to $300 a Month
In the Electrical business. Come here where you will be trained in these great $100,000 shops. Experts show you everything and you learn right on the actual apparatus. You work on everything from the simple bell to the mighty motors, generators, electric locomotives, dynamos, switchboards, power plants, everything to make you a master electrician. We have thousands of successful graduates. Just as soon as you have finished we assist you to a good position. We now have more positions than we can fill. Think of it.

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The Making of A Match

Tungsten is now used as an electric battery element. Electrical goods of American manufacture are extensively sold in Porto Rico.

INTRODUCING MR. R. W. DEmOTT

For eight months past Mr. R. W. DeMott has been advertising manager of this 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 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 columns of the ELECTRICAL EXPERIMENTER. Not only will they help your magazine by showing an interest in its advertising but you will benefit yourself to an even greater degree. I will take up these points one by one a 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 suggestions will be taken up in due course through this column.

For the next few months I will tell you about the advertisers and in 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.

The Ozonizer purifier has a purifying capacity of over 2,000 gallons a day. Therefore, any user is now independent of the condition of the water at the municipal plant in his city.

You benefit by mentioning the "Electrical Experimenter" when writing to advertisers.

AN OZONE WATER PURIFIER FOR THE HOME

For use in homes, offices, drug stores, restaurants, hospitals and institutions, a Milwaukee concern has 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 matters of the organism in the water and burn them up. The carbon dioxide formed by this chemical action passes out to air leaving a trace of the same effect produced in carbonated beverages, which adds to the palatableness 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
Taught By A Practical Man and in Your Home!

I am teaching electricity and electrical drafting to many men, young and old, and you will become sufficiently interested after reading this advertisement, that you will send for my catalog which tells what I am endeavoring to do and also places before you the simple way in which the instruction work is handled. The catalog is written in a very plain manner, much in the same style as my lessons are written, and tells you exactly what you get and what the course can do for you. My catalog, as well as my advertisements, is written in a very careful, conservative manner so there is no possibility of you expecting something you will not get.

The Purpose of the Course of Study

I have been designing courses in electrical instruction and teaching electricity, off and on during the past 17 years, and during that time I have had an unusual opportunity to make a special study of the teaching business, from the standpoint of a practical man. This course if my own is designed with a view of reaching those who do not have a lot of time and money to devote to study work, and to give them as thorough a knowledge as possible of electricity, in the shortest possible time. The instruction is given like you were working on various jobs, telling you what to do and how to do it, and giving the explanation necessary for the understanding of the theory covered by the subject under discussion. There are many conditions which seldom occur in the everyday run of electrical experience, and these conditions I lay particular stress on. This part of the instruction makes the course particularly attractive and valuable to those already engaged in active electrical work.

It Is Up To You

The instruction work is laid out and given in a way easily understood. It is not a cut and dried book plan, but the lessons are prepared especially for the purpose for which they are used and additional instruction is given to the individual student, with a view of meeting his particular needs. I have the information to give and I believe the ability to impart it to others, a fact which is in a way proven by other institutions which have made use of my services in the design and correcting of instruction courses. To understand this work, IT IS UP TO YOU! I will surely stick with you till you understand any part of the work you have gone over.

Practical Men Take My Course and Recommend it to Others

Sixty percent of my students are actively engaged in electrical work and find the instruction I give well suited to their needs. Several of these men have had their fellow workers take the course also and they are taking the instruction together, making a class-room proposition out of the and the results are in every way satisfactory to all concerned. One of these classes was started by a Chief Electrician, one of my students in Glen White, W. Va., who now has practically all the men under him taking my course. I believe the fact that these men who understand electrical work approve of my course to this extent is one of the strongest endorsements I could get.

Fifty Fifty

I work absolutely on a $50-50 basis with my students. You pay me the comparatively low price I ask, and I give you the instruction and other help as is stated in my catalog. No student is permitted to pay cash for his entire course, but starting, the course being paid for in small monthly payments as you go along. Students have the privilege of discontinuing the work if they should find that it was not just what they wanted, or if they are not doing as well as they expected at the same time. This is my way of doing business and I would not want your money when I was not giving you the instruction.
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The experimental stage has passed. Wireless now equals in importance telegraphy, and telephony. It has assumed its place among the great commercial industries of the earth. So rapid has been the development and growth of wireless in recent years that there has been left in its wake a tremendous shortage of operators. Actually thousands upon thousands will be needed for permanent "peace time" positions offering wonderful opportunities for advancement:

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The National Radio Institute, headed by authorities who have been closely allied with government training of students, has perfected an easily mastered course in wireless telegraphy whereby students are taught completely in ten weeks, either here in Washington at our large residence school or at home, by mail. Many of our students are ready to take up actual wireless work in much less time. The course is founded on actual practice, hence the rapid progress of the student.

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In the short period of ten weeks we can make of you a wireless operator, a man with a profession, independent, and not subject to the rise and fall of wages in the labor market. Salaries are as high as $200 per month. We give you this training at home, by mail, in your spare time. It is not necessary for you to lose any time from your work to take the course. Then when you have received your diploma we help find you a good position.

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Our plans of payment bring a wireless education within the reach of anyone who desires to learn. A small payment down and small payments twice a month enable you to earn the cost of your tuition while actually learning to be a wireless operator.

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This shows what big men think of the future of Wireless
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 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 throughout the available range of 3½ 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 shows vividly the relative transmission of light from a Maza lamp, fitted with water-proof 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 (0.3 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 of the incident light.

The amount of 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 a surprisingly short distance below its surface and that fish native to these depths are blind or carry their own illuminants.

EARTHQUAKE LAMPS

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 practicality 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 radio device $750,000 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. Coo said he had run the craft "all around vessels coming into the harbor at will." Mr. Hammond said an aviator after four years' 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 just 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.

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and get to the every top in this well-established and rapidly growing profession. The training given by the Columbia School of Drafting will give you just the knowledge you need to make good as a Chief Draftsman. No previous training is necessary. You can begin our course now and make rapid progress from the start under the Personal Instruction of the President of the School, Mr. Claffin, by mail. His carefully prepared lessons and personal letters of advice make each step easy and interesting.

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with big chances for better pay as the demand grows. All big engineering, construction and manufacturing projects must first go through the drafting room before the workmen can commence. All such enterprises depend upon large numbers of draftsmen. Salaries are advancing steadily.

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As soon as you enroll you will be sent our drafting outfit for your own use throughout the course. This entire outfit will be yours to keep. You are not obliged to return it after completing the course.

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The Columbia School of Drafting is probably the largest resident school in the country specializing in the training of Professional Draftsmen. Our Home Study Courses are an extension of the same instruction as given locally.

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Simply fill in the coupon below, return it to us and we will send you a copy of our Illustrated Catalog which tells all about our practical Home Study Course and how you may secure our instructions at once on easy terms so as to quickly qualify for one of the big positions open.

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Without obligation to me, please send me your Illustrated Catalog and tell me how I may secure your practical training in Drafting and your help in securing a position as Draftsman.

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State
WHAT IS A "KILOWATT" AND "KILOWATT-HOUR"?
(Continued from page 87)

will give a constant reading of 80 kilowatt-hours 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:

\[
\begin{align*}
\text{Kilowatt-hours} & = \frac{\text{Power in kilowatts} \times \text{Time in hours}}{1000} \\
& = \frac{40 \times 10}{1000} \\
& = 4
\end{align*}
\]

Making the same run in one-half hour we get:

\[
\begin{align*}
\text{Kilowatt-hours} & = \frac{\text{Power in kilowatts} \times \text{Time in hours}}{1000} \\
& = \frac{40 \times 0.5}{1000} \\
& = 0.2
\end{align*}
\]

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 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 x 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:

\[
\begin{align*}
1000 & = 25 \text{ hours}, \text{ or twenty 40-watt lamps} \\
& = 15 \frac{1}{2} \text{ hours}, \text{ for ten cents, since both conditions represent one kilowatt-hour.}
\end{align*}
\]

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 guard wired by the same concern.

