July

Science and Invention

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LEARN THE SECRETS OF INVENTION USED BY EVERY GREAT INVENTOR

INVENTORS ARE MADE—NOT BORN

Invention is the easiest, most natural function of the human brain. Every idea we have is an invention. The inventor of the O'Sullivan Rubber Heel walked upon hard cement floors all day. The jolts tired him, so he nailed pieces of a heavy rubber mat to his heels.

The young man who thought of putting "hooks" on the upper part of his shoes in place of "eyelets" did it simply because he wanted to save time lacing his shoes in the mornings.

A young man got tired of drawing water from the well with an old chain pump, and devised a "pressure pump" to do his work for him, with a saving of sixty per cent of his muscular energy. This idea is now used in the gasoline-measuring pump of every "filling station" in the country.

These men were not "born inventors"; they were plain every-day folks who applied their minds to practical needs.

WHY MANY INVENTORS NEVER SUCCEED

Many inventors do not succeed because they never patent their ideas, or fail to protect their inventions with the proper evidence of priority, or because they do not make broad enough claims. But the greatest loss sustained is by inventors who fail to fill a real need. The patent office museum in Washington is full of devices which accomplish no really useful purpose; no one wants to manufacture them, because few people would have any use for them. All successful inventors are men who have learned to discern a real need and who invent something which makes people exclaim, "Now, why couldn't I have thought of that?"

STOP GROPING IN THE DARK

Hitherto, every inventor had to work out the principles of invention for himself, often toilsomely, through months and years of discouragement and wasted effort. But now, for the first time, you can actually learn all the principles at once—exactly as other people are learning the principles of electricity, automobile mechanics, law, medicine. For the first time in history, invention is being taught as a science, just as Thomas A. Edison once predicted it would be. The easy-to-learn principles which every great inventor has used have at last been written down in black and white, by Raymond Francis Yates, and 15 other great inventors, and the Bureau of Inventive Science offers them to you in the first course in practical invention ever devised.

WHAT EVERY INVENTOR MUST KNOW

This course begins at the beginning and tells you everything necessary to help you in conceiving, developing, patenting and marketing your inventions. Here are the titles of the 25 inspiring lessons:

- Development and Application of Inventive Imagination
- Developing the Idea
- What an Inventor Should Know About Chemistry
- What an Inventor Should Know About Drawing
- Collection of Data as an Aid to Research and Invention
- Practical Application of Scientific Laws and Principles
- Development of Labor-Saving Devices and Machines
- What Not to Do in a Patent
- Different Kinds of Patents
- Foreign Patents
- What an Inventor Should Know About Infringements
- What an Inventor Should Know About Electricity
- How to Market an Invention
- Developing Memory and Concentration
- What an Inventor Should Know About Mechanics
- What an Inventor Should Know About Physics
- The Different Fields of Invention and Research
- Keeping Legal Records of Research and Invention
- What an Inventor Should Know About Manufacturing in India
- Applying for a Patent Laws of the Patent Office
- Patent Rights and Their Exploitations
- Organization of a Company
- Miscellaneous Advice

Nothing has been omitted. Everything you need in order to do practical inventive work is taken up step by step, and explained by experienced, successful inventors.

LET 15 INVENTORS SHOW YOU

The authors of this remarkable course have set down, for the first time, the laws and principles of Inventive Science. They have, in brief, actually shown you how to invent. In simple, easily understood language they explain how successful inventors work; how ideas are developed and made practical; and how to protect your invention and turn it into dollars when you have made it. Instead of groping blindly for years, learning through painful experience, this information will enable you to develop your ideas quickly, protect them, and become a market for them.

A FORTUNE WITHIN YOUR GRASP

Perhaps you may develop the idea for such a useful article as the snap fastener, which returned such enormous profits to its inventor that he paid an income tax of $29,000. You need not be a trained mechanic in order to realize a fortune from an invention; any simple little convenience like the "clipped" hairpin is enough, if it is new and practical, and fills a universal need. But whether you have an idea for an invention now or not, by all means take advantage of the Free Examination Offer that the Bureau of Inventive Science is now making.

We will send you the entire course of twenty-five lessons, as described above, with the privilege of ten days' inspection. Four only $2.95, plus a few cents postage, to the postman who delivers the course. This money will be returned to you at once if you decide to return the lessons within the time allowed.

This Bureau is not connected in any way with patent attorneys or manufacturers. Our only wish is to help ambitious men and women to develop their inventive ability—to become successful inventors.

Perhaps only one little idea, as simple as putting a rubber tip on a pencil, or a metal one on a shoe-lace, will bring you thousands of dollars. These two examples brought fortunes to the men who first thought of them. The man who whistled out the first "Kiddie Kar" for his own child is said to have made $5,000,000 out of it. Is there any better way to spend your spare time? One little idea may win a fortune for you!

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From the time I was last in Chemistry it has never been thus explained to me as it is to you. I am recommending you highly to my friends, and urging them to become members of such an organization.—CHARLES BUNN, JAMIN.

I shall always recommend your school to my friends and let them know you supplied my lessons.—R. L. ALLEN.

I am more than pleased. You did just to type an answer to your own name. I tell every man I meet that I've taken your course and I've improved.—W. H. THIBBS.

Thanking you for your lessons, which I found not only easy and uninteresting, but wonderfully interesting. I am—BOY, H. TRAYLOR.

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WHERE SCIENCE FAILS

By HUGO GERNBACK, F.R.S.

ONE of the most characteristic features of natural Science is that the more progress is made in it, and the more new inventions and discoveries come along, the less the average person seems to know about it. The reason is, of course, very simple. Science is so complex that it speeds up our lives in such a tremendous extent that every one of us, in order to compete in the struggle for existence, must become an expert in his chosen calling. If he does not do so, he falls by the wayside.

The man or woman, as a rule, knows one thing pretty well, but has little conception of what lies outside of his sphere. For instance, the business man in any line of business will probably be well conversant with the most subjects that touch his business. Outside of these subjects he seems to have little knowledge and does not seem to care to know what is going on. And this is really a pity, because, though he may not realize it, knowledge, as the saying goes, "never hurts," and if often happens that such acquired knowledge outside one's regular line of work comes in most handy at times when one's business changes or when new and unexpected developments in the same business occur.

To be specific, how many people are aware of scientific progress in the various sciences that are going on in day and day out? How many average individuals could name you the 12 greatest inventions or discoveries for 1925? You will find the percentage unbelievably small. But not only that—if ask a dozen individuals, so-called intelligent people, a number of absurdly simple science questions and you will find out immediately how the wind blows. Suppose you try the following list on your acquaintances and see how they "stack up" in their knowledge of everyday science. You will find that the average schoolboy or high school student probably fares better than the average business man or business woman, but even the youngest will give you some surprising answers that assuredly are not "to the book!"

Here are the questions:

1. What materials go into the manufacturing of a lead pencil?
2. What is static?
3. What is newspaper stock made of?
4. What is a short-circuit?
5. How long is the day and night at the north and south poles?
6. What metals does a magnet attract?
7. What is the difference between heat and cold?
8. Why are mountain tops colder than their bases, although nearer to the sun?
9. What is crude oil?
10. What is the difference between bacteria and germs?
11. What is the difference between a musical note and a noise?
12. Can brown or dark oil, due to the food eaten, cause black spots on the eyes of dogs?

These questions, as it will be noted, run the entire gamut of the various branches of science. To the scientific man they are, of course, absurdly simple, even childish. But try them on a crowd of people and ask them to write the answers down and see what happens. You will be surprised. Incidentally, the questions, correctly answered, will be found at the back of this magazine on page 180. Most of your friends will tell you that if they wish to know the answers to these questions all they have to do is to look them up in an encyclopedia or in a physics text book. This is very true, but at best a poor answer. It is not always possible nor convenient to have a text-book at hand. Moreover, many situations arise constantly in all of our lives wherein a little knowledge would do a tremendous amount of good, and the lack of knowledge often will mean...

Take such a simple thing as your wife accidentally splashing some grease spots on her new gown. Lack of knowledge probably will induce many people to send the gown to the dry cleaner, while the man or woman who knows a little bit about everyday science, or rather, chemistry, in this instance, will know that there is a common solvent for grease, the name of it being either gasoline or benzine. Very often a perfectly good dress or gown is spoiled by applying the wrong cleaner, because such a cleaner is not a solvent for the particular stain.

But to be a little more specific, when it comes down to your business. A certain concern for years has been manufacturing an item in which it was necessary to cover a bend made of wood with a piece of thin rubber tubing in order to give it protection. The rubber tubing had to be put on by hand, and it was an expensive and difficult method. Six months ago the concern had to discontinue manufacturing the article, because the dealers and stores no longer could afford to pay the high price. After the machinery had all been scrapped and the line discontinued, it was found out, quite by accident, that the article could now be manufactured by electrically rubber-plating the article. So the machinery had to be rebuilt, at a cost of thousands of dollars, and the firm now plates the article with rubber at a price considerably below what it was possible to do heretofore. If the president of the concern had been a reader of some popular scientific magazine, he would have been able to see the possibilities of the new process, and would have utilized the necessary knowledge and so effected a huge saving.

The above thing is by no means an isolated case. It happens every day, and only those who refuse to burden themselves with a little excess knowledge are the ones who lose out in the end. There is hardly an establishment in the country that the man of science, who knows his P's and Q's could visit without finding a vast amount of ignorance displayed at every hand. The up-to-date business man who thinks he has all the latest labor-saving devices is not nearly so up-to-date as he believes himself to be, and it is often the man who knows just a little bit more than the rest who forges ahead and passes his competitors.

A well-known radio manufacturer proved this quite a while ago when he applied an old principle to a new business. It was the custom among radio manufacturers to solder each wire to the various bus bars and other connecting wires or strips in the radio set. The manufacturer who knew the little bit more, however, applied the spot welding system to the radio set manufacture and built a completely new machine by means of which, in a single operation, mind you, it is possible to weld about 30 connections in the space of two seconds—an operation that takes the other manufacturers as long as 30 and 40 minutes to accomplish. Not every one knows about spot welding. It is simply the application of a little scientific knowledge to one's own business that may spell success or failure.

Either you are a manufacturer or not makes no difference. Some time in life there will be an occasion when the acquired knowledge will come in handy. Keep your tipster in Science and invention and keep hold of this bit for you. You should understand things—it is not enough to know where to find books about them. Make a library out of your brain.

Mr. Hugo Gernback speaks every Monday at 9 P. M. from Station WRNY on various scientific and radio subjects.

THE GOLDEN AGE OF SCIENCE is symbolized by the golden cover of SCIENCE & INVENTION. LOOK FOR THE GOLD COVER every month!

Science and Invention is published by Winfield Secor, Ltd., Managing Editor, T. O'Connor, Sloane, Jr., Associate Editor. The offices of the magazine are at 53 Park Place, New York.
First Airplane to Fly to North Pole

By H. Winfield Secor

Wonderful Round Trip to North Pole Made in Fifteen and One-
Half Hours by Commander Richard E. Byrd and Floyd Bennett, Pilot.

A FEW weeks ago two intrepid United States flyers, Commander Richard E. Byrd and Floyd Bennett, his pilot, completed in 15½ hours a 1,500-mile journey over the frozen Arctic from Kings Bay, Spitzbergen to the North Pole and back. The direct route followed by these daring flyers is shown in the accompanying photo-diagrams, which also bring out a number of other interesting features, such as the fact that flat landing spaces on the ice were frequently seen in proximity to the Pole, and that no land was sighted on the entire 1,500-mile journey.

Commander Byrd and his flying partner, Floyd Bennett, expert pilot, completed the round trip to the North Pole on May 9th without landing once on the entire journey. The dirigible “Norge” started on her momentous trip over the North Pole to Alaska, shortly after the return of Byrd and Bennett in their triple-engined Fokker airplane, the “Josephine Ford.”

As in previous cases of polar explorations, Commander Byrd waited for the spring of the year when the most agreeable climate was liable to be found in the polar regions. He also had the advantage of constant sunlight on the entire trip of 15½ hours.

The Fokker monoplane used by Commander Byrd was built at Hasbrouck Heights, N. J., not far from New York City, while the three wonderful engines which enabled this trip to be completed successfully, are of the type known as the Wright Whirlwind, each engine having nine cylinders of the air-cooled type. The cylinders are of the fixed radial type, and each engine developed 200 horse-power at 1,800 revolutions per minute. These engines are ideal for polar trips as cold does not affect them.

Commander Byrd and his companion Floyd Bennett did not depend on the magnetic compass, but used instead a bubble sextant and the new sun compass invented by Albert H. Bumstead of the National Geographic Society. As Mr. Bumstead stated—“The sun is visible for twenty-four hours a day in the summer in the far north. The sun compass used by Commander Byrd depends upon the fact that the sun moves regularly around the sky in twenty-four hours, and by having the clock with a twenty-four-hour dial the pointer can be kept following the sun while the instrument remains in one position.

“If Commander Byrd desired to travel in a due north direction he would set the compass dial for north, and then so maneuver his plane that a shadow thrown along one of the hands of the clock dial would be exactly superimposed upon that hand. This shadow is cast by a projection that rises from the body of the clock hand. The sun compass is very easy to use when the clock has been accurately set to sun time and the sun is visible enough to cast a shadow.

“Many people wonder how Commander Byrd knew when he had arrived at the North Pole. He had the distinct advantage of the new bubble sextant, which provides an artificial horizon. Even if the fog obscured the real horizon, the bubble sextant allowed the navigators to ascertain their position by sighting at the sun. A few years ago this would have been a more difficult process, but thanks to the Littlehales’ method of calculating positions in the vicinity of the North Pole, the flyers knew their exact position at all times.

In flying to the Pole, Commander Byrd flew at an average elevation of 2,000 feet, while on the return flight the average elevation was 3,000 feet. In flying back from the Pole, the two birdmen made extra speed with their Fokker monoplane, due to the reduced load of gasoline. New methods of navigation over the polar route were employed by Commander Byrd, notably the use of the new sun compass and Byrd bubble sextant and a new system of establishing his position at any time, as developed by George Littlehales.

Peary, when he reached the North Pole in 1909, stood on a mound of snow, bringing his eyes to a point sixty feet above the surface of the ice. Peary could only view an area of 5 square miles while Commander Byrd could see 9,500 square miles, when at an altitude of 2,000 feet. The aerial explorers could see 55 miles in all directions at the pole.
Norge's Flight Over North Pole

The hydrogen filled dirigible "Norge" has now successfully completed its wonderful trip from King's Bay, Spitzbergen, directly over the North Pole, landing at Teller, a short distance from Nome, Alaska. Thanks to radio and latest scientific navigation instruments, the "Norge" flew a practically direct route over the North Pole, as the map below shows.

The pictures above and below show route of first radio message sent from North Pole by the "Norge."

Above: If fuel or engines failed "Norge" could drift with wind.

Left: "Norge" carried parachutes and if necessary crew could have landed on ice, as shown. Airship carried sleds as well as snow shows and skis. Crew could have walked to nearest settlement.

Below: Very peculiar circumstance met with by explorers aboard the "Norge" is shown below. When directly over the North Pole all directions then point south.

Map above shows actual as well as proposed original route of dirigible "Norge" on her momentous journey from King's Bay, Spitzbergen, over the top of the world where she landed successfully at Teller, Alaska. The explorers were brought to Nome by motorboat, having to drive a dog team part way.
RAISING THE S-51

By RAYMOND J. WARDELL

(From an interview with experts at the Brooklyn Navy Yard.)

THE method by which the submarine S-51, is going to be raised utilizes buoyancy tanks or pontoons, in addition to the buoyancy created by blowing out the water from most of the S-51’s compartments. Fig. 1 shows large wood covered steel pontoons which are sunk into position along the sides of the submarine by filling them with water. When the time comes to attempt raising a sunken ship in this manner, the water is blown out of the tanks by compressed air sent down into the tanks through one and one-half inch fire hose lines. These lead to the surface, where they are connected to a large number of compressed air storage tanks aboard the tender ship. Note how the heavy lifting chains are anchored to the buoyancy tanks through large steel tubes passing diametrically through the tanks. Each pontoon is fitted with automatic relief valves, so that excess pressure can leak off through these valves as the pontoons rise with their load. The two pontoons anchored halfway to the surface by chains, will cease lifting when they broach or reach the surface, thus checking any further upward lift of the submarine. If all of the pontoons were sunk to the level of the hull, the ship would come up with a rush, and in this way accurate control of the whole lifting operation is obtained. When the submarine rises to within sixty feet of the surface the suspended wreck will be towed into shallow water. Here a new lift will be taken by flooding the pontoons and allowing them to raise the submarine again. By repeating this operation the submarine will be eventually raised to the surface and put into drydock. Fig. 3 shows how high pressure water jets are used in order to clear a passage through the mud around the midship section, so that chains can be passed around the hull. Figs. 4 and 5 show details of the improved oxy-hydrogen blowpipe used for cutting steel and other metals under water. A cone of compressed air keeps the water away from the flame and for melting copper and brass, an extra high pressure hydrogen line is provided.
$25.00 Prize for Human Aura Photo

NEW WAYS OF SEEING THE HUMAN AURA.

By FENN GERGER

I
t is fairly easy to see the Human Aura —that peculiar atmosphere that surrounds each one of us, and which chair-voyants and psychic mediums say is revealed all the while in movement and color. It is very easy to see that a wonder that more people have not seen it looking for it. A great many have, in fact, for whom I have attempted to show it have often confessed to having seen it before, but thought it was an illusion. The colors are not so easily seen.

The Human Aura is a haze, a mist, a gaseous appearance that surrounds the human body on all sides. It is usually restricted to a space within a few inches of the body, but on speakers of considerable emotional power (like a football coach, I have seen) it may expand out three or four feet while they are delivering a stirring lecture. Ordinarily, however, we do not see the full extent of the Aura; we generally see only the denser brighter portion which extends about 2 to 3 inches from the body.

Very close to the body, about ⅛ of an inch thick, lies a grayish-violet line, the clearest and most definite part of the Aura. It is like a “skin” (not a gas, and called the “Etheric Double” or “Etheric Body,” because it is supposed to be the over-lapping or extension of a body almost exactly like our physical body except that it is made of much finer “etheric” matter which enables it to permeate the physical matter of our body and to seemingly exist in the same space. As this matter is supposed to be very tenacious—as much finer and more active than a gas as a gas is than a liquid—the activity of its particles causes the Etheric Body to press outwards a little further than the physical matter of the body, and thus we have the overlapping phenomenon.

THE INNER AURA

Extending out further, than the Etheric Body lies the “Inner Aura,” which has a colorless appearance, ordinarily seen, and which is sometimes called the “Health Aura” because the radiating energy of which it is the expression forms striations like thick black lines, stand out at right angles to the surface of the body when the person is in good health, and drop when he is tired or in ill-health. This portion of the Aura is quite close and presents an appearance similar to the heated air over a radiator although it does not tremble. As usually seen by inexperienced persons under unfavorable conditions, it extends from 1 to 2 inches from the body all around; but under better conditions, or when seen by a person accustomed to observing it, it is often seen to extend from 6 to 12 inches all around and sometimes more. The striations are usually seen only by the more sensitive observers.

THE OUTER AURA

Yet further extends the “Outer Aura,” which is almost invisible and can be seen only under the most favorable conditions, so we will not deal with it except briefly. It may extend from 1 to 3 feet out from the body.

The means required to see the Aura are very simple and elementary. The first requisite is that the experimenter determine beforehand not to be let away in his enthusiasm by any sort of illusion, as this is a very disappointing pitfall for one who is not used to observing the delicate phenomena. The second requisite is a suitable background, which should always be matt (that is, unpolished, like the surface of calcimine or velvet) unless otherwise specified, and as free from decorations or marks as possible. Decorations or marks on the background distract the attention and make it difficult to focus the eye properly on the area near the body. The best backgrounds are black velvet or matte; and, if in a diffused indirect light, white polished tile or porcelain. The blank, white wall, especially if made in a booth large enough to contain the whole body with outstretched arms, is best for detailed study and for carrying out Dr. Walter Kilner’s experiments mentioned later on; while the white tile is best for learning how to look for and see the Aura. One can easily see the etheric body and the aura around one’s head when washing in a porcelain washbowl; and a dim light is particularly favorable. Other good backgrounds are yellow, cream-colored, and blue calcimine, green and orange are permissible too, the only unfavorable colors being red and brown. The background need not necessarily

be calcimine, although that is best because there is almost no direct reflection of light to interfere with seeing the Aura. The white background, with the exception of dead black, tends to render the Aura invisible. This is probably because dark colors absorb much light, and therefore it is difficult to see back through the Aura.

There is one exception to this, which is that if one will look through a silcony three or four stories above a sidewalk or an asphalt pavement —a cloudy day is best—one can look down on human beings, dogs, cats, horses, etc., and see their Aura, for example, in an envelope of mist or gas. This strikes one as very comical on first sight, but when you look at it from the front or the side. It is like seeing the effect of the atmosphere on the sun; when it is high in the heavens there is little atmosphere to pass through and it appears bright; but when it gets down near the horizon, the greater thickness of the intervening atmosphere begins to reveal itself in dimming the sun’s light to a deep red.

THE USE OF COLORED SCREENS

The Aura can also be seen by observing it through chemical or colored screens. Dr. Walter Kilner in his book “The Human Atmospheres” describes the use of a glass water-cell (such as that used in lantern-slide machines to project the reactions of chemicals in solution) with this glass slide in which is put a solution of dicyanin (a rare coal-tar dye used in sensitizing photographic plates to infra-red light) in pure alcohol. He advises the use of two solutions, one rather light in color, the other dark. To use these screens, one first looks through the dark one at some source of daylight for two or three minutes; then, when he has his back to the window when observing the Aura.

Dr. Kilner gives methods of seeing the colors in the Aura. He turns his back to the light, and then, little by little, and finally, the human aura is revealed, as it may be in a chemical or colored screen. He also advises utilizing the effects seen by the use of a colored band of paper; then he looks
Synchronizing Voice and Movies

By JOSEPH H. KRAUS

ONE of the most recent of the scientific developments which will revolutionize the exhibition of motion pictures in small theatres in little towns has just been announced as having been perfected. The developments are the result of research in the Bell Telephone Laboratories, The American Telephone & Telegraph Company and The Western Electric Company, who have been working upon this system for the Warner Bros. Pictures, Inc. By this system it is possible to synchronize the motion pictures with the reproduced sound, and have that sound perfectly natural. The photograph at the right shows a scene at the recording laboratory. The music and songs may be picked up from more than one remote place and may be made to act on the record after being carefully mixed in the mixing panel.

The camera is driven by means of an electric motor at a speed in exact synchronism with the motor driving the recording disc, or turntable.

The particular scene depicted on this page is one in which a duet is being sung. Microphones are seen suspended overhead but will not appear in the finished picture. They could, of course, be concealed in the scenery. The heavy curtains overhead prevent echoes. The sound is picked up by the microphones and then transmitted by wire to the amplifying panel, from which the amplified sound goes to the cutting needle and is recorded on a thick, cheese-like record. The man standing is examining the grooves.

The illustration at the bottom of this page gives a representation of how small theatres will be benefited by this system. When the show comes to Broadway the finest orchestras will record the music for the picture. This need not be done in a studio but can be done in a theatre and the orchestra music picked up can be relayed to a distant recording laboratory. The only precaution required is that the recording and projection motors must be in synchronism. When the film arrives at the small theatre the record and the projection machine are driven by the same motor. One of the new types of phonographs which employ vacuum tube amplifiers is used to reproduce the music and in this way the audience at the town theatre will get the benefit of an orchestra of unusual size. Talking pictures do not present enough appeal to warrant feature films to be made, but the music present enough appeal to warrant feature films, but the music is necessary.
The conveyance illustrated in the diagram above is capable of a speed of 150 miles per hour over the surface of water and can carry a large number of passengers. It rises on the water until the lowest hydrofoils are in the water, while a large percentage of the lift is obtained from the air foils as well as the hydrofoils in the air. It is driven by means of propellers coupled to airplane engines. It is possible at the present time to construct a craft of this type large enough to cross the Atlantic at an average speed of 120 miles per hour, which is greater than the speed attained in actual flight. Because its skims the water it is entirely safe. Emergency sails are provided in event of engine failure. The propellers are of the regular aerial type.

—F. E. Loody, Aeronautical Engineer.

A Natural Ice Mine

IN this ice mine the ice-forming process starts soon after the close of winter. The temperature inside is below freezing in the summer and higher than the surrounding temperature in the winter. The icicles are fifteen to twenty feet long. During warm weather a heavy fog-like vapor is seen to rise from holes in the ground near the mine. A very strong out-draft can be noticed at the mine in the summer. The theory is that small fissures in the rock lead from the pit to some point higher up the hill. In the spring the outside air being warmer, causes a current of cold air to come down and out the shaft. Warm air drawn in at the top is chilled to such an extent that it will freeze any moisture in the mine.

Here is an actual photograph of the ice mine at Sweden Valley near Coudersport, Pennsylvania. The ice lasts all summer and melts during the winter. The shaft is ten by twelve feet at the top and almost forty feet deep.—R. M. Holland. Photos courtesy Coudersport Ice Mine Co.
Colored Lights Transform Scenery

ONE of the most remarkable methods for the production of apparent motion is that of employing a series of colored lights for the production of the effect. This system is not a new far-fetched idea; it is actually being employed at the present time for animating painted colored signs. There are several ways of producing this motion and two examples of the systems are illustrated in the diagrams at the bottom of this page. In the one at the left, two bulls are seen on opposite sides of a fence. These are both painted red. Now when a red light is flashed upon either bull, it disappears. At the same time that the light is flashed upon the bull on one side of the fence, a blue-green light illuminates the bull on the other side of the fence, making it visible and producing a black color. The retention of vision produces the illusion of the bull actually leaping over the fence. In the figure at right, the see-saw is made to apparently swing up and down.

This particular system is of extraordinary value in stage effects. For instance, a winter scene can be instantaneously converted to a summer beach scene, the snow disappearing entirely, the hills of ice being converted to the waters of the beach, and a pile of snow in the foreground becomes converted into a bathing house. Even the girl's costume miraculously disappears from her back and she stands there in a one-piece bathing suit or even less if the management so desires. By means of these lights, costumes can be made to appear and disappear. The outer garments of the girl are made of cellophane, or red gelatine. When this is illuminated by a blue-green light it becomes opaque and jet black. The instant that a red light is flashed upon the costume it becomes as transparent as a sheet of glass.

By alternately flashing red and blue-green light at the figures, they may be made to move.
In the photo above we see how the author arranges orchid seedlings in glass test tubes with a tuft of cotton in the top of each tube.

The most important orchids used as cut flowers today include all of the many species of Cattleya. The flowers of Cattleya are well built, large, and exceptionally vivid and peculiarly showy in tint so that they attract instant attention. These flowery fancies are more wonderful than the most extraordinary vision of the imagination, and whenever orchids are mentioned, these seemingly fragile and delicate blooms, are re-created in the minds of those who know them. By far the greater part of them are natives of the riverbank jungles of Brazil and Central America where light, dampness and heat cause them to thrive in superabundant luxuriance. Although these native flowers may be exceptionally bewitching in their appearance, the florist has successfully formed a large number of hybrids which far surpass the original species in beauty.

The crossing of orchids is not only successful with species of the same genus, but related genera can also be used and even these hybrids have been found able to propagate themselves. Many hybrids have been formed between Cattleya and Laelia, although other genera are equally adapted for the production of new varieties.

As a rule such hybrids grow quite rapidly, develop many wonderful flowers, are very variable, and produce fertile seeds with great difficulty. Crosses of this character only become a possibility through the fact that the organism itself is variable, and has no definite unchangeable characteristics. All things in Nature are pliable, one form merges imperceptibly into another; she never produces the same thing twice, and the meaning of life and reproduction becomes apparent when the law of variation is more closely studied. Without variability and hereditiy, new properties could not be produced, and without the law of heredity, these could not have been passed on to the progeny.