This portable successfllly fills a demand for a substantial handle guard which does not need to be left loose in the house. The halves of the guard including the handle itself, open from the hinges at the outer edge and can instantaneously 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-scrubbed floors of 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 guards repays repair 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 patent!"

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 through experiments 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 photovoltaic action 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 Science.

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 conductive 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. 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-cp. 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 photocell and with the selenium cell.

Selenium. This metal was solid, thus differing from the impure material, which is a bismuth.

The results obtained proved disappointing, this metal being quite insensitive to light. When the cell was exposed to daylight the photocell current produced a deflection of only 4 to 5 mm., whereas similarly exposing a potassium photocell the photocell 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 photocell (vacuum 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. C. C. Brown and having a receiving surface less than one sq. mm. when exposed to the standard lamp gave a deflection of more than 50 cm., which shows its greater sensitivity as compared with other substances.

The mounting of the selenium crystal consisted of metal electrodes between which the crystal was placed between a glass plate by compression. When operated as a photophone, by connecting the selenium crystal with an Audion amplifying a loud sound note was obtained.

Tellurium. This metal is said to be 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 30 mm. No change in conductivity was observed when the crystal was exposed to daylight or to the standard incandescent lamp.

Sphalerite. The size of one sample examined was 6 cm. by 6 cm. and was attached to it by heating a copper wire to incandescence in a gas flame and bringing it in contact with the plate of sphalerite.

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

Boulangierite. The specimen of boulangierite (2PbS·Sb2S3, Irkutsk, Siberia) investigated was obtained from the Siberian collection. Several samples were examined. In one sample, 4 by 7 by 0.8 mm., the electrodes consisted of copper strips melted into the material as just described. The reflection 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 lamp produced a deflection of 2 to 3 cm., which is comparable with the preceding when one considers the size of the exposed surfaces.

Another 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·Sb2S3) Smithonian.

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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-sensitivity (change in resistance) when exposed to direct light or to the standard incandescent lamp.

Bismuthinite. Bismuthinite, Bi₂S₃, was obtained from the Smithsonian collection from Jefferson County, Colorado, and appears to be 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 mass 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 c.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 those published by those 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, selenium, was 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 bismuthine 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 a large crystal was exposed along the line of contact with the copper electrode. Covering the crystal with red glass did not reduce 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 boulangerite was exposed to intermittent flashes of light (photophone or, rather, radiophone) is


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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 the explanation for the phenomenon known as Mental Telepathy. Our question then resolves itself into the manner of transmission of this energy.

Sir William Crookes has suggested that the transmission of this energy is effected by means of a peculiar unaccountable light, which he terms "light of the ether." These rays also possess characteristics differing both in quality and quantity from the visible light in the order of the spectrum. Pro. Froumoy suggested that these waves are undulations starting from the nervous centers in the brain. The intensity of the ether in the rays is so tremendous that the theory of telepathy is that the intensity of the received impulses is not inversely proportional to the square of the distance, but 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. Pucocck has suggested that the 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 very minute that the telepathy has been observed. The excess energy passes on—enable to produce any effect upon the apparatus. This explains why the intensity is diminished by distance.

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 the "sunlight." He found that the phosphorescence of certain substances is increased when they are brought into the vicinity of contracting muscles or one of the corneal nerves of the cerebral cortex. He demonstrated this by the use of a simple piece of apparatus. A lead tube about two inches in diameter was covered at one end by a piece of paper or silk treated with phosphorescent calcium sulfide was employed. By placing this tube near a nervous center 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 intensity of the ray was varied in relation to the subjects psychological activity. From this he concluded that the brain was the seat of active radiations. With greater attention not concentrated no variation in the luminosity is noticeable. Di Brazza found that the activity in the temple, the eyes, and behind the ears. This experiment may be repeated by exercising greater will. It must be remembered, however, that these variations in luminosity are extremely small.

There have been many experimenters in this branch of science, many of whom have recorded remarkable phenomena of telepathy or action at a distance, as it is sometimes called. Professor Henry Sidwicjck 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 transmission of thought, both sympathy and affection may be the outward growth 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 the increase in brain and civilization that a conscious use of this thought language may be found. Who knows but that the future may find a practical application for this radiation from the brain, and a higher and a more delicately made creature may result who would effect mutual understanding by means of this marvelous and as yet little understood psychical activity.

MY INVENTIONS
(Continued from page 885)

travel at a rate of about one thousand miles a year, impracticable. 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 internal energy of terrestrial bodies. I had discovered that objects on the earth's surface, owing to the diurnal rotation of the globe, are moving 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 first point in the universe.

At the termination of my vacation I was sent to the Polytechnic School in Graz, Styria, which my father had chosen as one of the oldest and best respected institutions. There I had eagerly awaited and I began my studies under good auspices and firmly resolved to succeed. My serious training was above the average, due to my father's teaching and opportunities afforded. I had acquired the knowledge of languages and worked thru the books of several libraries, picking up information more or less useful. Then again, for the first time, I could choose my subject and 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 work during the whole of the 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 professor 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 paid to find a package of letters which (Continued on page 907)
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This does not by any means exhaust the list, but a great many more apparatus can be built actually and effectively.

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the professors had written him to the effect that he would not be allowed to make his way away from the Institution I would be killed thru overwork. Therefore I devoted myself chiefly to physical and mathematical studies in order to spend the hours of leisure in the library. I had a veritable mania for finishing whatever study I undertook and not meet 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 pages in a thick volume which that monster had written while drinking seventy-two cups of black coffee per day. I took the book and laid it aside for the last book I was very glad, and said, "Never more!"

My first year's showing had won me the admiration of several professors. Among these were Prof. Rogner, who was teaching arithmetic 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. He was the most magical and able lecturer to whom I ever listened. He took a special interest in my progress and would find time to have an hour or two in the lecture room, giving me problems to solve, in which I delighted. To him I explained a fairly successful attempt made at a visionary invention, but one based on sound, scientific principles, which has become realizable through my turbine and will soon be governments of both Professors Brehm and Poeschl were curious. The former had peculiar ways of expressing himself and had a way of asking questions which I could not follow, by a long and embarrassing pause. Prof. Poeschl was a methodical and thorough going man, a man of energy and resource, 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 studied. Then Professors Poeschl and Poeschl began demonstrations, running the machine as a motor, the brushes gave trouble, sparking badly, and it was not 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, in the conclusion of which he remarked: "Mr. Tesla may accomplish great things, but he certainly never will, unless he can be convinced of 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 something of logical deduction or any other willful effort of the brain, is futile. For a time I waivered, impelled by the greatest doubts, but soon convinced I was right and undertook the task with all the fire and boundless confidents.

I started first by picturing in my mind a direct-current machine, running it and following the changing flow of the currents in this. I would imagine an alternator and investigate the processes taking place in a similar manner. Next I would proceed to the comprising motors and generators and operate them in various ways. The images I saw were to me perfectly real and tangible. All my remaining teachers, Gratz was past in intense but fruitless efforts of this kind, and I almost came to the conclusion that the problem was insolvable. In 1890 I went to Prague, Bohemia, carrying 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 detach-
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 even now 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 Goethe’s “Faust.” The sun was just setting and reminded me of the glorious passage:

“Sie rückt und zieht, der Tag ist überlicht, Dort sitzt sie hin und fordernt neues Leben. Oh, dass kein Flügel mich vom Boden hebt ihr nach und immer nach zu stürzen!”