In every hybrid the characteristic properties of two individuals are united into one by the sexual method. When species having constant properties are crossed with each other, the resulting hybrid possesses a well defined regularity in its hereditary properties, and contains the peculiarities of both its parents. Should such a constant be lacking in the parents, the properties of each being still variable—such a regularity in its hereditary properties will not be found.

The results obtained from the first generation are not sufficiently characteristic to give any certain conclusion as to the progeny of such crosses, certainties become a possibility only in the second generation. Hybrids are partially fertile and partially non-fertile and, in general, the more remote the relation of the parents the less likely are they to be crossed and less likely will they be able to reproduce themselves.

Hybrids, having but little reproductive power, can be treated so that they partially recover their regenerative ability. This is accomplished by simply propagating them vegetatively for several generations.

In the second generation a splitting up of the progeny occurs, and this in a well known percentage is known as Mendel's law. From a careful selection of this generation, the next, or third, will come true to form. For, on crossing different genera, certain well defined characteristics may combine, but these characteristics of the hybrid are not so firmly established that they can not be resolved again.

**CHARACTERISTICS OF HYBRIDS**

**CROSSING SPECIES**

It is a common practice to cross species of the same genera. If this process is utilized for the production of new forms, the coloration of the flower is most important. The variations of the existing floral tints are always limited to a certain extent, to the color of the main genus. Blue can be replaced by red, but if yellow is lacking, it cannot take the place of blue. On the other hand certain red colors may change to a blue, as the coloring matter, anthocyanin, which is dissolved in the cell sap, is known in a red, purple, and a blue modification. But not every red is adapted for this purpose. The yellow pigments of the flower is usually produced by chromatophores which, when xanthin is present, is yellow, and when this and carotin are present, is changed to orange. Rarer in occurrence is a yellow colorating matter dissolved in the cells as, for instance, in Antirrhinum, Verbascum, Dipsia variabilis, etc. White flowers do not contain a coloring substance but, between the glassy, transparent cells of the flower, the tints are formed.

It is these existing colors, which may be light in one and dark in another, that the florist must take into consideration while producing new colored varieties. If two different plant species of the same or related genera possess different colored flowers, then both can undoubtedly, be successfully crossed and the hybrids derived from the seeds may take on characteristics, which lie midway between the parents. Continued propagation can, if conditions are favorable, result in a new variety of flowers having

(Continued on page 272)
The picture above shows the openings along the hull and below the waterline through which the water enters and escapes from the anti-rolling tanks, a new German invention, which bids fair to become popular in the design of ocean steamships. Here nature does the work.

Permanent Electric Charges a Scientific Wonder

For many years we have known and used permanent steel magnets, but what would you think if a man handed you a small metal box containing a cake of wax, which he told you contained a permanent electric charge? In other words according to this idea, we shall before long be going into an electric shop and asking for a 100-volt cake of wax, or maybe they will be rated in kilowatt-hours. Thanks to the remarkable experiments of a Japanese physicist, Prof. Mototaro Eguchi, it has now become possible to impress a permanent charge of electricity into a cake of wax. Molten wax, as shown in the picture at the left, is allowed to harden by cooling in the presence of a strong electric field. The wax mixture employed by Prof. Eguchi usually contained 50 per cent. of resin, mixed with 50 per cent. of carnauba wax. The electrostatic charge is applied to the wax by means of a metal plate lowered on to the molten wax, and also through the metal pan containing the wax. The high potential is obtained from vacuum tubes as shown in the picture here-with. As will be seen the metal pan and the metal plate lowered over the wax, constitute a high voltage condenser, and the wax mixture as it hardens, is acting as the dielectric of this condenser. One side of the wax is found to be permanently negative, and the other side permanently positive. Some of the charged electrets have lasted since 1919.
WORKING as a hired hand, for $1.25 per day, on a dairy farm near Youngstown, Ohio, a struggling youth was obtaining a livelihood and sharing his meager funds with the demands of an education. Thirty-five years later, this same individual has achieved the revolutionary thing of transforming sunlight directly into electricity. This remarkable discovery which may prove to be one of the far-reaching achievements of science within this generation, is to be credited to Dr. William W. Coblentz, Chief of the Radiometry Section of the U. S. Bureau of Standards. Delving into all sorts of substances and studying their reaction to radiant energy from sun, moon, and stars, Dr. Coblentz has discovered a mineral that performs the incredible feat of changing light directly into electric current. Molybdenite is the name of this magic mineral and, unfortunately, each sample contains a spot no larger than the point of a pin that produces this marvelous result of converting light into electricity. This sensitive spot, small as it is, when exposed to the sunlight, generates enough electric current to throw the needle of an electrical measuring instrument clear off the scale.

Samples of molybdenite used by the Bureau of Standards in its experiments of transforming light into electricity, are placed in ordinary pill boxes, the piece of mineral being soldered between two fine wires. The chip of molybdenite contains a very small spot, barely larger than the point of a pin, which manifests this inexplicable phenomenon of changing light into electric current. A single pin hole is made in the pillbox, the tiny hole being opposite the magic spot on the mineral, and when exposed to the sun, sufficient electricity is generated to deflect the needle of the galvanometer.

The large picture at the right shows how electric sun power plants of tomorrow may furnish our electric current. Electricity from light-activated cells charges a storage battery; the current being drawn from the battery as required.
HUMAN TORTURE IN THE
ROMAN ARENA

The picture speaks for itself. Each victim has a hand nailed to the upright plank behind him and they stand there in agony, while the lesson given and its moral are supposed to be dialoged on by the preacher. The strange costumes worn and the curious mitre-like hats are supposed to be correctly shown.

A BED OF TORTURE

On the right: The unhappy victim lies prostrate on a plank driven full of pointed nails. One of the executioners is shown tying him down and the others are working upon his shoulders apparently to see that he escapes no whit of the torture. The general impression from this old engraving is that it was an everyday occurrence.

APPARATUS FOR BREAKING
WITH THE WHEEL

The victim tied to the wheel is turned round and round over the fire prolonging his torture for a period of many minutes, or even hours.

TEARING APART BY HORSES

The victim is being torn apart by four horses. The old engraving well illustrates the barbarity of the torture witnessed by a number of cold-blooded spectators, some of them evidently men of high rank.

IN SPAIN

On the left is shown one of the Roman Caesars who was said to have covered victims with melted wax and had it lighted, so as to have human torches. The engraving shows them on fire in the arena. We do not know how well authenticated the story is.

The victim placed upon the sharp series of ridges has his bones systematically broken by dropping the heavy wheels upon the victim spacing the blows by the openings between the ridges.

Above is shown an apparatus for breaking with the wheel. The victim placed upon the sharp series of ridges has his bones systematically broken by dropping the heavy wheels upon the victim spacing the blows by the openings between the ridges.

To the left is a reproduction of a curious old engraving showing various instruments of torture, the uses of which our readers will now be able to appreciate after the very wonderful series of old-time illustrations which we have reproduced in these columns.

Reproduction of a curious old print, showing various instruments of torture.
The subject of torture has quite an extensive literature. It is surprising in the larger libraries to find so many books on the subject catalogued. Torture in its ancient origin and for many centuries was regulated by exact statutes of law, varying in the different countries. Some hundreds of years ago it was a subject that concerned law-students in their theses, and to use a colloquialism, for a period covering many centuries, it was considered "quite the thing." It was regarded as the best method of teaching the status in law of a criminal; the idea was to induce a witness to give testimony in the case of an alleged criminal, and it was used in the most curious ways to induce an alleged criminal and one who was believed to be a real one, to confess his crimes. There was a very definite feeling of almost statutory force, that no one should be punished for a crime unless he acknowledged having committed it, and he himself acknowledged it and to force him to confess the supposed offense, torture, was applied. This seemed to satisfy the conscience of the judge—it was a sort of "ipso iuris," on the alleged criminal's past.

It is told of one of the English kings that he had the thumbscrews—a well-known instrument of torture—applied to his own thumbs; as he began to feel the pain, he called out to stop it, and said that another turn of the screws would be the last of all. It is perfectly obvious that this was the expression of the probable effect of torture. The means and method of inflicting it and the instruments used were quite varied and a certain degree of ingenuity, of what may be termed the diabolical order, were exhibited by their constructors and inventors.

Our readers will find numerous examples of the instrument of torture illustrated here. It is stated that as many as 600 different instruments have been invented for torturing and some of the most curious things are brought out. Thus one authority declares the torture could be legally inflicted only with ropes and then he describes a number of ways of doing this.

One of the English methods of torture involving death was to hang, draw and quarter. The victim would be hanged until part dead, if we may use that expression. He was then lowered to the ground and disemboweled, and the story is told of a lady being given a strait-jacket around the victim's head in her lap while she was cut open, as if that could assuage the victim's pain. But even this incident gives a viewpoint for the psychologist.

Another form of torture used in England bore the name of the Seavenger's daughter. A man named Sir Wi. Sleevington revived its use in England and his name was transformed into Seavenger. It is a simple wire hoop. The victim was doubled up and trussed into it and left there in constantly increasing agony.

The stocks were used in comparatively recent times. One of the pictures shows a man with one foot in the stocks, and the foot bare and a boy tickling it. And one of the most excruciating tortures is given as holding the feet with brine and causing a goat to lick them with his rough tongue, tickling the epidermis. It is curious to read of the Stewarts in again he was convicted, and it might have been well to send him out of the world by the quickest method. We hear of Sir Robert, who was carried through the streets of London from the Tower to Hyde Park Corner, a distance of about two miles. The latter was the locality of the famous Tyburn, where the unfortunate man received several thousand stripes. He survived all this and lived for many years after. One of our illustrations in the last issue of Science showed people being boiled in oil.

The Russian knout was probably the most terrible weapon of all in chastisement, short of the chain scourge. It was a whip with a single lash about 1½-inch square, of leather or hide which had been made hard and thorny to make it harder. The executioner was trained in its use. He practised upon a pile of sand, giving vertical strokes and by pressing the knout against them close against each other, so that a succession of strokes covered the whole back, leaving it a mass of mangled flesh, and if it did not kill the person, it ruined him for life. It has even been said that the second blow might be fatal.

Maria Theresa was Empress of Austria when a document was issued in 1769, giving elaborate instructions for the administration of torture giving descriptions and illustrations of implements in use and how to employ them. The tragic death of her daughter, Marie Antoinette, followed this after a little over twenty years. In parts of Germany torture was kept up until 1831.

The pouring of cold water on the extremity of one of its victims proved to be a very severe torture, and as late as 1838 it was inflicted with fatal results in Auburn Prison, New York.

One of the cruellest things about humanity is that they seem to enjoy the infliction of suffering. We have seen it in our own country when the two plowsmen were killed in Chicago a boy trying to commit suicide who termed "the perfect crime." We are told that in England, in the days of the infamous Judge Jeffries, people used to go to the hemp works where unfortunate women criminals were used to work on the hemp for ship's ropes and cables, and the visitors went there for the purpose of seeing them.

(Continued on page 278)
How Unusually Life-like Results Are Obtained By Trickery

By A. P. PECK

The scene shown in the photograph below was taken in a large motion picture studio, and is illustrated at the left. The finished picture gives every indication of having been taken in the out-of-doors, but this illusion was easily accomplished by means of a miniature set and clever scene painting and lighting.

Now let us review another short section of a motion picture. The scene is the deck of a ship. It is pitching and tossing violently on the waves of an angry ocean. Viewing the scene on the screen, you can almost hear the wind whistling through the rigging and feel the salt spray against your face. The hero, braving the rough sea, is admiring nature in one of her wildest moods from the deck of the yacht. Suddenly, without warning, a huge wave approaches, breaks over the rail and sweeps the girl against the side of the cabin with great force. When you see this on the screen you would almost accuse the person who told you that this scene was taken in a studio of stretching the truth to say the least. But he would not
be doing anything of the kind. Scenes such as this are daily occurrences in many of the large studios and we have illustrated in connection with this article just how the work is accomplished. The way that Famous Players-Lasky set a deck scene of this nature is to construct it as illustrated. The entire scene is mounted on a ball pivot and is controlled by means of a series of long levers operated by stage-hands. By proper manipulation of these levers in a predetermined sequence it is possible to give a very realistic rolling and pitching motion to the set. Sometimes the photographs taken on a set of this nature are exposed from the deck of the simulation ship itself, but more often are taken from the side as illustrated. In this way the rolling motion is accentuated and the effect of it more readily imparted to the audience. The monster wave scene is taken by providing an imitation wave from a series of water tanks set up above the deck level and so mounted as to be easily tipped. Then at the critical moment, one of the tanks is tipped over and the effect is exactly the same as if a huge wave had come over-side and swept the heroine off her feet. The background for a scene of this nature is usually painted on canvas as is illustrated.

A FIGHT WITH A SHARK

We have all heard at one time or another of the pearl divers of the south seas. These intrepid adventurers dive into water infested by sharks, gather pearl oysters from the bottom and return to the surface. Often they are supposed to engage in deadly combat with the sharks and such a combat would be most interesting to see. It is almost impossible to film this with any degree of satisfaction, but by resorting once more to the studio and its trickery, it is possible to produce a motion picture that would give all the thrills of an undersea fight without any of the dangers. One of our illustrations show how this is accomplished. An expert swimmer and diver was employed for this work and was suspended in mid-air from a very fine yet strong wire. A flexible dummy shark was also suspended by wires which were controlled from above the scene. By clever manipulation of the control wires, the shark was made to attack the swimmer in a very realistic manner and since the actor was an expert in the water, he went through exactly the same motions as if he were actually swimming. The entire scene was photographed through a glass tank filled with water and in which several small fish were swimming. Thus local “atmosphere” was added. Other scenes interspersed with the fight scene were taken in a large tank and show the diver actually performing aquatic maneuvers. Such insertions of scenes actually taken under water help to sustain the illusion and to cause the audience to believe that they were actually viewing a battle between a swimmer and a ferocious shark.

This is the way the deck scene looked in the movies when the wave came over-side.

When the facts put forth above are presented in cold type it does not seem possible that the effects described could actually be produced and could actually fool the people. However, such is the cleverness of motion picture directors and the trickery of the cameraman that things can often be made to seem just what they are not. And thus the motion picture audience treats its happy way to the neighborhood theatre, is fooled and returns home just as happy as ever though they may know that the pictures that they have been viewing disproved the old saying that the camera cannot lie.

The clever methods worked out by scene artists for the moving picture studios are numerous indeed, and strange as it might seem the problem to be solved for each photoplay production are hardly ever twice the same. Some of the best productions seen on the screen in the last year or two have been made up of a combination of scenes taken aboard a full size ship, sand-witched in between close-up views of cabins, etc. In some cases particularly where ships are to be photographed in a storm scene, a miniature vessel one foot or so in length is caused to bob about in a small tank in a studio. Artificial waves are easily produced with a paddle and with water sprayed over the ship from a garden hose, acted upon by the breeze from an electric fan, a startling storm scene is enacted before the camera.

One of the unusual features of motion picture work, both in the studio as well as in the open, is the fact that colors which show up well on the regular theatre stage, do not photograph distinctly in the movies. Therefore the visitor to the movie studio will be surprised at the peculiar and insipid colors frequently used, both in painting the scenes as well as for facial “making up.”

Those interested in the various tricks used in photographing startling scenes for the movies will find some very interesting reading by looking over past issues of this magazine. Spectacular and unusual scenes which have appeared in many of the leading photodramas and comedies including some of Harold Lloyd’s features, are discussed and elaborately illustrated in the articles which have appeared in these past issues. One of the most stupendous photoplays ever produced, “Ben Hur”, was described in the March issue in elaborate detail.

A scene showing a huge wave coming over the side of a ship and creating havoc on the deck was taken on a studio set as shown above. The ship was rocked by means of the levers shown. The entire setting was carried on a ball pivot.

A battle to the death between a swimmer and a man-eating shark was recently filmed by using a flexible dummy shark and suspending it and the actor on thin wires. The scene was photographed through a tank of water.
"Lost World" Above Berlin  
Movies and Music Aboard Airplane in Clouds

The initial showing of the motion picture, "Lost World" in Germany took place in an airplane over Berlin to the accompaniment of music supplied by radio. The above illustration gives some idea of the effect that was produced.

The pilot of the plane in which the motion picture was being shown increased the uncanny illusion by flying through dense banks of clouds, thus darkening the cabin of the plane and making the showing of the motion picture more effective. The broadcast music received by radio emanated from the Berlin Broadcasting Station and was very well received by the flying receiving set. A loud speaker reproduced the music for the benefit of the audience who enjoyed the sensation thoroughly.

The Starvation Limit Illustrated

<table>
<thead>
<tr>
<th>Animal</th>
<th>Days without Food</th>
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<tbody>
<tr>
<td>Bird</td>
<td>9 days</td>
</tr>
<tr>
<td>Man</td>
<td>12 days</td>
</tr>
<tr>
<td>Dog</td>
<td>20 days</td>
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<tr>
<td>Frog</td>
<td>360 days</td>
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<tr>
<td>Tortoise</td>
<td>500 days</td>
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<tr>
<td>Snake</td>
<td>800 days</td>
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<tr>
<td>Fish</td>
<td>1000 days</td>
</tr>
<tr>
<td>Bug</td>
<td>1200 days</td>
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</tbody>
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It is indeed strange to note the varying lengths of time which various members of the animal kingdom can subsist without food. The above illustrations show the average periods from that of a bird, which can exist for nine days without food, to that of an ordinary insect which lives without nourishment for a period of one thousand two hundred days, nearly four years.

Folding Umbrella

A FOLDING umbrella that will fit into a coat pocket yet when opened is as large as a standard umbrella, has recently been invented by Frank J. Pugel. The umbrella is strong and very durable, yet is light in weight. The steel tube handle telescopes and a few turns of it engage concealed screws which automatically close the umbrella. The outer half of the ribs folds upward and inward against the lower half which in turn folds downward and inward. When the handle is unscrewed and extended the ribs and the covering are automatically opened and held rigidly in place.
Invertible Life Boat

If because of high seas, this new life boat should overturn, the passengers cling to the hand rail on the keel and by rocking backward and forward can soon turn the boat over to its normal position, and climb back in and bail out the water.

New York’s Motor Vehicles

It has been estimated by Harold M. Lewis of New York City that the motor vehicles in that metropolis if placed in one single line would reach from New York to Salt Lake City as illustrated at the right. The saturation point has nearly been reached and relief must be sought from traffic congestion.

New Highly Efficient Storage Battery Promised

If the claims of a young Viennese engineer Gunther Polcich are verified after practical use, we may soon expect a revolution in low-voltage, high-amperage electrical work, such as up to the present time has been and is being accomplished by means of large storage battery installations. Polcich claims to have discovered a new method of battery construction whereby it is possible to make up a storage battery equal in energy to that of a standard battery such as is in use today, yet which will weigh only 1/12th as much. Such a battery would be a great boon to electrically driven automobiles which with ordinary storage batteries have a cruising range of only 70 miles on one charge of the battery. With the new method of constructing batteries, the same size and weight of automobiles could travel 840 miles on a single charge. These batteries are not as yet available as they are in the experimental stage, but when they are brought out for general use, they will undoubtedly greatly increase the number of electrically operated automobiles in use.

Another claim made by Polcich is that he has discovered what he terms a “primary element” and which is capable of producing electricity directly without the use of a charging source, as is required by ordinary storage batteries. The use of this element would do away to a great extent with the use of mechanically generated electricity. Thus by a chemical means it may soon be possible to generate an electrical current at a minimum expense, and in a smaller space than with any other generating and so-called storage system known today.
The Taste Organ

That the sense of taste is responsive to harmonies produced by the proper combinations of materials has been determined by a French scholar, as reported by C. F. Schurch. After developing the theory, this investigator actually built an experimental model of what might be termed a "taste organ" and found it quite successful. In order to enjoy the taste harmonies, it is necessary for the "listener" to hold a small tube in his mouth so that the various concentrated liquids can be injected either singly or in the correct combinations. The organ could be made up to be operated in the manner shown at the left and this illustration is our artist's conception of a completed taste-organ. Consideration of this subject is quite as interesting indeed as that of the "smell-organ," described several years ago in the pages of this magazine. It is problematical if satisfactory jazz effects could be produced by this instrument, and how about the Charleston?

Gold Leaf

Gold, most malleable of all metals, can be beaten into sheets 1/250,000th of an inch thick. A comparison between one million sheets of this gold leaf and the same number of sheets of paper of average thickness and the height of the Woolworth Building is shown above.

A Contrast In Ovens

In the farming sections of Quebec, Canada, bread is not baked in the house in the summer time but in large open air ovens constructed of rocks and clay and covered with a protecting roof as illustrated below. Compare this primitive kitchen with the one at the right. Which would you rather use?

Safety Barrels for Waste

Keeping cotton waste and oily rags of an inflammable nature in steel barrels reduces the fire hazard, shown by the photo at the left. The fire has gained great headway in the wooden barrel but has been slowed up and confined by the steel barrel. Photo courtesy Sheet Steel Trade Extension Committee.

That every match is a potential fire is a fact that cannot be denied and it is certainly well worth while to do everything in your power to prevent fires. The use of sheet steel barrels for containing inflammable waste material is a great step toward fire prevention and the efficiency of such barrels as compared with wooden barrels is graphically illustrated above. The flames in the wooden barrel tend to spread while those in the sheet steel container are confined. The metal barrel operates to cut off the air supply.
Finding the Best No-Knock Fuel

In the past few years there has been a tremendous interest aroused in the automobile world by the development of several fuels which would eliminate knocking in the engine, due to the manner in which the fuel exploded in the cylinder. Tetra-ethyl-lead gasoline did the work admirably, but at present it is out of favor, due to its suspected poisonous characteristics. As pointed out in a communication to the Editor from Prof. George L. Clark of the Massachusetts Institute of Technology, where tests on various no-knock fuels have been made with the apparatus illustrated at the left, there are many brands of commercial gasoline which do not contain tetra-ethyl-lead and yet have non-knocking properties. Benzene and fuel mixtures containing benzene are known to be excellent in this respect.

In the drawing and photograph to the left, the test engine is shown as well as the disposition of the photographic plate and the bouncing pin for determining the amount of knock in each fuel. The engine cylinder is fitted with a 3/4-inch thick fused quartz window. A synchronous motor is utilized for comparing the reaction at the four quarters of a stroke. The spectra are obtained with a quartz prism spectograph.

Cork Kills Vibration

It has been ascertained that felt, rubber, sand, springs and pulverized cork are not the proper mediums to use in eliminating vibration from machinery. The natural cork has been found very satisfactory, however, when properly treated, and this is the material used in the new vibration-proof substance here illustrated in diagram and photo. When properly treated, it has been found that the natural cork is quite inde-
Bicycles That Are No Longer Serviceable for Their Original Purposes Can Be Used in Many Other Ways As Shown and Described On These Pages

New and Unusual Parts of

By P. C. VAN

The illustrations on this page show the following objects, using parts of old bicycles. 1. is a bench grinder, saw or other similar appliance. A bicycle wheel makes a good pulley for a light hoist as at 2. The weather vane shown at 3 employs a bicycle crank and pedal and at 4 cranks are again used for hanging a porch swing. Cranks make excellent gate hinges as is shown at 5. A frame for a circular loop aerial as at 6 is composed of a bicycle rim. The motopeller, see December, 1924, issue of Science & Invention, may be attached to a bicycle frame equipped with skates as at 7. A device of this nature can be made to make an excellent speed over fairly smooth ice and if skiis are used in place of the skates, the vehicle is useful on snow as well.

The Flettner rotor ship shown at 8 and 8a is a particularly interesting device. Properly constructed and equipped with a small gasoline engine, it can be used quite satisfactorily.

A water bicycle that will afford much sport is illustrated at 9. It is steered by a front rudder and propelled by vanes on the rear wheel.

A very interesting model that can easily be made large enough to carry one or more persons and which is propelled by the Flettner rotor principle is illustrated at 8 and 8a. The bicycle rims and parts of the frame are used for shaping the rotor and keeping it rigid. The rotor, suitably braced by lengths of strap iron is turned at a slow speed by means of a small gasoline engine situated in the hull of the boat just under the rotor and suitably geared to it. The general plan shown here should be followed but the details will be dependant upon the material which may be at hand.

The illustration at 8a shows the appearance of a complete experimental Flettner rotor ship.
Uses For The Old Bicycles

PETEGEM

Two bicycle wheels can be used for the ventilating top of a circular tent as at 10. Lengths of bicycle frame tubing suitably suspended make an excellent carillon as shown at 11. By mounting a bicycle wheel as at 12 and placing vanes on the spokes, a wind mill is made. An interesting roulette wheel is shown at 13. 14 shows a film drying rack or reel. A lamp stand, 15, can be made by using sections of wooden bicycle rims. Light canoes can be molded into shape around rims as at 16. A boat rudder is shown at 17. Axles are made into tools as at 18 and a saddle is used as a portable seat as at 19. A door latch is made from a crank as at 20; an automobile starting crank as at 21; a table of bicycle rims as at 22; an antenna spreader of a rim is shown in 23 and a coat hanger is at 24.

All of the illustrations show sufficient details to enable anyone at all handy with tools to make similar devices and to improvise others of his own design.
Transfusing Blood Electrically

By J. W. VON STEIN

The above photograph shows the new method of blood transfusion which differs from the old inasmuch as it uses electrically driven apparatus instead of the usual forms of hand pump. The apparatus was developed by Dr. Angelo Sorese, Professor of the Principles of Surgery at Flower Hospital, New York City. The tube here shown leads from the arm of the donor or the individual from whom the blood is taken. Another tube goes to the recipient.

The diagram illustrates the special cupped ends of all connections to prevent possibility of blood clotting due to sharp projections. Bracelet holds needles.

The accessory shown in the photograph above is used in conjunction with the electrical blood transfusion apparatus and simplifies the processes of local infiltration or regional anesthesia. It is connected to the recipient's terminal of the blood flow controller while the donor's terminal is connected with an anesthesia tank. The anaesthetic is drawn from the tank and forced through the six needles which are to be attached to the end connections shown.

This illustration shows the schematic view of the blood flow controller, the valve in position as they would be when the blood is being drawn into the pump from the donor. The ring on the upper plug prevents the valves being inserted upside down. The balls are seated in the valves by gravity.

The illustration at the left shows the comparative length of the old and new type of needles. The latter can obviously reach a larger area without reinsertion. The construction of the syringe portion of the transfusion unit is also given. The spiral spring renders action of syringes more gentle. Below and to the left, A indicates the method of producing regional anesthesia with the apparatus illustrated at the center of the page. B shows the system of effecting auto-transfusion, when the body of an exsanguinated patient has been opened and a blood vessel has been torn or cut. The body needs blood which is routed from the arm to the body. C shows the method of treating cases of hemophilia. The two needles are inserted in the same individual and the blood is taken from the circulatory system for a few seconds and then re-injected. This lowers coagulation time. Prus may be removed as indicated at D.
A Dozen Daily Dangers
Everyday Dangers That Can Be Easily Avoided By Exercising Judgment
By L. B. ROBBINS

During thunder storms, it is not advisable to touch the metallic parts of telephones, lighting fixtures and plumbing appurtenances. A severe shock may possibly result if such is done.

Do not hunt for gas leaks with a lighted match. An explosion is very likely to take place and to result in injury.

When bathing in a strange place, ascertain the depth of the water before diving. Never go swimming immediately after a heavy meal.

Do you dive before you look? Looking first may save a broken neck.

It is obvious that gasoline should not be handled while you are smoking, but this is often done with fatal consequences.

The result of sitting in a chair as above, may be a fractured skull or injured back if the chair slips, and such is very likely to happen.

No type of internal combustion motor should be allowed to run in a closed space as the exhaust gases are deadly. This particularly applies to small garages. Open doors when motor is being adjusted.

If you must board a train or trolley car while it is moving, always do so through the rear door. When trying to get on at the front door, a slip may throw you under the wheels.