* * *

Ein schöner Traum indessen, welche Geburt, Ach, zu deren Flügeln wird so leicht Komma in der Luft eines meiner Flügel sich gestatten? 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 invention 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 that I could have seen my mother’s face when I reversed it. I cannot begin to describe my emotion. Pygmalion seeing his statue come to life could not have been more deeply moved. And the secrets of nature which I might have stumbled upon accidentally I would have given my life to discover. I was happy to prove from her against all odds and at the peril of my existence.

* * *

* * *

“TRESLA ON HIGH FREQUENCY GENERATORS.

Editor, Electrical Experimenter:

It is to be regretted that a letter address to Mr. J. Harris Rogers, in your care, was published in the march number of the ELECTRICAL EXPERIMENTER, altho the concur- ment of the facts, in some wise the 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 contribu-
tion, which I expect to prepare for your next issue, I shall express myself on this subject without prejudice and in the inter-
est of truth. However, the article by your copy, I might say to Mr. H. Winfield Secor on “America’s Greatest War Invention—The Rogers Under-
ground Wireless” contains a reference to a novel and original high frequency generator” of his 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 1899, in speak-
ing of circuit controllers, I said: “I may mention the device 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 speed, from an orifice connected with one pole of a generator, thus the primary of the induction coil, against the other question puzzles 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)
It contains the following 44 chemicals:

- Alum (Al₂(SO₄)₃
- Ammonium Nitrate (NH₄NO₃)
- Antimony (V, VI) (Sb)
- Ammonium Aqua
- Ammonium Hydroxide
- Ammonium Carbonate (NH₄)₂CO₃
- Ammonium Chloride (NH₄Cl)
- Ammonium Sulphate (NH₄)₂SO₄
- Barium Chloride (BaCl₂)
- Boric Acid (H₃BO₃)
- Bromate (Potassium) (K)
- Bicarbonate (Calcium) (CaHCO₃)
- Calcium Oxide (CaO)
- Calcium Sulphate (CaSO₄)
- Carbonic Acid (CO₂)
- Carbonate (Sodium) (Na₂CO₃)
- Carbonate (Semicarbonate) (NaHCO₃)
- Carbonate (Zinc) (ZnCO₃)
- Carbonate (Zinc) (Zn₂CO₃)
- Carbonate (Zinc) (Zn₂CO₃·H₂O)
- Carbonate (Zinc) (Zn₂CO₃·2H₂O)
- Carbonate (Zinc) (Zn₂CO₃·3H₂O)
- Carbonate (Zinc) (Zn₂CO₃·8H₂O)
- Carbonate (Zinc) (ZnSO₄·7H₂O)
- Carbonate (Zinc) (ZnSO₄·10H₂O)
- Carbonate (Zinc) (Zn₂CO₃·H₂O)
- Carbonate (Zinc) (Zn₂CO₃·2H₂O)
- Carbonate (Zinc) (Zn₂CO₃·3H₂O)
- Carbonate (Zinc) (Zn₂CO₃·8H₂O)
- Carbonate (Zinc) (Zn₂CO₃·10H₂O)
- Carbonate (Zinc) (Zn₂CO₃·12H₂O)
- Carbonate (Zinc) (Zn₂CO₃·14H₂O)
- Carbonate (Zinc) (Zn₂CO₃·18H₂O)
- Carbonate (Zinc) (Zn₂CO₃·24H₂O)
- Carbonate (Zinc) (Zn₂CO₃·30H₂O)
- Carbonate (Zinc) (Zn₂CO₃·40H₂O)
- Carbonate (Zinc) (Zn₂CO₃·60H₂O)
- Carbonate (Zinc) (Zn₂CO₃·78H₂O)
- Carbonate (Zinc) (Zn₂CO₃·90H₂O)
- Carbonate (Zinc) (Zn₂CO₃·100H₂O)
- Carbonate (Zinc) (Zn₂CO₃·110H₂O)
- Carbonate (Zinc) (Zn₂CO₃·120H₂O)
- Carbonate (Zinc) (Zn₂CO₃·130H₂O)
- Carbonate (Zinc) (Zn₂CO₃·140H₂O)
- Carbonate (Zinc) (Zn₂CO₃·150H₂O)
- Carbonate (Zinc) (Zn₂CO₃·160H₂O)
- Carbonate (Zinc) (Zn₂CO₃·170H₂O)
- Carbonate (Zinc) (Zn₂CO₃·180H₂O)
- Carbonate (Zinc) (Zn₂CO₃·190H₂O)
- Carbonate (Zinc) (Zn₂CO₃·200H₂O)
- Carbonate (Zinc) (Zn₂CO₃·210H₂O)
- Carbonate (Zinc) (Zn₂CO₃·220H₂O)
- Carbonate (Zinc) (Zn₂CO₃·230H₂O)
- Carbonate (Zinc) (Zn₂CO₃·240H₂O)
- Carbonate (Zinc) (Zn₂CO₃·250H₂O)
- Carbonate (Zinc) (Zn₂CO₃·260H₂O)
- Carbonate (Zinc) (Zn₂CO₃·270H₂O)
- Carbonate (Zinc) (Zn₂CO₃·280H₂O)
- Carbonate (Zinc) (Zn₂CO₃·290H₂O)
- Carbonate (Zinc) (Zn₂CO₃·300H₂O)

The following apparatus are furnished:

- One Standard Washbottle
- One Alkaline Lamp
- One Conical Glass Measure
- One Heterometer Flask
- One Glass Funnel
- One Delivery Tube
- One Assorted Test-Tubes
- One Test-Tube Holder
- Ten Sheets of Filter Paper
- One Glass Dropper
- One Spoon Measure
- One Tubing
- One book containing Treatise on Elementary Chemistry and 100 Chemical Experiments to be performed with this outfit.

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The apparatus furnished are all of the best obtainable make and of standard laboratory size and shape. A list of the 17 pieces of apparatus furnished with this outfit is printed herewith.

The Instruction book is a real Chemistry Course for the Beginner. Some of the Contents are: Division of Matter: This is a Treatise on Elementary Chemistry and deals with the theory of the Elements, Molecules and Atoms, etc. Chemical Nomenclature. This explains in simple language the derivation of the chemical names of the Elements and their compounds. There is a chapter on Laboratory Operations: Glass Working: First Aid: Fire Extinguishers: Experimenters' Aphorisms, etc.

A good part of the book is devoted to Weights and Measures. The Metric System, the English system and the U. S. System are fully explained.

The following tables are furnished: Symbols and Atomic weights of the Elements; Measures of Weight, Volume, Capacity and Length; Per Cent solutions; Conversion of Measure expressed in parts; Poisons and their antidotes; Technical and common name of chemical substances; Formulas for Cleaning various substances, etc., etc.

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Mercury Vapor

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

A. Under a pressure of 700 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 on a fine wire 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 rashes, 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.

Back Numbers Containing "Experimental Chemistry Series"

The "Experimental Chemistry" series, by Albert White, was begun in the June, 1916 issue of the ELECTRICAL EXPERIMENTER and has run continuously since that date. Prizes on the back numbers containing these respects have been given, of which have been of the greatest value to High School as well as Correspondence School and University, and have been won by many letters which we have received from readers of all classes, will be furnished upon receipt of stamped and addressed envelope. You are invited to send us your 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 audition, music has even been transmitted with charming effect for many miles. With a clever man at the adjustments, a long dash can be construed into a melody. An A that 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 that they can run the sound waves into the visual stage and make you 'see what I mean.'

"Mike, I am sure that I am not making too much praise. Aren't you satisfied?" evolve into a likeliness of Bill Hobbsen, or "They are wearing them lighter in Hawaii" into an X-ray.

"Tesla, De Forest and Marconi do not hold the whole stage in the wireless field. Prof. Fessenden has councils of patents in the Pat. office on the stuff, and there are a lot of other guys who have earned the price of a real mea culpa and make that makes"

― (Continued on page 918)

Popular Astronomy

(Continued from page 809)

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 therefor secondarily stands out sharp contrast to a sky of inkly blackness in which the solar corona (Continued on page 912)

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 treating the soap flakes in a mortar with 75 grams of the so-called "lead plaster" (which consists practically of lead olate), which may be obtained from your local drug store and 20 grams of dry potassium carbonate. When the two are thoroughly 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 with two portions of lead plaster, which may be obtained from your local drug store. This is then collected in a bottle and the mixture placed aside to settle. The clear liquid is decanted off thru a filter, and then the soap solution filtered thru a filter with more spirit. The volume of the liquid may now be made up to 200 or 250 cc., this forming a mixture of equal volumes of spirit and water.

Solvang Process


A. Sodium bicarbonate, commonly known as sodium alcohol, commonly called as the source from which the sodium alcohols are derived. The starting point of this process is therefore salt—in the form of a 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 ingredient of the electrolytic cell is carbonic acid, the same as is used to make soda water fizzle. For the purpose of this process it is obtained from limestone, by heating the stone and washing the product. Sodium 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 and 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 bicarbonate of soda. The crude bicarbonate of soda separates out as a white powder and the sal-ammoniac remains dissolved. The Ammonia takes the place of the carbonate in the salt, and the sodium combines with water and carbonic acid to form the well-known baking soda (Sodium Bicarbonate).

It is prepared from the liquids by filtration. It is then necessary to prepare this for a commercial product by heating it in a furnace, and taking all the water and carbonic acid gas. The product is then known as sodium carbonate, or soda ash, the finished product of the Solvang process, and the starting point of all commercial forms of alcohols. It is used in the preparation of soap, and is supplied at a cost with time to recover the ammonia from the soda lime, and sold again—no ammonia remains in the soda.
and the stars appear even in the lunar day.

To one equip with an opera glass on the moon range of the wonders and curiosities of our planet would be revealed; the shadows of our lofty mountains would be seen fading across the desolate plains and passing rain 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 live on this alien planet at close range is granted to a world devoid of all forms of life while the great telescopes of our own world can barely search 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 may 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 magnitude star. Our planet earth on the other hand is so distant from Jupiter that it appears but a small planet scintillating 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 heavenly bodies which are reflecting to our planet earth from the distance of Jupiter without telescopic aid and were it possible to set up a telescope 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 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 we have to make a pass 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 hardly worth a search in the telescope.

(The next installment will appear in the May number.)
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 addressed to "Patent Advice" cannot be answered by mail free of charge. Such inquiries are paid for here for the benefit of all readers. If the idea is thought to be of importance, the writer is asked to enclose a stamped, self-addressed envelope. 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.

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

Steam Boat Brake.

(309) Otto L. 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 wheels folded up against the body of the ship in normal position. If the boat is to be stopped, the posts automatically open up at right angles to the boat, and the ship, thereby exposing an additional surface to the water, consequently slowing it down. A. This idea is a good one but unfortunately it has been described before, and in our mind no patent can be obtained upon it today. We do not think the device works out in practice.

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 steel sheet 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, etc.

Fire Truck Device

(311) M. Dunbar, Lorain, Ohio, writes: "I wish your advice about a patent on an electrical device I have that will immediately start the engine of a fire truck. My idea is, as soon as the alarm rings to close 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 existing requirements, we believe that such a device should prove of considerable benefits, and most of the Fire Departments now have devices whereby the fire alarm the engines is started within a few seconds after the alarm has sounded.

Our Patents, Trade-Marks, and Copyrights. If this form is filled in correctly and returned to us together with model or sketch and description of the invention, we will give our opinion as to its patentable nature.

We are asked to give this information without cost because the books are written to enable the inventor to determine for himself whether or not an invention is patentable. This is the best insurance we can give an inventor, and the cost is so reasonable that every inventor should take advantage of it.
ELECTRICAL EXPERIMENTER

April 1919

NEW PULL SOCKET HAS CURRENT TAP.

In many cases it is desirable to connect an electrical appliance to a single-lamp socket without first opening the 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 "R" type" or pull-through type control which directs 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 of this type of socket gives it the elimination 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 passing through the wall 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 with 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 press and the lighting news from a daily newspaper to ships in the harbor and places on land equipped with apparatus designed to bring a sound from 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 American would be the first plane or dirigible within the next two or three months.

TESLA ON HIGH FREQUENCY GENERATORS.

(Continued from page 969)

brought within practical 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 results greatly different 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 the circuit can be designed and employed by me for a long time, proving very convenient and useful. Water does not give the best results, however, but it is 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.

You benefit by mentioning the "Electrical Experimenter" when writing advertisers.
NEW YORK TO CHICAGO VIA THE AIR IN 12 HOURS.

(Continued from page 85)

this important subject. Mr. Hawley said: 'Aerial transportation is here and here to stay.' Said the master of the Aero Club, speaking along general lines. Aerial 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 clouds to check after reaching your flying level.

It has been estimated that aerial express could be carried profitably at a charge of $2 a pound for packages of a given size between New York and Chicago. The two-minute aerial express makes the New York-Chicago trip without stopping, carrying a thousand pounds of express matter.

The post office has been operating an aerial 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 express by ground.

'British dirigible balloons, some of which are capable of carrying sixty tons of useful load at a speed of 90 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 85)

own, as they obtain it on their own electric power and steam for heating and other purposes, from the railroad companies near the respective railroad stations 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 connecting 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 powerhouse.

My guide suggested that we next visit a typical "guest floor", and so we took an elevator to the eighth floor, where 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 into 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 introduce him to the first of all the "servidores", as its name implies, is a scheme for rendering service between the guest and the hotel 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 in the few hotels which may have to bring in a table to serve a meal or something of that sort. The accompanying illustration includes a drawing of the "servidor", which as the time is also the "door" of the room, and "believe me, Xantippe", that door is one of the greatest masterpieces in all the hotel business, and there 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 swings out on a pivot, giving a depth of ten inches between the inner and outer curved panels, which extend the full height of the door. These hinged panels are provided with an interlock, so that the outside or hall door in the

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STUDENTS ART MAGAZINE

Dept. 441, Kalamazoo, Mich.
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 the 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, sends it to the man in charge of the"room service" kitchen, and as soon as you have finished, she writes it on her teletypewriter transmitting plate. Then two impellers rapidly and efficiently in the teletypewriter reproduce in writing your exact order for the meal, from coffee to cigarettes, all the way. With the announcement of your order in the "room service" kitchen in the basement,—while the second teletypewriter 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 any meal. Every system works out very beautifully in this way, and gives the greatest expedition possible to rapid service. Each floor has its own "room service" kitchen, which contains all ordinary things such as bread and butter, and which are supplied from this pantry. In this way the food is brought in the shortest time possible by speed electric dumbwaiters communicating with the "room service" kitchen in the basement, and which brings to any balcony at the last moment, such as chops, steaks, etc., are prepared in the main kitchen, they are whisked skyward via the automatic dumbwaiter to your floor. When the dumbwaiter reaches the floor, a buzzer signals the fact, buzzing continuously until the door is opened. The dumbwaiter then is put in the jack, the door closed, after which the dumbwaiter is dispatched kitchenward. By means of a flexible cord and plug and a set of jacks, the 19 Floors have a large kitchen service dumbwaiter may be dispatched root-ward and caused to stop at any one of these jacks. This makes it possible to put the plug in the jack corresponding to that particular floor. When the meal is ready, one of the room service waiters stands in your room on your floor serves the meal in your room, and invariably of course, a table has to be provided for this purpose. Eventually, we promise you that this will be entirely electric and simplified, so as to permit the serving of meals, albeit this is questionable for the reasons already stated.

Returning toward the lower regions of the hotel we quickly descended me down a long hallway on one of the main halls and we inspected the children's open-air playground, arranged by the large windows 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, men's 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 man's and a hair-dressing parlor and character.