When using a sharp knife, never cut toward yourself as above. If the knife should slip, there is great danger of inflicting a severe cut or doing other damage.

Washing windows in the position shown above is dangerous as a slight dizziness might cause a fall. Wash the windows from the inside by pulling the sashes up or down.

If the fire refuses to burn, do not throw kerosene upon it. An explosion will be the rule rather than the exception in this case.

Before examining any kind of a gun, look in the breech to be sure that it is not loaded. Then the illustrated action is safe.

"Jay" walking is a dangerous yet common habit. Do not indulge in it, but wait for traffic to stop to allow you to pass.
The photo at the right shows a rear view of the new alternating current electric clock.

The enlarged view of the rotor and a view of the stator are given here.

The frequency of current is carefully maintained at the power house, and because this frequency is so accurately checked the electric clock is always correct.

Electric Clock Can't Lose Time

One of the latest devices to make its way to the American market is the Telechron Clock. This is an electrical clock operated from any A.C. circuit. One need merely plug the cord leading to the clock into the lamp socket and set the clock once, and it will continue to run as long as it has a supply of current and will keep absolutely accurate time. Should the current at the power-house be cut off for some unknown reason, a small red disc drops into view and notifies the user of the clock that the time is no longer accurate and that the clock should be reset. The motor consists of a small two-watt motor provided with shading coils and the rotor is illustrated in the upper left hand corner of this page. The frequency of the current must be carefully checked at the central station, because of its use in operating motors in weaving plants.

Photos courtesy Electime Company.

Triplex Ammeters

With the meter illustrated above it is possible to take readings in three different phases simultaneously as contrasted with the usual scheme of having one ammeter and switching it from one transformer secondary to another by means of the conventional jack. Three-phase circuits may thus be more evenly balanced, thereby tending to prevent uneven loading.

Photo courtesy Roller-Smith.

Giant Rotorship

The Barbara-Barbara, the latest and greatest rotorship just launched, is a 3000-ton vessel with a 1000-H.P. engine. Through the propeller this engine will give her a speed of 10 knots without the rotors. In a fair breeze her three rotors, requiring 40 H.P. each to drive her, will give the vessel a speed of 11 3/4 to 13 knots. Obviously, the saving in fuel is very great.

The photograph above gives us a representation of what the Barbara-Barbara, Anton Flettner's new Rotorship will look like on the high seas. Spinning the rotors enhances the effect of the wind on the cylinders, in accordance with the well-known Magnus effect.

Photos courtesy Roller-Smith.
New Devices of the Month

On this page we are showing a group of the newest devices which can be employed around the home and in the office, as well as in the field of sports. The addresses of the manufacturers of these devices may be obtained by writing to this publication.

The bowl above combines all the advantages of a high chair, a rocking horse, a play pen and a walker, without the drawbacks enabling the baby to turn, but making it impossible for him to tip over. The bowl may be locked when the baby is to be fed and the feeding tray may be attached.—R. L. Doak.

Opening case is an easy task with a device like the one shown here. Pick up the can, turn the handle and the top is off, leaving the edge clean and smooth.—R. L. Doak.

The secret of a long drive on the links depends upon the speed of the head of the club at the time it makes contact with the ball, and this speed can best be obtained when the club is held loosely. This grip permits of relaxation.—P. A. Valie.

A very unique can opener is illustrated above. This can opener will remove the top of any shape of can. The cutter itself cuts down into the top instead of cutting around the edge. The teeth grip the sides of the can.—Walter J. Shampel.

The above photograph shows a new type of compressed air scooter. It will be noted that the device runs on two wheels and is steered by turning the front wheel. The tank at the back furnishes the air for driving the scooter and the supply may be replenished at any "free air" gas filling station.

The photograph shows an apparatus for purifying the air in a room or for passing perfumed air through the room. The webbing in back of the fan dips into an essence of salt or balsam, producing an effect of sea air or pine forests.

The latest development in check insurance is the application of the finger-print identification method to the signature. The pad holds the ink and a cleaning paste.

Turning the crank operates the can opener shown.

You can save yourself a fright and make baby's bath safe by putting this support into the bathtub. The support consists of a metal frame on which a canvas hammock is supported. It hangs from the edge of baby's bathtub by means of suitable clips and the height may be adjusted at both ends so that the child's head may be kept out of water regardless of how she may slide down into the tub.

The two photographs above show an electric lamp which requires no batteries. This is a French idea. The dynamo is rotated by the turbine which is operated by blowing into the tube. The turbine rotates so easily that the light can be kept going for a long time without producing the usual tiring effect. The action is almost that of breathing.—N. C. McLoud.
Interesting Bits of Science

In the last few years, science has pursued the teller of untruths relentlessly with its knowledge and has succeeded in constructing several different devices that make it possible to mechanically detect whether or not a person is telling the truth. Several devices of this nature have been described heretofore in the pages of this publication and one of the very latest models is shown in operation at the immediate left. The gentlewoman standing behind the instrument is its inventor, Herbert Laplan, psycho-analyist and the subject of the experiment is Miss Dolores del Rio. She has been asked her correct age and the machine will immediately reveal whether or not the "Twenty" that she answers is correct. One of the important uses of this device is said to be the determination of the ages of film stars. It is not unusual for a young lady to clip a few years from her correct age, especially when trying to enter the movies, but it is essential to the directors that they know the truth.

Motor-driven roller skates that require very little exertion on the part of the user are the latest German novelty, and are shown in operation in the photograph reproduced at the left. The control wires are held in the hand.

One of the roller skates shown in operation above is illustrated in the close-up photograph at the left. The power for driving these roller skates is furnished by tiny acetylene gas-driven motors. It is possible to roll along at quite a respectable rate of speed with these skates and use of acetylene gas in the efficiently designed motor reduces the operating cost considerably below that found if gasoline is used. These roller skates were designed by Gebhardt, a noted automotive engineer of Germany, who has recently concentrated his efforts toward the production of small, light-weight high-powered engines particularly adaptable for use in airplanes and other places where light weight, economy and great power are paramount.

The photo at the left shows the interior of the cab of one of the locomotives used on Captain Howey's miniature railroad system. Eight miles of track are now available and the locomotive in use will draw coaches carrying 300 passengers. The power of the engine, whose cab is shown in the left, makes it possible for it to draw a load of 75 tons.

The colors preferred by insects are studied by means of the device shown above, so that proper bait for traps or poisons can be determined.
By PROF. T. O'CONOR SLOANE, Ph.D., LL.D.

The experiments illustrated on this page illustrate capillarity and phenomena of water pressure due to siphon action and some demonstrations of surface tension of water. The surface of water in its action is comparable to a sheet of thin elastic rubber. In the pores of the blotting paper, the little surface areas creep along the opening and drag the water after them. In the experiment with the needle and loop of thread, it is the surface tension that does the work. If one watches a drop of water, say on the edge of a window blind, you could picture to yourself that the film of water forms a little bag to hold the fluid, and when it gets ready to fall, a neck forms above it next to the wood, and this is illustrated beautifully in the experiment shown below in this column. The presence of alcohol reduces surface tension in water, and this is why, because of the unaffected water outside, the thread is drawn into a circle and the needle floats because of surface tension. The experiments with siphons speak for themselves and will be readily understood by our readers.

It is the old story of water seeking its own level told in experiments. In the siphon water acts as if it were a rope passing over a pulley.

**Capillary Vacuum**
A piece of thick blotting paper is placed upon a piece of glass. A wine glass is filled brimfull of water. The glass and paper is placed upon it and it is inverted on the table. The paper is drawn into the glass by the vacuum and the glass can be held as shown. Evaporation of the water from the blotting paper increases the vacuum.

**Surface Tension**
A loop of thread is floated on water. Touching the water inside it with alcohol, the loop flies out into a circle. By using a bent hairpin, a needle can be floated upon water.

**Capillary Siphon**
A bent wire has a lamp wick wound around it as shown. The wick is thoroughly wet, and when placed as shown will act as a siphon, and will keep up a continuous drip. This is of use for nursing invalids, where a bandage or compress is to be kept moistened for long periods.

**Siphon Action**
A lamp chimney with a piece of thin sheet rubber tied over its end demonstrates the action of the siphon when placed below the level of the water in the graduate. On the right is shown the action when above the level of the water.

In this case the longer arm of the siphon exercises suction upon the water in the lamp chimney drawing the India rubber inwards.

**Giant Water Drop**
A hoop has a sheet of thin rubber stretched tightly across it. By pouring in water the illustration of the formation of a water drop is beautifully produced. Immersing the hand in the water depresses the rubber and upon lifting the hand out the rubber will spring back.

**Pressures Due to Siphon**
Mercury is contained in the bottom of the test tube. The cork fits tightly. As water is siphoned into it, the column of mercury is forced upward by the pressure produced. It is an excellent demonstration of siphon action. The siphon must be started with the cork out of the tube, and then the cork is put in as quickly as possible.

This may be taken as a version of the experiments with the lamp-chimneys and India rubber diaphragm. The mercury acts as the elastic sheet of India rubber did. Another way of utilizing the mercurial column is to place the beaker below the test tube when air will bubble through the mercury.
The Month's Scientific News Illustrated

By GEORGE WALL

In a most unusual accident which occurred in Fresno, Calif., George Krabian received contusions of the right chest, produced by one of his car's rubber tires when it suddenly left the wheel, struck a locomotive and re-bounded in the manner shown.

Out in the Green River Canyon, Washington, flames shoot high in the air from a pool of cold salt water. Gas passing up through the water is ignited whenever a match is thrown in the pool. Sometimes it sinks almost out of sight.

The picture above shows the Bureau of Standards' method employed for photographing the interior surface of a rifle barrel. A long periscope carrying an electric light is inserted in the barrel, and a special lens and movie camera photographs the interior of the barrel. Six exposures taken the whole interior.

How would you like a braid of hair thirteen feet long? Not only that, suppose you were a midget and good only 23 inches high? As shown in the interesting picture above there actually was a man of this small stature who possessed a quizz 15 ft. long, and his name was Che Mah. This famous midget was for years a stellar attraction of Barnum and Bailey's circus and died recently at the age of 38. He died leaving a good sized fortune.

Walter D'Arcy Ryan, illumination engineer, proposes to project movies against a smoke screen at Atlantic City soon.

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While a number of inventors have advocated the use of a large parachute for the purpose of saving a falling airplane, here is the latest idea for such a device.

Fall River, Mass., recently had its electric current supply cut off because Fussy attempted to get a spar for breakfast, and short-circuited a transformer.

New method of cancer diagnosis devised by a German scientist, whereby this disease may be diagnosed by examining a few drops of the patient's blood. The blood is examined spectroscopically.

In a ship fire near New Orleans, some of the crew saved their lives by jumping overboard and swimming under water until they got beyond the range of the burning oil on the surface.

The gigantic Sesqui-Centennial Exposition at Philadelphia this year boasts of a huge Liberty Bell mounted over the entrance gates to the exposition. The appearance of this seventy-foot bell is illustrated above. It weighs 42 tons and is illuminated as night by 26,000 incandescent lamps, enough to light up a fair sized town in brilliant fashion and provide a "white way" in the bargain. This represents but one of the many magnificent displays at the Philadelphia exposition.

The picture at the left depicts an ingenious scheme for showing motion pictures against a smoke screen, as proposed by a well-known lighting expert. This stunt is to be tried out in connection with a proposed permanent international exposition for Atlantic City, N. J. Similar schemes to this have been proposed and tried out before for advertising purposes with clouds as a background, but this is too much of a gamble. A smoke screen should solve the problem quite successfully.
Knock-Down Porch Furniture

By WILLIAM M. BUTTERFIELD

There is always considerable interest in porch and other out-door furniture. The drawings herewith show how to build an armchair, a rocker, a table, a settee, and a bookcase. Oak is probably the best wood out of which to build this furniture, as it is very strong and will give the longest service. Moreover, the oak finishes up very nicely with a minimum of trouble, the dull wax or oil finish being simple and easy to apply. The furniture may be given a coat of the new popular gray stain and then finished with wax, or else a coat or two of thin varnish.

There is a secret about applying the much desired gray stain, and it involves the mixing of white paint or white lead with the stain, until the desired color is obtained. Mix sufficient stain to finish the whole job to avoid matching colors. One inch oak material is used for armchair and rocker. A seat made of one-fourth inch veneer board is used on the chairs. The table top and shelf as well as the chairs, are covered with striped canvas. The bookcase is made of any desired size of three-quarter inch oak; the back is made from one-fourth inch veneer board.
Tarrano the Conqueror
THIRTEENTH INSTALLMENT

By RAY CUMMINGS

First American and Canadian Serial Rights

SYNOPSIS

In the spring of the year 2325, all of the rulers of the various countries of the earth are mysteriously murdered. Jac and Grayson have been sent to Venus to find that the murderers are the result of a plot and that the inhabitants of Venus, Tarrano, an ex-royal colonel officer of the Cold Country of Venus is found to be at the head of a plot to rule the universe.

Dr. Brendel, a friend of Jac's, has discovered a medical method whereby human beings may be kept from growing old. The Doctor is killed by a group of 'Venus-men' and Jac, Elza, the Doctor's daughter and Georg, the Doctor's son, are captured and taken to Venus, a city on the earth inhabited by people of Venus.

The next day, Tarrano offers to return the papers and models of the invention made by Georg's father, which he has confiscated and brands young Brendel as an impostor. To offset this accusation, the Doctor performs a story to the earth as well as to Venus and Maida. He and his party, Maida go to the station but there they disappear.

Jac, Wolfgar and Elza, still captives, are removed from their prison and taken to the top of a huge tower. Jac is locked in a cell, and then taken to the trial room, where communication with the palace is allowed. He is warned not to speak, and in his stead, the disappearance of the Princess Maida and Georg by television. The Doctor has been brought by Tarrano's agents. On Mars, Tarrano's followers are attacking the vessel, and Tarrano offers to the people if they surrender to his college to achieve more than they anticipate the Earth people, that he will not give them the slightest declaration and declare war upon them. W. H. C. is a guard in the reproduction of the air war vessels of the Earth government. Start to attack Venus, but Tarrano's vessels of combat and those with Elza, Jac and Wolfgar, are exchanged for a space-flight. They are attacked and are taken to Venus to where Georg and the Princess Maida have previously been transported. They are royally welcomed and go to the palace. Maida and Georg are there attacked by Asgo, one of Tarrano's men, who shoots a colored beam of light across the room, separating Maida to the left of the party. He threatens to kill her, when suddenly Wolfgar throws himself into the light and takes the colored beam from her. He flies over and tells Maida to love her and Maida had been talking.