Just as we were leaving the plunge rooms, we were surprised by seeing two nurses passing down the hall just ahead of us. Upon hot rooms, that the hotel management had not even overlooked such a possibility, and one to be cursed with when such a large number of guests are crowded together, it seems 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. As a matter of fact, in the 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 second floor, which is accessible from the hallways.

In various parts of the hotel, where the architects have found room for them, one suddenly bumps into unsuspected scenes of practical interest. They are in the dining floors, as well as in spare rooms on the roof, one finds carpenter shops, painters and decorators' shops, an up-to-date upholstery shop, a laundry, etc., even a small operation for the care of the vast amount of silverware used in the dining rooms, employees' club rooms, plumbers' shops, 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 gathered up by handiemen, after once being removed from the dining tables. They are placed in metal carriers resembling large drip pans as soon as they are taken from the dining doors. Here they are placed on continuous moving platforms, which travel along at a constantly changing speed over the power of gravity, and eventually the dishes reach the dish-washing department, which is quite an establishment all by itself. The dishes are transferred via water to water to water to a large tank filled with steam and boiling water. Every germ is thoroughly killed as soon as he touches the soiled dishes are then rinsed in other tanks filled with boiling water, which is so hot that the dishes are dried and finally dried and then put into the tank, due to the rapid evaporation of the water vapor remaining on them. The clean dishes are then whisked away on another conveyor, which takes them to their respective kitchens. The scenes in these great kitchens are ones that you will never 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 accomplished. The steam, which is 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 and aptly named the "home cooking kitchen." This kitchen is one of the features of the "Pennsylvania" and is in charge of the "home." 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 good things, can have just what his stomach craves. When the visitor wrote the kitchen, it was near dinner time, and the chefs were busy cooking squabs from 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 in the kitchen 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 of all hotels, is the storage room, where wagon-loads of vegetables are kept, to not mention several auto-truck loads of meats and fish. Large electric refrigerators, kept cool by the ammonia compressor, is the only one, maintain a constant degree of cold in them.

Of course, there are the usual wine cellar, one of which extends the whole block, not to mention the large room 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 off.
"Old Doc. Fleming got a good one in the form of a 'valve,' which is a lot like the audition. It was a close second in the patent office and only lost first place by much wrinkled and perspiration on the part of a wise old judge who weighed the proposition like a pair of mason's tongs.
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 he: 'Sh! boys, before you put up your aerial zigzags, see! Nix on those wireless wires! We've got to take care. Whazzamatter with our good old aerial?'
"Not much, says Jimmy, 'except that aers 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 two ends to any once was 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 tune out the life out of you, is gone for good, along with the war. Simple, if you know how!'
"I guess that's a pretty good idea 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 friends in Africa—when we are in Siberia or Sing-Sing. The present wireless is a great success—so was the steam 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 that we might be able to wear on our coat lapels a cactus plant. WAY back in the old ignorant days, when a gink thought that it was no worse to marry his sister in the same colony than we consider a divorce or Wall Street play, there lived an old bird who observed that a little houseplant in the window would not hurt a wall street that and 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 box and began to play in the electrical game—there are a string of years ahead of us yet—perhaps some electrical banks will show up. Don't get it in your head I am going to create a new financial house. It is that. What would Caesar have done had he possessed a machine gun or a telephone—what would Edison do with the observations and discoveries of the lot? Men, we are moving! Moving as men have never moved before!

PREPARED TO DELUGE GERMANS WITH GAS.

American next spring would have smoothed the German front with undreamed of quantities of poison gases, that Eastwood Arsenal thru gas production.
DO RADIO WAVES TRAVEL ABOVE THE EARTH OR THRU IT?

(Continued from page 572) 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 practice. 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 antennas and which were reported in the journal "Jahrbiich Für Deutsche Telegraphie und Telephonie" and the essence of these tests is illustrated diagrammatically at Figs. 6 and 7. The investigator, Kielset, working with such antennas, utilized a form composed of insulated conductors placed in an open trench, as shown in Fig. 6, and later he covered the trench 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, "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 proved.

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 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 experiments as well as theory both show that the penetration into moist earth or water increases with increasing wave lengths. Hence it is that of late, as the wave lengths

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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 antenna was at Block Island in July, 1903, when the connected receiver was by telephone line running across the island from the wireless station towards the Point Judith (K. J.) transmitter. Fine loud signals were thus received.

In 1905 I used a bare copper wire lying 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 promoters of the Marcouli interests have made capital over this performance of their station in 1918, when similar performances had been numerous and was a matter of record for at least two years prior to that date.

I give below a news clipping sent me by Mr. C. A. Smith, 1916, by a wireless station at Awara, New Zealand, which is self-explanatory.

I have received many communications from this station which, unfortunately, I have not felt authorized to publish, recounting similar "anti-podal" radio-transmission.

"In connection with Commander Crewe-ll's statement regarding the reception at various Australian wireless stations of messages sent out by Nauru and other places in Germany, it is stated that similar messages are received nightly at several of the New Zealand radio stations, especially Awara, which is probably the best equipped in the Dominion. The distance from Nauru to Awara 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 are inexplicable is not yet understood (referred to the World War), would excite world-wide interest, lie in the fact that ultra-audion reception is one of the most remarkable and simple pieces of apparatus invented since Marconi's first experimenting. Dr. de Puyfong, who 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 feature of this sort is accomplished, 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 Alexander alternator today enjoys over the arc transmitter. After witnessing what the arc transmitters are doing in Europe, as well as in the United States, together with their simplicity and efficiency, I can see no facility with which any wave length can be instantly obtained, it is doubtful in my opinion whether the alternator will soon supplant the big arc transmitters 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 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 too close to the exciting circuit, then several wave lengths or harmonics of various wave lengths may be heard, and an incorrect reading obtained. Furthermore, 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 Fig. 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 inductive 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 sides 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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GRAPH, Fig. 5

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By FRANK HARTLE

YOU probably know dozens of people like my friend John Brainard. Strong, robust, a man who dressed in his own clothes, who put up with a real bulldog for stamina, and a very likeable fellow in spite of his entire lack of sympathy for sick men 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 that an if you happened to mention that you didn't feel extra well Brainard would say, as courteously as you can imagine, what it is. "Thad, very sorry"—and you could almost see the entire matter sail off out of his mind. "Sick?"" hadn't seen to it that any sick people were foreign to John Brainard and he couldn't understand it in other people, that was all.

When Billings once said, "Health is like muny. We never have a true idea of its value until we lose it." And quite obviously John Brainard realized what ill-health is. Too much overwork, inconsiderate hours, immoderate meals, and general indolence to his health ("I'm not going to tell you what I did on the bus.") One day I went to his apartments and found him in bed with a severe attack of sciatica, but funning up with his very first treatment 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?—I can't be sick," and he jerked himself to a sitting posture only to fall back in pain upon the pillow.

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

Next day I was at lunch with George Con - rad, 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 pre - sumptuous or anything like that, but I certainly believe that the Doc will fix John up fine, but there's a treat - ment which entirely cured my wife of chronic neu - ralgia, and now it's bringing total cure to my cousin, another scatic 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 tiptoed 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 work surely at least on his own scatic sciatica. When I had cured other folks' sciatica, neuralgia, hay fever, asthma, neuritis and dozens of other diseases, and thirty 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 and well I'll swear by it for life. Cast in the dynamo, or whatever it is."

"It's 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 anesthetic 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 re - marked 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 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.

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Eminent physicians from all over the country apply the Violetta with wonderful results. Dr. H. B. 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, Nervitis, Neuralgia and Lumbago, and find it very useful. In fact, I regard it as an essential and a part of my work, and I'm sure that it is worth the price."

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SECRETARY DANIELS TALKED BY RADIO TO PRESIDENT WILSON AT SEA.

Secretary Daniels transmitted a telephone 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 telephone equipment had been set up by the Daniels staff and installed in his office. With Rear-Admiral Griffin, Chief of the Bureau of Steam Engineering, and Commander Hooper, the ra- dio operators of the bureau, supervising the experiment, the Secretary's regular desk telephone instrument was connected up through the high wires to the transmitting station at the seacoast, where his voice was projected by radio waves to the aërais of the George Washington.

The Secretary said a great welcome awaited 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)

A microphone circuit could be loaded simul- taneously with such an immense number of lines which practically constitutes a short circuit, and while the thing is possible in a very slender way by means of induction coils, not more than two or three hundred sub- scribers could be linked up by such means. Therefore, the system hereafter was a failure.

The invention of the Audion, however, has changed this and by using audions to "load" the circuits, it 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 considera- tion. Thus, the telephone engineers did not think it good business to tie up twenty thousand to fifty thousand lines simultaneously for several hours at a time on account of the congestion of the calls that would prob- ably ensue, but this is really only a small consideration and not of much importance if the enormous revenue that the current system 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 tele- phone company could easily double this revenue for at least 20 per cent of all of their subscribers by installing the operative service.

Today the man who owns a phonograph thinks nothing of spending between three to five hundred dollars for a recordCribs which are "used." If he knew he could hear Carno, Gallici Curi or any of the other stars tonight in one of his "used" Cribs, the man 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 full ticket, would hear the music in his own home, without having to travel to and from the opera house. 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 hundreds of music shows, operas, 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, similar 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 strengthened and projected to 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 amplifier 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 telephone cabinet could be sold direct to the subscriber or otherwise rented to subscribers by the telephone companies.

We feel confident that a plan similar to the one outlined above would soon come into general use, as there is a positive demand, particularly in America, for good music and entertainment.

But like all other large interests, the telephone companies are slow moving organizations and do not make innovations unless those innovations are a large part of the public actually wants them. Therefore, if you are in favor of this plan, 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, 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 systems as they are governed by the law 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 accomplished 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 unequalled success.

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HOW AIRPLANES FIND THEMSELVES BY RADIO.

"The use of directional effects of loops or coils for receiving radio signals has resulted in the development of radio compass for airplanes which gives positive information to the aerial navigator and enables him either to locate his position by triangulation with reference to two or more beacon stations or to fly at any given angle with respect to a certain beacon station. The apparatus consists of two main 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 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 disturbing 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 Astrophotography. Pictures can be taken which the eye cannot see because of fog, cloud, haze or distortion. By the use of this apparatus, the enemies guns camouflaged so as to be indiscernible to the eye are photographed and their positions located. A method of locating gins is very important. Three sounds are heard from a shell sent by the enemy. First we hear the hissing noise of the shell whizzing then 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 spread of sound, and the difference in time recorded at these stations, the position of the
A TIMELY REINFORCEMENT. A Copper Plated Stomach.

(Continued from page 587)

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 thing 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 prefer to call it. That's the steeple; 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 cooled by liquid, K. At the further end, both the tube and the spiral wire are connected with the perforated metal hollow sphere, E. The atomizer-brottle, F, is filled with a solution of sulfate of copper, and the spiral wire is connected with one pole of the spark-coil secondarily, and that's what's left on the waist is then blacked 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 mouth. Thus the patient is constantly drenching his back and belly, and living in perfect health and joy within the tummy. Mark the patient closely: a really delightful surprise is about to be served up! Pressure on the bulb, G, projects a spray of copper sulfate from the perforations of the sphere, E, while the current, H, through each of the key, L, causes a shower of sparks to be thrown from the ball toward the metallic belt without. The sparks pass easily through the patient's skin, and oxidize the sulfate. This is decomposed by the electric current, and metallic copper is deposited on the gas-tight lining, forming a highly polished, smooth, and highly polished, 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 magnesium tablets, together with a pepperminite "life-saver"? This is one of the other products of the reaction, sulfuric acid—otherwise the patient might as well be dead to death as the way he is. The magnesium salts neutralize the copper salts with 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—equipped with a perfectly-fitting copper stomac, enclosing a tempe-rance-chink as a hint to guide him in a selection of future contents for it—like a new tin bank for little Willie, with a dime in it.

Voila, you've just made a deal. Really!—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 civilized countries. "That's me all over—liberal, Mabel."

Note—the editor tried "Tom's" latest stunt. It was the latest stunt from the hospital, and was at last equipped with his copper "insides," he felt pretty weak! He complained of constipation and cramps in the gas-tust with his next meal. The copper "insides" made a great deal of noise, and the editor received the patient for a second visit. It works so well that he has given up all food in preference to zinc dust. At dinner yesterday, he was served with magnesium dust—it tastes better, and gives a much higher voltage. Iron filings were tried, but they made the editor "rusty."

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Consequently the engine would have to be operated at various rates and at all times. This is uneconomical. By using a storage battery it is possible 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 storage battery between the generator and the lights. Further, the storage battery tends to improve the character of the lighting. 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, 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 240-volt dynamo is already installed, or if it is desired to use such a machine for charging, it can be done simply by disconnecting the series windings on the field coils, thus converting the machine into a shunt dynamo.

The battery into 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 volts to charge it, going in practice to employ a 45-volt dynamo for charging. In fact, we may largely consult convenience when charging a battery, provided the excess voltage is not too low. A 110-volt dynamo may be employed, at times, for charging a 30-32 volt battery, but this, I think, is going rather than low. A 110-volt dynamo may be employed, at times, for charging a 30-32 volt battery, but this, I think, is going rather than low. A 110-volt dynamo may be employed, at times, for charging a 30-32 volt battery, but this, I think, is going rather than low. A 110-volt dynamo may be employed, at times, for charging a 30-32 volt battery, but this, I think, is going rather than low.

The alkaline battery, with which we are concerned, is made up in a variety of sizes, of which known as A is quite popular for electric automobile and trucks. A numeral used along with the letter indicates the number of parallel plates in the cell. These numbers furnish a rough guide by means of which the comparative capacity of the two is to be determined. The reason underlying this is that ampereage is determined by the total area of plate surface exposed to the action of the electrolyte. A flat plate has about half the capacity of an A8 cell, etc.

**Charging.**

The positive terminal of the battery is connected with the positive line of the supply, 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 to remember that the little containing the plates. The round tubes belong to the positive plates, and the flat pockets to the negative plates. If subsequent his charging, it is found that at one cell pole during the charging operation, it is to be taken as indicative of an imperfect connection. A black bushing is used for the negative pole. A further means of determining the positive and negative poles is to remember that the little containing the plates. The round tubes belong to the positive plates, and the flat pockets to the negative plates. If subsequent his charging, it is found that at one cell pole during the charging operation, it is to be taken as indicative of an imperfect connection.

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 become live and the other will remain dead. This wire 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. After the electrolyte is in the container, this column will measure ¾ inch. Simply a glass tube is required. No rubber cap or tube is needed in addition and the tube of an ordinary fountain-pen may be used. The rubber bulb is removed and the larger end of the tube is inserted into the electrolyte. The operation is, of course, already explained, involves the production of gas. Some, at least, of this gas comes from the decomposition of water in the electrolyte into its constituent parts. These gases will certainly be lost, and the result will be a slight reduction in the total volume of the electrolyte. Consequently, a very proper time to examine for height of solution is subsequent to charging. The remedy for this loss is the 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 container, the electrolyte is transferred to the surface to the required height or to correct a solution that has become too strong, a strong—electric “filling outfit” may be advantageous. 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. Of course, if 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 lower than the current it is proposed to deliver. The amperage will fall off as the charging goes on, but by reading-station 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, is without further adjust- ment. 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.

---

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ELECTRICAL EXPERIMENTER PUBLISHING CO., INC., 223 Fulton Street, New York, N. Y.