A year later, Maida and Georg are married and rule as the royal family of Venus. They are married and rule their own planet.

The air war vessels of the Earth government start to attack Venus, but Tarrano's vessels of combat and those with Elza, Jac and Wolfgar, are exchanged for a space-flight. They are attacked and are taken to Venus to where Georg and the Princess Maida have previously been transported. They are royally welcomed and go to the palace. Maida and Georg are there attacked by Asgo, one of Tarrano's men, who shoots a colored beam of light across the room, separating Maida to the left of the party. He threatens to kill her, when suddenly Wolfgar throws himself into the light and takes the colored beam from her. He falls over and tells Maida to love her and Maida had been talking.

The evening after the burial of Wolfgar, Jac chances to be alone in a small boat near the palace, and Maida, who is his lover, brings him a sardonic smile leaning down at him. She says, "Do your best, my friends!" and then moves on. Out of the boat, she can be heard to exclaim, "This is a wonderful broadcasted word!"

Up there in the clouds a gigantic image of Tarrano was materializing. His head and shoulders were in a sadistic smile leaning down at us. "Lips moving," he said, "are keeping Tarrano waiting most impatiently!"

CHAPTER XXX

The Monster

I STOOD frozen with horror; but as my brain cleared—awoke at last to full rationality and consciousness—beneath the horror came a surging joy of the knowledge that at last Elza was near me. The scream was repeated; inactive no longer, I dashed the thicket branches apart with my arms and plunged forward through the darkness.

Ahead of me the thicket opened into a sort of clearing. I saw the sky, the stars—paling stars with the first blush of dawn overpowering them. I stood at the edge of an open space in the dim, flat-gray illumination of morning twilight.

Elza! She was there, standing near a huge isolated tree; Elza, pale, trembling, a hand pressed against her mouth in terror; disheveled, her garments dirty and torn with her wanderings through the forest.

A swift glimpse as momentarily I paused; a second or two only, but the scene was impressed upon my brain as an image of light upon a photo-screen. Close by Elza, partially behind her, I saw something small, no taller than Elza's waist. A naked thing of sleek, gleaming skin. The monstrosity of a human child; a bulging head, wavering upon a neck incapable of supporting it; a thick round body; twisted misshapen limbs. A face ... human? It made my gorge rise with its gruesome suggestion of humanity. Nostrils—no nose; a mouth, lipsless, but red like a curved gash with upturned corners to make the travesty of a grin; a triangle of watery eyes, goggling. Sensedly, it stood watching Elza with a dull, vacant curiosity. Not human, this thing! Yet most monstrously repulsive in its hideous suggestion of an idiot child.

Elza was not facing it; my gaze instinctively followed her to the tree. Crowning horror! The adult of this thing upon the ground hung swaying by a thick band and arm from a low limb; hung, then dropped Groveling, moaning as though it would try and form human words of menace, it picked itself up and shambled toward Elza.

I leaped for them. Elza seemed too terrified to run. The thing reached her, towered over her; seized her in its arms. She
screamed—the agony of revolt and terror; but over her voice rose my own shout of rage, and abruptly the thing dropped her and turned to confront me. Snarling, glaring with its three hideous blood-shot eyes; waving its thick, bent arms.

I had no weapons save those with which nature had endowed me. The regret of that came as a fleeting thought; and then I crasht into the thing; my fist, passing its awkward guard, struck it full in the face. I sickened. Even in the heat of combat a nausea swept me. For no solid flesh and bone met my blow. Like the shell of an egg, my fist crashed into and through its face.

Warm, sticky moisture... a stench... The thing had toppled backward, with me sprawling upon its bloated bulk. It struggled, writhed... Its arms gripped me, its huge fingers clutched my throat... I caught a glimpse of its smashed face... so close, I turned away... a face of yellow-white pulp...

My fist cracked and sunk into its chest. I pounded, smashed; broke the shell of its distended body... noisome... the revulsion, the nausea of it all but overcame me.

At last the thing lay still; and from the wet, sticky fœdity of it I rose and stood shuddering. Elza lay on the ground; but she had risen upon one elbow and I saw that she was unharmed save for the shock of terror through which she had passed—a mitigated shock with the knowledge now that I was with her, and that I too was unjutred.

The infant thing had vanished. I hastened forward.

"Elza! Elza, dear..."

Joy lighted her face.

"Jac..."

I would have lifted her up; but the consciousness of my own fœdity—the yellow-white slime streaked with red which smeared my arms, splattered my clothing—gave me pause. In the growing light, beyond the clearing, I caught the silver sheen of water. Without a word I ran for it; a shimmering pool the existence of which no doubt had drawn these gruesome beings of the forest into its vicinity. To the cleansing water I ran, plunged in, purged myself of that horror...
The Cylinder from Olympus

Mephistopheles' Glass Plate

A plate of glass measuring 12x14 inches is suspended in mid-air by means of two ribbons hanging from the edges. Inside the center of the plate is a small metal cylinder. The assistant, pulling the string attached to this cylinder, makes it disappear. A handkerchief is left inside, and presto! anything that the assistant wishes to pull through the hole in the glass remains.

Rising Cards Improved

With the use of the prepared deck made as illustrated above a very pretty card rising effect can be produced which is almost impossible of detection.

Chinese Box Trick

A small box about six inches square without top or bottom is shown and a ribbon passed through holes in the sides of the box. The ends of the ribbon are held by two spectators, the box is covered for an instant by a handkerchief, and a billiard ball with a hole bored through it is caused to appear on the ribbon. The secret lies in the construction of the box, which contains two metal hemispheres, through which the ribbon is passed in being threaded through the box. Under cover of the cloth, the shells are brought together at the centre and their edges joined.
AWARDS IN $5000.00 MATCHCRAFT CONTEST

Replica of Metropolitan Tower Wins
First Prize--$100.00

THIS extraordinary example of the Matchcrafter's art, won for its maker, Mr. John Petry of New York City, the first prize in this month's Matchcraft Contest. Mr. Petry started to build this model about three months ago and kept at it on spare time. Of course, he had the advantage over the folk living in other cities in that he could go to the tower and examine it and make sketches of its architectural features and duplicate them in match construction. In the model as submitted in the contest there is no celluloid used in place of glass in the windows. The openings are devoid of any material, although it would be a simple matter to place something in back of the window frames so as to give the effect of glass. The clock on the tower is also made of matches and does not actually run. Mr. Petry is thinking of substituting a timepiece for each of the clock faces when the model is returned. An idea of the size of the model can be obtained by comparing it with the photograph of Miss Frankey DiOrio standing beside it. The height of the building is 11½ inches and the tower alone is 3 feet 2 inches. Approximately 15,000 matches were used in the construction.

$5,000.00 Prize "Matchcraft" Contest

FOR the present year, SCIENCE AND INVENTION magazine will award a total of $5,000 in prizes in a new contest. You are asked to make models, fashioning the same entirely from safety matches. Please observe the following simple rules:

1. Models submitted must contain at least 90 per cent. safety matches in their construction.
2. Models made of toothpicks, paper matches, or non-safety matches, are not eligible in this contest.
3. Models can be built around boxes or other supporting articles. Walls, roofs, etc., must all be self-supporting and made of matches.
4. All liquid adhesives, such as glue, shellac, cement, etc., are permissible.
5. Models may be painted, gilded or silvered.
6. Models may be of any size.
7. In order to win a prize, it is necessary that either models be submitted, or, if this is not practical, owing to their size, a 3" x 7" photograph of the model must be sent in letter size. The best models submitted each month will be awarded the prizes scheduled herewith.

16 Monthly Prizes

First Prize ............................................ $100.00
Second Prize .......................................... 75.00
Third Prize ............................................ 50.00
Fourth Prize .......................................... 25.00
Fifth Prize ............................................ 20.00
Sixth Prize ............................................ 15.00
Seventh Prize .......................................... 12.50
Eighth Prize ........................................... 10.00
9th to 16th Prizes of $10.00 each ................. $80.00

(8) All models submitted to SCIENCE AND INVENTION Magazine will be promptly returned to the builders, who will pay for all charges.

Caution—Soak or cut heads from matches before building your model so that the models may be expressed or mailed. The strike-everywhere square cut Liberty matches can be used if the heads are cut off.

REMEmBER—This is a monthly contest offering sixteen prizes every month. Don't hesitate, send in your model now!
SECOND PRIZE — $75.00.
The two photographs at the right show the Matchcraft model of a Mississippi River steamboat which won the second prize in this month’s contest. Note how realistically the gangplank and rowboat are supported and also observe how carefully the matches have been laid in place so as to form an artistic pattern. The stairways in this model are also made of matches and they can be clearly seen in the enlarged view at the extreme right. The winner is John David Sanghood of Ft. Thomas, Kentucky.

THIRD PRIZE — $50.00. The match hat shown here was made by Mr. Fred Spinden of Abingdon, Illinois. Mr. Spinden was a winner of the third prize announced in the March issue. We hear of him again as the winner of the ninth prize in the April issue, and now he is with us again. Note that every one of the matches is bent.

FOURTH PRIZE — $35.00. The very interesting model of a tennis racket and ball was made by Mr. Carl Fichtner of Philadelphia, Pa., who has been an aspirant for the first prize since the contest was started. It will be remembered that Mr. Fichtner won the ninth prize in the contest announced in the May issue. The ball is hollow and the strings on the racket are made of matches dove-tailed and very accurately fitted.

ELEVENTH PRIZE — $10.00. The alligator, or is it a crocodile? Illustrated below is a most remarkable piece of work. Its body is hollow and it surely looks like the real thing. The animal is holding a colored child in its jaws; the teeth, tongue, roof of the mouth are also composed of matches as is the infant. The prize is awarded to Mrs. Annie L. Tuttle of Jacksonville, Florida.

SIXTH PRIZE — $25.00. The structural work of the body and lower wing of a biplane was so well executed that the judges awarded Paul Walter, West Palm Beach, Florida, this prize. Rudder and elevators are operated from seat.

THIRTEENTH PRIZE — $10.00. The model of the church here illustrated was made by Albert W. E. Henne of Denver, Colorado. This model was not painted and its lines can be clearly seen from the they are not painted because the match construction can be shown more clearly in the photographic reproduction. It is hard to show how these models are built up when they are covered with a thick paint, shown below any justice. The glider construction on this model is made of matches which are split in the top road bed four parallel tracks are laid for the trains. Note the ruler in the photograph. This model was built by David Savidge of Tower City, Pa.

Flowers, Baskets and Pens Now Made of Matches

TWELFTH PRIZE — $10.00. After carefully bending his matches to form a vase, and gluing them in place, Mr. Eugene Jefferies of Anacortes, Washington, carefully sandpapered the vase inside and out, smooth- ing it down. Not being satisfied with a plain vase, he decided to make flowers of split matches. Miss Doro- thea A. McGarity appears above and close-up of vase.

NINTH PRIZE — $1.00. The spinning wheel here shown is also of match construction. Instead of drilling the holes in the wooden match posts which serve as the bearings for the moving parts of this wheel, the holes were burst in the wood by means of thin hot wires. The spokes for the wheel were made of matches shaved down to make them thinner. This novelty was built by Oscar Solow of New York City, who also won the fifth prize in the June contest.

FOURTEENTH PRIZE — $10.00. Mr. E. Don Bailey of Columbus, Indiana made the banjo-uke illustrated here. It is being played by Miss Ruth D. Olsen. The body, sides and back as well as the neck and head are made of match construction. It may be remembered that Mr. Bailey won the fifteenth prize for the battleship which he made and entered in the April Matchcraft Contest. An enlarged view of the uke is also illustrated.

SEVENTH PRIZE — $15.00. This beautiful parthenon-like building with its myriads of columns was built by Mrs. E. V. Schep- per, Asotin, Long Island, who won the Fourteenth Prize in the June issue and the Second Prize in the May issue Matchcraft Contests. There is a carved figure in the building which can be seen through the front doors.

SIXTEENTH PRIZE — $10.00. Two views of the self-filling fountain pen are illustrated below. A slot in the side enables a coin to be used as the filling trigger. The maker did not send his name.

TENTH PRIZE — $10.00. Exercising great care in laying his matches in place, Mr. Charles J. Lovell, of Clinton, Maine, made this waste paper basket. He used the ordinary type of strike-anywhere matches, but made them safety by cutting off the striking heads on each and every one of the matches.

FIFTEENTH PRIZE — $10.00. The motor below or perhaps it is a dynamo is built entirely of matches. In order to make the construction more nearly one hun- dred per cent matches, Mr. Walter Hud- son of Milton, Wis- consin, made com- mutator and brushes of matches also.
Looseative Wins Third Science and Invention Trophy Cup

Harry L. Woodson of St. Louis, Missouri, Is Awarded This Month's Prize.

Each month this publication awards a handsome cup 15 1/2 inches high and weighing nearly five pounds for the best model submitted during the month. The model can be a ship, an airplane, a submarine, an engine or in fact anything. Photograph of the cup, the certificate of award and the locomotive model which won it is shown at the right. Mr. Woodson and his model are shown in the photograph at the left.

Rules for Model Contest

1. A handsome trophy cup engraved with your name, will be awarded as the prize for the best model submitted during the month. The decision of the judges will be final and will be based upon, A—novelty of construction; B—workmanship; C—operating efficiency of the model as related to the efficiency of the device which the model simulates, and D—the care exercised in design and in submitting to us sketches and other details covering the model.

2. Models of all kinds may be entered. They may be working models or not, according to the subject that is being handled.

3. Models may be made of any available material, preferably something that is cheap and easily obtainable. Models made of matches should not be submitted to this department but should go to our Matchcraft Contest Editor.