Wanted—Bluprints of motor windings, see add under Blueprints, etc., this issue. Charles L. Chatteaton, 81 W. 28th St., Kansas City, Mo.
Wanted—Bound Volumes, 3 and 4 of Electrical Experimenter, Printing Outfit or Wireless Receiving Sets, and various other books and papers. The Word, 11 E. 37th St., Neosho, Minnesota.
Wanted—Complete Outfit, 7 kw. Open Core Transformer, complete outfit, cost $15.00, or exchange. Milwaukee Telephone Transmitter with 25 records in continental code, practically new, $25.00. Leonard Ustapf, Freeport, Ore.
Wanted—Complete wire outfit, 2 kw. O. K. Motor Company, Milwaukee, Wis.
For Sale—Two home coupler receiving sets, commercial type, best construction, and phones. Special ad in this issue will secure special opportunity for amateur station. Call Saturday evening, 647-7228 at Ave, near West 41st Street, New York City.
For Sale—Train, Camera, and other small stuff. Mahan Sales Co., 27-29 and 31-33 N. Dearborn St., Chicago, III.
For Sale—Telephone generators, $5.90; Battery telephone, 750; Electrolytic interrupter, $12; 110 volt, 15 ma. Chemistry Laboratory, $2.00; Brandi Super, $5.90; Telephone transmitter, 20; Aston, $5.90; Double Barreled shot-gun, 12 gage. $160.00; jewelry Waltham, silver case, $2.00 each, W. A. Type A 950, 1919, written in every detail. All in excellent condition. Gun box is perfect. Henry Cole, Rockland, Maine.
Will Swap—No. 2 Folding Autographic Brownie Camera for sale. Will trade for a good 16 or 35 mm. camera. Will also consider offer for Norton, Max Felder, 144 W. 19th St., Chicago, Ill.
Wanted—Parts type 400-500 Edison Primary Batteries. Michael Roland, Forest Avenue, Englewood, N. J.
For Sale—3 kw. Whistler, Maple Road, Linthicum Heights, Baltimore, Md.
For Sale—New 5 record Omnigraph, buzzer, and records, $15.00. Margaret Ewing, North- weston, Conn.
For Sale—Hy-Ton Rotary Gap ½ kw. Trans- former, Pancake Type Oscillator, Unusually fine glass plate condenser NAA Cou- per, 2 kw. new, low price. V. Van Zundt, 1665 Winfield St., Los Angeles.
For Sale—Nonpareil printing press, number 22; Baudouin type case and ornaments $45. Denis Peglow, LaPorte, Ind.
For Sale—Daisy Educational Electra- pedia, for sale or exchange. 7 kw. Monroe Whaley, Maple Road, Linthicum Heights, Baltimore, Md.
For Sale—Exchange—Motor, fans, switches, spark plugs. Advise what you have or have for sale. H. C. Hancock, Bogota, N. J.
For Sale—Twelve complete wrestling lessons, 60¢. Harry Schalte, 250 Buchanan St., Baltimore, Md.
For Sale—No. 5 (No. St. Omnigraph worth $50.00. Unusually fine glass plate condenser, used, $2.50. K.W. sending transformer, state price. Walter B. Heckman, Winnsboro Md., Annapolis, Md.
Wanted—Telegraph Apparatus. Write Gowan, 61 George, Peoria, Ill.
For Sale— Audion Tubes, Tuner, Condenser and receiver parts. Cahu, 851 Pulaski St., Brooklyn, N. Y.
Business Opportunities—Continued.

Make Big Money opening sales and setting combination locks. John Strong, F. O. Box 1490, Los Angeles, Cal.

Men, get into the wonderful tailoring agency business, big money waiting for you and your own clothes free. We furnish line sample and complete instructions. Write today, Banner Tailoring Co., Dept. B, Chicago.

Attention manufacturers—What have you to offer for your product? Must be easy to market. Can use large quantities. Address, Guarantee Sales Co., Detroit, 202 Newberry Blvd., Detroit, Mich.

Luminous Paint makes watches, clocks, anything visible at night, green bottle. Luminous Paint Co., 1430 S. Church St., Los Angeles, Cal.

Your Opportunity—U. S. Correspondence courses bought and sold. Dollars saved. Write now. Educational Correspondence Co., 722 S. Dearborn St., Chicago, Ill.

Japanese Incense producers fragrant souvenirs. Similar to sandalwood. Sample sent free. 621 S. La Brea Ave., Los Angeles, Cal.


Cats create! What can you do with a "cat's fur" (a Bielle cloth museum, stuffed with cat) and a "cat's fur coat" (your "kitty" will like it). Address: Percy Ewing, Decatur, Ill.

You Can Be a Winner. Gain Power and Individuality and become what you are, through our well organized PLAN. Practical, positive benefits. Send 90c and birth date for interesting and informative lesson in Efficiency. Thomas-Heywood Co., Dept. P, 125 W. Madison St., Chicago, Ill.

Catch Fish. Descriptive folder containing valuable information mailed for stamp. George Julian, 2118 W. Division St., Chicago, Ill.


Wanted—Engineers and Machinery Operators. Cash paid for 1 to 4 cylinder light weight Motors, 4 to 10 H. P. Johnston, End West, Pitts, Indiana.

Snow-Flume. Removes snow from sidewalks, etc. Easy to construct. Can be used also by you. A. T. Fally, Bensenville, Ill.

“Opportunity to sell new, wonderful product results over 3,000,000 circulation, etc. Other firms are making millions. Position open. For proof address Classified Department, Electrolytic Experimenter, 23 Fulton St., New York City.

Wiring.

Amateur Radio will be Prohibited in Five Years unless amateurs organize for protective legislation! Will amateurs be organized body able to protect their cherished hobby? Join NOW American Radio Club. Write today, American Institute of Radio Engineering, Omaha, Neb.


Mineral Detectors are not one hundred per cent efficient without a storing silver carboy. Better than gold, 19c each. Gooding and Layton, 13 S. Heald Street, Winslow, Delaware.


Better stock up now on switches and widely points for that new set. Circular describing the most important, K. E. Night Co., 522 S. May St., Chicago, III.

Learn Welding at Home Cheap. Through home course outlined which will not exceed $6, answer any questions free therefor. Complete instructions and details sent free. A. J. Eames, 229 E. Roosevelt, New Orleans, La.

Switch Points, Binding Posts, Switch levers, and small parts, all described therefor. Descriptions and these other goods. A. W. Bowman & Co., 23 Church St., Boston, Mass.


Chemicals.

Chemical Analysis honestly and correctly done by John E. Tenney, 225 E. 6th St., Denver, Colo.

If you are in need of Chemicals you will be办事 very far wrong if you do not consult the 4th Annual List of Manufacturers of Chemicals that are most rare and most difficult to obtain. Get this list. Ziegler Experimental Laboratory, 4 Judson Street, Rochester, N. Y.

Electrical Supplies & Appliances.

Motor Windows: See ad under blueprints, etc., Charles L. Snell, 111 W. 18 St., Kansas City, Mo.


For Sales: 296 Pen бес paper exact representation of automobile parts complete with 2 cell guaranteed battery only 69c each. Also 7 cell batteries 20c. Also 2 1/2 cell tuber flashlight As used by Marines 75c extra on either. J. A. McLindon, 245 Edgewater, West Roxbury, Mass.

EDT-ohm double pole double switch receivers—Not permanent magnets. Can be disassembled and reassembled, $1.25. Electro Sales Co., 1544 Cleveland Ave., Chicago, III.

Electrical Tapping Machine and Supplies—Catalogue Stamp, Prof. Tekau, Exp., 109 Vine St., St. Louis, Mo.

Recharge Dry Cells for Five Cents. Directions, E. Gillett, 34 Chestnut, Binghamton, N. Y.

For Sale—Electrical apparatus all kinds. List for purple stamp. Wm. Doby, 29 John St., Portland, Oregon.