4. Models must be submitted in all cases. Good photographs are also highly desirable and where the maker does not desire the model to be taken apart, legible drawings with all dimensions covering parts that are not accessible must be submitted.

5. Models should be securely crated and protected against damage in shipment and sent to us by parcel post, express or freight, prepaid. Models will be returned when requested.

6. Models for entry in any particular contest must reach this office on or before the 25th of the month preceding date of publication. For instance, models for the September contest must reach us on or before the 25th of August.

7. Address all entries to Editor Model Department, c/o Science and Invention Magazine, 53 Park Place, New York City.

Mr. Harry L. Woodson, who won the third cup for his model of a locomotive and tender built this model of odds and ends of material. The boiler of the locomotive is made of a sheet of copper, seamed and soldered at the bottom. The cylinder is made of a piece of brass tube and the box on top of it was poured directly on the tube, using a mixture of solder and Babbitt metal. The sliding valve was made of Babbitt. In the construction of this engine, the soldering iron is the main tool.

This is a close view of the locomotive and tender. The tender houses the gasoline blow-torch, the nozzle of which projects under the boiler. Note how the paint on the pit beneath the boiler has been cracked due to the intense heat. Because of the large bore and long stroke of the engine, the locomotive develops a surprising amount of power. The head-light on the front is wired to two flashlight batteries clamped beneath the tender.

A CUP A MONTH—Who Will Be The Winner In August?
Model Locomotive With Gasoline-Fired Boiler

Drawings Show the Assembly of the Model Locomotive Which Won the Third SCIENCE & INVENTION CUP.

THE model locomotive (assembly drawings shown above) was made entirely of scrap parts by Mr. Harry L. Woodson of St. Louis, Missouri. The scale at the bottom of the drawings is in inches. With its aid, one can obtain the comparative size of the various parts of the locomotive. This locomotive has an ordinary cylindrical boiler which in this particular model was made of a strip of copper seamed at the bottom and hard soldered. The steam exhausts into the smoke stack. The cylinders are made of brass tubing and the metal for the valve chambers is poured on each tube with half solder and half Babbit metal. The cylinders have a one-inch bore and the pistons have a two and one-quarter inch stroke. The tender contains fuel tank and torch.

A cup is awarded every month. Send your model in now.
EXPERIMENTAL CHEMISTRY

Experiments With Ozone

By RAYMOND B. WAILES

Ozone is the stuff which is popularly believed to give the tang to ocean breezes, and the freshness to the country air. It is really an allotrope of oxygen, masquerading under a made-over countenance, with nose stuck high into the air. But, despite its haughtiness, it is very easily come down to another notch, to be once again ordinary oxygen. Such high-faluting properties can be easily imparted to oxygen or air, and then again rapped on the shins and made to assume their normal state, as the following experiments show.

Most of us have noticed the peculiar garlic-like odor in the atmosphere surrounding motors, even of the small toy type. The author first noticed this effect when, as a boy, he spun a little cotton-spool windmill by the well-known "Little Hustler" motor. A toy motor when running at high speeds as they do, and sparking heavily at the brushes as they also do, gives off quite a bit of the form of oxygen gas which is commonly termed ozone. The gas can be detected by its odor. "Your nose knows." This is the most obvious test for the presence of ozone, namely its peculiar oniony odor.

Ozone will discolor certain chemicals, among them being a mixture of potassium iodide and starch. Its action in this case is to set iodine free which with starch solution produces a bright blue color. The solutions should be rather weak to give good effect. A pinch of starch is shaken into a test tube one-quarter filled with a warm solution of potassium iodide. Into the suspension formed, strips of white filter paper are dipped, removed, dried and preserved in a tightly stoppered bottle. One of these strips, if moistened and exposed to the air near the brushes of a toy motor in operation, will turn blue if ozone is being formed by the sparking at the brushes. These potassium iodide-starch papers can be used as tests for ozone in any of the following experiments.

Another simple method of producing ozone is by the slow oxidation of phosphorus. Bits of phosphorus are placed in a bottle fitted with a stopper carrying two tubes, one protruding into the bottle and reaching it nearly to the bottom. A small quantity of water, just enough to half cover the phosphorus lumps, is placed in the bottle. At the end of the day the air within the bottle will be ozonized, and by passing a stream of water into the bottle through the longer tube, the ozone-laden stream of air will issue from the shorter piece of tubing. A strip of moistened iodide of starch paper, hung at the exit will become quickly discolored if ozone is present.

A simple way of producing ozone electrically is to utilize a simple home-made glass dielectric condenser made from a glass tumbler coated on the inside and the outside with tinfoil, the foils not touching each other. It is a sort of simplified Leyden jar. The inner foil should be connected with one secondary terminal of a spark coil and the outer coating of the glass tumbler connected to the remaining secondary terminal of the spark coil. A Ford coil can be used. On operating the coil, a silent or brush discharge will take place through the glass between the foils, and some of the oxygen of the air between the glass and the foils will be converted into ozone. It can be recognized by its odor or by the iodide of starch paper. It is best to lay the inside foil within the tumbler and not affix it snugly to the glass.

Another method for the production of ozone is brought about by a slightly different apparatus. Two bare copper wires are connected to the secondary of a spark coil. The wires run the length of a glass tube on the inside, but are not permitted to come in contact with each other in any way. A stream of air passed through the tube becomes ozonized when the coil is operated. A better method for producing ozone is carried out with an apparatus shown in one of the photographs. A coating of tin or copper foil is wrapped around the glass jacket of a Leibig condenser, which has a straight inner tube. One end of the condenser, preferably the delivery end, is closed with a cork. The other end of the condenser is fitted with a cork which carries a wire for contact with a dilute solution of salt water, sulphuric acid, or any other electrolyte which is poured into the inner tube of the condenser. The cork which carries the electrode is inserted and the electrode connected to one side of the secondary of a small spark coil. The tinfoil or copper foil is connected with the remaining electrode. A stream of oxygen or of air is then passed through the outer casing or tube of the condenser, entering by one of the side tubes. If the coil is operated, a stream of ozonized air will be delivered from the other side tube. An interesting experiment with ozone can be performed which produces much amusement. Several crystals of potassium permanganate are moistened with water and upon the little pile a drop or two of strong sulphuric acid is allowed to fall. A stream of illuminating gas directed against the pile of crystals will immediately become ignited, and burn with a white flame.

Science and Invention for July, 1926

www.americanradiohistory.com
Luminous paint can be purchased or it can be made up of phosphorescent calcium sulphide dissolved in the proportions shown in the upper left-hand corner of this page. The paint so prepared should be distributed smoothly over the surface of a glass plate and allowed to dry. Several thin layers are better than one thick coat. The plate so prepared is placed in a frame together with a lantern slide or other positive transparency, the frame being conveniently made as shown.

The luminous plate should be exposed to sunlight or to burning magnesium ribbon either before or after it is placed in the frame. Inspection of the assembled photograph will show a very weird effect. Luminous stencils can be made by placing a cut-out sheet over a luminous plate as at the right.

Actual luminous photographs can be made by exposing a prepared luminous plate in a camera in just the same way as a photographic plate is normally exposed. Follow the directions given for exposure, experimenting until the correct time has been determined. Before exposure, the prepared plate should be kept in darkness and should not be exposed to light for a day or two before use. Variations are to expose luminous plate to light through stencil or through negative, remove the covering and the designs will stand out in luminous relief.

Luminous photographs are made by exposing the prepared plate in a camera.

Luminous pictures can be made up of phosphorescent calcium sulphide dissolved in the proportions shown in the upper left-hand corner of this page. The paint so prepared should be distributed smoothly over the surface of a glass plate and allowed to dry. Several thin layers are better than one thick coat. The plate so prepared is placed in a frame together with a lantern slide or other positive transparency, the frame being conveniently made as shown.

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Electrolyzing by Alternating Currents

By Wesley Cole

IN preparing a solution of water, salt, and zonite (a hypertonic electrolyzed solution of sodium oxychloride), and passing a 60-cycle alternating current at 100 volts through the solution, the hydrogen and oxygen, which result from the decomposition of the water, will be polarized and will pass to the electrodes, and will lose their charge as soon as they reach them. The electrodes are neither anodes nor cathodes, due to the change in polarity of the current. The gases therefore do not form into separate columns of hydrogen and oxygen, but bubble off together.

When the solution is first placed in the gas-collecting apparatus, it is colorless, but after a while there comes a brown sediment due to the sodium. This gradually combines with the water to form a very weak solution of lye.

A gaseous element such as hydrogen, oxygen and chlorine which become molecules of the element gas and pass off.

The salt furnishes respectively one ion of chlorine and one of sodium which when they reach one of the electrodes lose their charge and become atoms. The chlorine passes off as a gas while the sodium remains for the present in the solution. The difference between, for instance, Cl, and 2Cl is that 2Cl is just two atoms of chlorine while Cl is a molecule and may pass off as a gas. The water and the zonite each form an oxygen ion which becomes two atoms of oxygen on touching an electrode and then after they unite with each other, they form a molecule of oxygen gas which passes off. All the products formed are gases except sodium of which there are two atoms. These two atoms of sodium combine with two molecules of water to form two molecules of a weak lye solution.

The preceding information may seem technical but it will help those who are used to definite formulas. There is nothing more which can be explained to the chemist. The following illustration serves to make it clear:

A small electric lamp bulb which has been burst out or one with the filament broken is necessary. Knock the tip off. Air will rush in. One may easily break the glass filament support rod in the bulb. The bulb should be entirely clear of pieces of filament or fragments of glass.

Then prepare a solution of salt, zonite, and water of which the proportions may vary. Fill the prepared bulb with this solution, screw the bulb into a socket in such a position that the bulb will point to the ceiling. Send through 110 volts. It is advisable to have a 25-ampere fuse or possibly a thirty-ampere fuse in the fuse box. One will see bubbles rise in the tip. The gas will escape through the hole in the top of the bulb. After current has been going for about two minutes steady, feel the bulb. It is warm. An illustration is pictured opposite.

The escaping gas can be easily collected by natural means of which I will not attempt to explain here. The youthful experimenter can work on this which will prove profitable.

A Puzzle Lamp Circuit

By Wm. B. Taylor

The interesting combination circuit shown above has been used for making money at a fair, letting people try to light the temple light without lighting any of the others. The description follows:

Take a square box about 14"x14"x5" deep with four 3-way switches and 5 sockets, you can connect them as shown in diagram, without any short circuit. By so doing you can obtain a numerous lot of combinations. You can have one light lit at a time, 2 lights in series, 3 lights in series, 4 lights in series, 1 light with 3 in series and different other combinations. The light supposed to be red and this is the puzzle, to have the center light lit when the other 4 are off.

I have made this little wrinkle myself, and have been asked for the loan of it on several occasions, for such as Garden Parties, and sales of work, in different halls of this town. In one case in particular this wrinkle cleared $15.00 in one night, at 5 trials for 5 cents and the center light was lit once by one fortunate person for the night. There is only one way that the center light can be lit and if you will trace the wiring you will see how it can be done.

This diagram is drawn looking into the box, seeing only the bottom of back of switches and sockets. By turning the box right side up the switch and sockets will be exposed ready for use.

Alternating Current Experiment

By Fred Regel

An interesting and at the same time highly instructive experiment is illustrated above. An ordinary step down transformer, 6-volt battery, and a switch or radio key is all the apparatus required.

Since we wish to obtain A.C. we must change the current or intermittently interrupt it. The latter is accomplished by alternately opening and closing the key or switch. This makes the magnetic field in the transformer build up and collapse, a condition which results in alternating E.M.F.

Every time the key is depressed and released the buzzer works. However, if the key is kept down the buzzer will not work since there are no changing lines of force. If one canes for visible proof a 6-volt auto lamp may be substituted for the buzzer.
Wehnelt Interrupter

By PAUL LINDHOLM

A WEHNETL interrupter, if made as explained in the following article will give a much longer and hotter spark at the secondary of an induction coil than would be obtained from a battery.

The most necessary parts for a Wehnelt interrupter are:

1. Glass jar approximately 4" wide, 6" high
2. Lead plate approximately 4½"x1½"x1/6" thick
3. Glass tube ¾" wide, the length depending upon height of jar
4. Piece of platinum wire No. 20 or 24 B & S gauge ½" long
5. A little mercury and some sulphuric acid
6. Cut a piece of wood or hard rubber big enough to cover the top of the jar leaving a half-inch all around extending beyond the jar. On the cover is mounted the lead plate and glass tube as shown in Fig. 2.
7. Put a hole in the cover for ventilation.
8. In sealing the platinum wire into the end of the glass tube, put the end of the glass tube over a Bunsen flame and keep turning it till it comes to a point. Just before it is entirely closed, insert the platinum wire, leaving a small portion of it extending out as illustrated in Fig. 1a. Keep turning it till the glass has melted around the platinum.
9. In mounting the glass tube have the length of the tube down to about the end of the lead plate. Most likely the hole you have drilled for the tube to pass through the lead plate was too small or just a little bit too large, which makes the glass tube slip down to the bottom of the jar. A remedy for this, is to blow a bulb on the tube to fix the position you want the tube to be held at. Hold the glass tube over the Bunsen flame and as soon as glass becomes a little soft blow into it till it forms a bulb as shown in Fig. 1b. Put the glass tube back in the cover and fill it half full of mercury and insert a heavy wire into the mercury to make a contact. Be sure to have the lower platinum point extend up in the glass tube far enough to make contact with the mercury. Put a heavy wire on the binding post for convenience.

Now we are ready to prepare the electrolyte, a solution of water and sulphuric acid. To begin with have a very weak solution and gradually add acid till proper results have been obtained. The interrupter is now ready for its final assembly. Before putting lead plate and glass tube in the electrolyte, it is well to put some paraffin around the under side of the cover and around the edge of the jar to prevent acid from creeping up over the edge of the jar.