Personal.

Are you self-conscious—embarrassed in company—shy in self control? These troubles overcome by E. S. Variations, trained hypnotist, New York.

Letter Specialists.

Letters That Land Orders and Money Orders—written for $10; three for $30. Guaranteed. Erskine, 621 S. Church St., Los Angeles, Cal.

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. Health and Con- tertainment. This all is within your reach at modest prices. Write today. Beautiful land on the St. Johns River. Here we have the freedom, comfort and economy of country living, the comforts of city living and the delights and resort centers like Tampa and St. Petersburg. Our community is new, but is growing the fastest of any in the state. There have not gone sky-high and living expenses are moderate. 2000 families already here. They like it—but perhaps you may. Let us send you further information." Board of Trade, 80 New Port Richey, Fla.

Motorcycles.

Motorcycles from $25 up—New and second- hand. Easy terms, large list to choose from, all makes, all models. Sometimes you can get a second-hand Motor without and without paying a dollar. Write for list. The Los Angeles Motorcycle Company, 829 S. Dearborn St., Suite 250, Chicago.

Song Poems Wanted.

Wrote the Words for a Song. We write music and guarantee publisher's acceptance. Submit Ideas. F. W. D. Music Co., 538 S. Dearborn St., Suite 250, Chicago.
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Dear Reader—In my Miscellaneous and Scientific books appeal to you, send for my catalog, a free copy. We have books on Personal Magnetism, Concentration, Electricity, Magnetism, Self-Hypnosis, Physics, Will, Mind, Hypnotism, Mesmerism, Char-acter Reading, Astrology, Science, Success, Salesmanship, Mechanics, Entertainment, etc. The success and value of our books will be sent to you upon request.


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N. S. P. Carne, 45 North Main Street, New York.


Blue Prints.
Blue Prints—1 ½ H.P. Gas Engine 20c, 1 ½ H.P. Steam Engine 50c, 1 ½ P. H. Boiler and Engine 75c, all in complete, free. Universal Gas Motor Co., 344 Monadnock, Chicago.

Blue Prints—Motor windings, 100 A.C. connections, 100 different, complete, 24 diagrams $1.00 each. Send postcard for samples. Write for information. W. L. Berendo, 2811 West 8th Street, Kansas City, Mo.


Health.

Tobacco or Snuff Habit Cured or no pay! $5.00 Guaranteed. Remedy sent on trial. Superba Co., 51 Baltimore Street, Baltimore, Md.

Prickles—H. E. Kelty, D. D. S., M. D., pyro- renologist for 15 years, has developed a suc- cessful home treatment for pyorrhea. Paritying, scaling, prevention, treatment and booklet 50c. Circular free. Dr. H. E. Kelty, 1680 Grandview, Columbus, Ohio.


Stomach.
St-Stomach-ting and Stomaching curdled at home. Inventor for J. B. McDonald, 1913 Pennsylvania Building, Washington, D. C.

For the Hair
I was Bald. Obtained hair growth by an In- deed's oil. Now am very dark and 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-290, New York.

Tricks, Puzzles, Jokes, Toys, Games, Novelties, Domestic Appliances, Escapes and Illusions. Large 129 catalog takes Magical Co., Dept. 540, Oshkosh, Wis.

100 Stage Tricks with 500 illustrations. Cata- logue free. Mr. Rockwell, 1400 26th Street, New York Co., Sta. 6, 170 Eighth Avenue, New York.

25c. Inexpensive, Free, Trick Catalog (766 cards each) mailing list, $1.00.

Ventilequium taught almost anyone at home. Small cost. Send today 3c stamp for particulars.

Inquiries directed to Miss G. V. Smith, 381 Bigelow Street, Peoria, Ill.

10c. We supply Joke Puzzles, Catalog and leader 100 postpaid. Western Puzzle Works, St. Paul, Minn.

Phonographs, Needles and Supplies
Build Your Own Phonographs and manufacture them for profit. Drawing instructions, Parts, Blue Prints, etc., complete, sent free upon request. Write today. Associated Phono- graphs Co., Dept. E, Cincinnati, Ohio.


Phonograph Owners: Test our wonderful, new Ring Bell, Buy our Bell, and make money selling to your friends who hear the famous brilliant tone of the new, greatly improved instrument, very interesting. Single mode, price $2.50; 500 free. Write for samples and special offer. K. Kenyon Company, 11 Union Street, Brockton, Mass.

Wonderful 175 Phonograph. 42 inches high, 12 records album, needles, 5c. Stamp 61c Newmarket, N. H.

Motors, Engines and Dynamo's
Small Motors and Generators: 1900 New Motors and Generators from $1.50 each to $15.00 each. A. W. Linhorst, C.-initialized., 15 N. 9th Street, Atwater, Minn. 200 Motor Generators, 320 generators, 20,000 motors, 500 engines, 350 gas engines, 250 steam engines, 150 high, 100 low, 500 free. Charged, Lighting and Dynamo Motors for sales and use. Motors for all phases of current improvement. Immediate deliveries. Write for details. A. W. Linhorst, 15 N. 9th Street, Atwater, Minn.

For sale—The following 60 cycles, simple-phase machines, 100 r. p. m., new, 125-150 volts; 380; 300 r. p. m., 150-200 volts; 450; 500 r. p. m., 175-250 volts, 2-2 200 watts, Electric Machinery Equipment Co., 714 W. Van Buren St., Chicago.


Pouring.
100 Bond Noteheads, a line and 100 envelopes, prepaid, $3.00 Southwestern, 1415 H Berendo, Los Angeles, Calif.

100 Engraved Style Visiting Cards, 200, 300 Emblem Cards 75c. H. Gregory, Warwick, N. Y. Supplies, et cetera.

Stamps and Coins.
100 Finely Mixed United States or Foreign Stamps, 1c, Philatelic Star, Madison, N. J.

California Gold, Quarter size, 20; Half-dollar size, 50c; Dollar size, $1.00, Large cent, 19c, and catalogue 36c. B. D. B., 23 West 32nd Street, New York.

Stamps—all different free. Postage, 5c; Meaton paper, Wabash Stamp Co., Toledo, Ohio. Please mark all coin with 95% approval. Benji, Forbes, 160 Devilisters, Detroit, Mich.

Free packet of stamps to approval applicants. Laslaris, Union City, Pa.

Stamps 100 different, 20c. 200c. Approvals, Michaels, 909 Prairie, Chicago.

Acme Stamp Co.—Send stamp for pocket list, 100c. Acme Stamp Co., 2819 Broxley Building, Buffalo, N. Y.

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YOU can easily make a highly sensitive detectorphone 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.

One of the main advantages of the Skinderviken Transmitter Button lies in its ultra-sensitivity. 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, still 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.

Full directions for connecting up the button for use as a detectorphone 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 detectorphone.

The only instruments needed to complete a detectorphone outfit, in addition to a Skinderviken Transmitter Button, are a receiver, battery, and, if desired, an induction coil.

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.”

“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 experimental.” “I have been using one of your transmitter buttons for experimental work and it certainly lives up to all you say for it and then some.”

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.

Figures 7 and 8 illustrate the method of transmitting sound by means of the vibrations in a body while speaking. Speech will be reproduced by the receiver just as if the experiment 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—and in a dollar bill RIGHT NOW! You can lose. If you’re not satisfied, you receive your dollar back. Isn’t that fair? Send a 5¢ stamp for a copy of Booklet No. 4.

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STECO, 2134 North Clark St. Chicago, Illinois.

Get my order for:

[] Skinderviken transmitter buttons .............................................. $1.00 prepaid

[] 110 volt generators .............................................. $1.00

[] Ringers .................................................. 10 cents

[] Cords .................................................. 10 cents

[] Induction coils .............................................. 30 cents

[] Transmitters with T. Button .............................................. 1.50

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