Taking the Resistance Out of Parallel Problems

By CLARENCE SWANSON

THE method for finding the joint resistance of devices connected in parallel as given in textbooks, is known as the Reciprocal of the Reciprocal, or the Reciprocal of the Conductivity method. At any rate a sort of beating-around-the-bush route. An illustration of which follows:

Let \( R \) be the total resistance

Then \( R = \frac{\frac{1}{\text{ra}} + \frac{1}{\text{rb}} + \frac{1}{\text{rc}} + \frac{1}{\text{rd}}}{\frac{1}{\text{ra}} + \frac{1}{\text{rb}} + \frac{1}{\text{rc}} + \frac{1}{\text{rd}}} = \frac{1}{\frac{1}{\text{ra}} + \frac{1}{\text{rb}} + \frac{1}{\text{rc}} + \frac{1}{\text{rd}}} = \frac{1}{3} \cdot \frac{1}{8} + \frac{1}{4} + \frac{1}{16} = \frac{1}{16} \)

Parallel circuit illustrating a simple way of determining the resistance of the same, a very ingenious simplified calculation.

Slide Wire Wheatstone Bridge

By MICHAEL H. TAYLOR

THE drawing shows a simply constructed slide wire bridge used to determine resistances. The slide wire bridge is interesting from the point of view of simplicity and of demonstrativeness.

The material needed is one piece of paper 36 inches long and 4· inches wide, 3½ inch thick. Three strips of brass, one strip 36 inches long, two strips each 6 inches long, 1 inch wide, and 3½ inch thick, and 40 inches of No. 14 German silver resistive wire and a known resistance.

First the baseboard should be shellacked and sandpapered several times before putting on the final coat. The 36-inch strip of brass is fastened one inch from the edge of the board and 4 inches from each end. The 6-inch pieces are fastened at the ends with their centers exactly 1 meter apart (39.37 inches).

Diagram of a slide wire bridge, a simplification of the Wheatstone bridge and a particularly good for its principles.

Binding posts are soldered at the points A, D, E, F, G, K. One end of the galvanometer connects with the point C and the other end with the slider marked S. For the scale a piece of paper 1 inch wide and 40 inches long with marks in ¼ inch apart is fastened under the slide wire.

In use after connecting the unknown resistance the slide is moved until the galvanometer needle stands at zero. The proportional lengths of the parts of the strip on each side of the slide gives the ratio between the known and unknown resistance.

It is an admirable exposition of the principle of the bridge.
How to Make an Electric Motor
By HAROLD JACKSON

I THINK that every boy has a desire to make an engine of some kind. I made several when I was younger and I am going to tell you how I made my most successful one. This little motor is simple in construction and no special tools are needed.

The base of this motor is a piece of board eight inches long and four inches wide. A permanent magnet taken from an old magnet is mounted on this board with a strap iron clip as shown in the illustrations. The magnet furnishes the field of the motor and takes no energy from the battery as does the field of a motor where the field flux is furnished by an electromagnet.

The next part to make is the armature core. This is made of a piece of soft iron or a half inch thick and is filed into the shape shown in Fig. 2. A three-sixteenth inch hole is drilled in the center for the shaft. The shaft is about four and a half inches long. The armature core is soldered in place at the center of the shaft. Two bearing supports are made of strap iron in the shape shown in Fig. 2. These are just the right height to support the armature midway between the poles of the magnet. Paper shims can be used under the supports if necessary to make them the right height.

The commutator is made as shown in Fig. 1. It consists of two segments cut from a piece of brass pipe which are rounded with stout cord, to a small pulley-like core which is made of wood. The holes in this core should be a tight fit for the shaft.

The armature is wound before the commutator is driven on. The winding consists of many turns of No. 18 bell wire. About a half a pound will be plenty. The wire is wound on until the notches are full. The armature will look something like a half. The commutator is driven on and the ends of the winding are soldered to the commutator segments, one end to each segment.

The commutator is placed on the shaft so that the line between the segments is about forty-five degrees in advance of the center line of the armature core.

The armature is now ready to be mounted in its bearings between the poles of the magnet. End play is prevented by soldering small wire rings around the shaft just inside the bearings. These will hold the armature in the center.

The next and last things to make are the brushes. These are made of springy strips of brass, bent into an "L" shape, with an old battery binding post soldered to one end as shown in Fig. 1. Two brushes are required. They are secured to the wood base with two small wood screws. The brushes are located so that their upper end bears rather firmly against the commutator. Be sure that the brushes do not touch the bearing support. This would cause a short circuit.

Footlights Dimmer for Amateur Theatricals
By NORMAN O. WILSON

I HAVE found the apparatus shown in the accompanying diagram a dependable dimmer for the dozen or so footlights of the average amateur stage. The variable resistance unit, was made from a standard four-pound jam tin 5" dia. by 4½" deep. A binding-post was connected directly to the side of the tin. The moveable electrode was an iron rod about ⅜" in diameter with an insulating knob at one end (mine was the knob of an old fashioned two-piece dial) so that it could be raised or lowered with the hand. This rod moved up and down smoothly through a collar which had a thumbscrew in it so that the rod might be held in any position, and the whole was held rigidly in place by a piece of insulating material bolted to the rim of the tin. Contact to the rod was made through a flexible lead. The dimmer switch was made by taking apart a d.p.s.t. switch and using the arms separately. Bakelite top binding-posts made excellent insulated knobs for the arms. Common salt solution was used as the resistance in the tin. The correct amount was found by experiment to be about a teaspoonful. In connection with the fuses it is well to remember that the current drawn by the lights is equal to the sum of the wattages divided by the voltage, and that the maximum current allowed for should not be above the carrying capacity of the supply wires.
Small Storage Cells

By A. E. UNDERWOOD, Farnworth, Lancashire

Now that so many uses are to be found for small accumulators, it is an opportune moment to give an account of how these useful but sometimes expensive apparatus can be made at home at a small cost. There is, however, one point which requires particular note, and that is, the maker of the accumulator in this case must have access to a direct current of some description, such as a D.C. lighting supply, the reason being that the first "formation" of the plates is a somewhat difficult job when the primary battery is used. If carefully made, the accumulators possess a good life. To start with, the size of the plates can be decided by the container used to hold them, and any rectangular glass jars or old celluloid cases can be used for the purpose. Having decided on the size of the plate, the first job is to make a mould for the grid. Now, there are many ways of making a mould for this job, but after a trial of many types, the one described gave the best grids.

A piece of sheet brass about ¾ in. thick and 2 in. larger than the grid will be obtained, and I think it will be as well if we fix on some definite size, say, a 4-in. by 3-in. grid; we will therefore require pieces of brass 6 in. by 5 in. by ¾ in. In this brass the pattern of the grid is cut, and the quality of the best grid will prove to the maker how skilful he is with saw, chisel and file. The type of grid favored by the writer is depicted at A, and gave very satisfactory results.

As is generally known, the lead accumulator undergoes continual expansion and contraction during its states of charge and discharge, and for this reason large masses of active paste are to be avoided. With this point in mind, we make a fine mesh grid as shown. The channels are cut with 5/16-in. and 3/16-in. chisels to a uniform depth of 3/16 in. and should be very slightly tapered towards the bottom. It will be noted that the lug side is ¾ in. by 3/16 in., whilst the front limb is 3/16 in. by 3/16 in. So also are the top and bottom limb. The lug is best placed at one end and can safely be made ¾ in. wide. The way to mould the grid is to put the brass mould on a small tripod with a Bunsen burner under it. A piece of mixture of lead 95 parts and antimony 5 parts is laid upon the mould which, when hot enough, will cause the mixture to melt. The hot mixture should be distributed over the meshes of the mould and the surplus scraped off with a piece of smooth wood and the gas turned up. When the lead has hardened, the lead will have set, the mould then being placed in a bucket of cold water. By inserting a pen-knife blade under the lug end, the grid can be struck free from the block. If the mould should cause the grid to stick badly in any place, it requires the taper increased a little at that point. When the mould is in proper form it will be possible to make a grid in five minutes, so a little time is well spent at first getting the mould correct.

When the number of grids have been cast, with a bit of care they can be done carefully for cracks and trimmed with the point of a sharp pen-knife. It will be noted that no provision is made for holders, but this is not necessary in this type of accumulator.

The next process consists of filling in the grids with paste, and perhaps the following method will be new to a few. No red lead is used for the positive plates. All the grids are pasted on a sheet of glass with "litharge" and ammonium sulphate. The "litharge" should be carefully chosen and should be in powder form. Any "litharge" which is in the form of tiny flakes should be discarded. The ordinary commercial ammonium sulphate can be used, and is very fine at least eighteen hours in a dry room. The paste must not be hard and forming. Short pieces of lead fuse wire are twisted tightly round each lug, and the plates are now put into a small jam jar, preserve jar, or other vessel with care, so that it will hold two plates. They are next coupled up in series. A quantity of pure sulphuric acid, sp. gr. 1.84, should be put in, that must be distilled water (either distilled or rain water) until it has a sp. gr. of 1.12.

This acid, when cool, is used to fill the containers up to the tops of the plates, and the current is immediately switched off. For the size of plate in question not more than one amper will be needed, and this must be divided into separate "run" (either distilled or rain water) until it has a sp. gr. of 1.12. This change is uniform all over both sides of the plates, the current can be switched off and the plates connected across a moderate resistance to discharge them. Other should not be quite discharged, however, but the discharge should be stopped when the voltage of each cell is about 75. The plates should then be washed out the acid and washed in three changes of water and dried.

Each complete cell of any number of plates and are then assembled in the following manner: A negative plate is put on a flat surface; it is then covered with thin strips of wood that the kind of wood is important. Such woods as pitch pine, which contain resin, etc., should not be used. A piece of good white pine is the best, and shavings about 1/16 in. thick are easily obtained.

Great care must be used in fixing the shavings so as to be sure that the next positive plate will not touch the negative one. When the first negative plate is covered with shavings, a positive plate is placed upon it. The positive plate is then covered in the same way and a negative placed upon the other. The cell, all negative plates are placed at one end, and all positive plates at the other. In this way the cell is built up, say eleven plates, five positive and six negative. The back of plates are then carefully bound together with tape to enable them to have any shavings trimmed. This is best done with a pair of small nips. The lugs of each side are then burned together with a small blow-pipe, and the connecting terminals are fixed at the same time. All that remains to be done is to fix the cell in its container, fill with acid to 1/16 in. and charge slowly until the cell gasses freely.

In the experiments of the writer, which spread over a number of years, it was established, amongst many others, that the wood insulation fixed between the plates in the manner described does not in any way diminish the output of the cell, while forming a compact block of cells, anything that it almost impossible to short-circuit through loose paste, and makes an admirable construction for withstanding vibration.

The wooden shavings discarded cells may be used instead of shavings; the idea of using the latter is to secure simplification.—London Electrically.
THE CONSTRUCTOR

How to Build Your Own Airplane

This Handsome Single Passenger Sport Plane of Proven Performance Has a Ceiling of 7,000 feet and a Speed of 100 Miles Per Hour with 30 H. P. Engine.

I t is with great pleasure that we introduce herewith the greatest of all sports today, that of flying. Thanks to the great advances made in the designing and building of easily constructed aircraft, Young America doubtless will soon be winging its way over the countryside. There are sufficient flying fields in most locations, so that if desired the man who builds or buys such a plane as the one described here, can take flying lessons and thus obtain a first hand knowledge of the “feel of the air.” By practising with the plane and taxing over the field, allowing the airplane to take its own speed and then landing again, flying knowledge can be obtained at first hand. We recommend, however, that whenever possible, the services of a competent pilot be obtained in order that he inspect the machine before any flights are taken, to see that it is sufficiently strong in all of its parts, especially if the craft is home built. Also, will give you all the pointers you should know before ever trying to rise from the ground. This includes such instruction as always starting off or landing into the wind. With the exception of the space here to give a course in flying, and the people who sponsor this sport plane and who supply all the parts, engines, propellers, as well as the complete plane, ready to fly if so desired, also furnish at $5.00 a practical home study course in aerodynamics. The complete blueprints, as furnished by the builders of this famous sport plane, cost $15.00, and orders will be filled by the publishers of this magazine without any extra charge above the prices quoted above.

ENGINE AND SPEED DATA

This little sport plane is of very beautiful lines and has attained a speed of one hundred miles per hour, its usual maximum speed being rated at 90 M.P.H., with a cruising speed of 75 M.P.H. Its landing speed is 35 M.P.H., which is quite safe, all these speeds being obtained with the Anzani three-cylinder 30-35 H.P. engine. This engine will cost several hundred dollars, but it is one of the finest makes for aircraft that is available today. A cheaper engine is the Lawrence, 28 H. P., two-cylinder type, and this with propeller is worth $55.00. Quite a creditable performance can be obtained with this sport plane utilizing a common motorcycle engine. There are a number of other light airplane motors on the market, and of course these could be fitted without a great deal of trouble. To those interested in purchasing the complete plane with Anzani motor, it may be said that the price is about $1,200.00, and if the Lawrence 28 H. P., two-cylinder engine is substituted, the plane ready to fly will cost $1,200.00, while the plane built complete without any engine but with mounting for engine, costs $895.00.

This little sport plane is very economical, and will fly thirty-five miles per gallon of gasoline used. The flying range of this sport plane is 250 miles with one loading of fuel, and it can climb at the rate of 800 ft. per minute. It is interesting to note that the designers have figured on a factor of safety throughout of eleven, i.e., each part of the plane, when properly constructed and assembled, is eleven times stronger than necessary to stand the given load and strain.

It will be seen by inspecting the drawings herewith that the span of the plane is 20 ft., which means that it can be stored in a very small hangar. The wings are covered with grade A linen, or airplane cloth; which should receive five coats of nitrate dope, and they are then finished with two coats of Valspar varnish. There are a number of books available in public libraries or from publishers which contain information on how to cover the wings and apply the nitrate dope, but the course mentioned above is strongly recommended if you have had no experience in building aircraft before. In the next installment, special drawings made by our own draftsman, will show just how to build the wings and cover them with the linen cloth. It is an interesting process, this covering of the wings, and the method of sewing the cloth to the ribs will be shown in the forthcoming drawings in the August number.

DESTRUCTION

There are many new features infused in this little craft and by the removal of seven bolts the plane may be dismantled and ready for crating or storage in less than 30 minutes. The entire tail unit is of welded steel tubing construction. The stabilizer is of symmetrical camber and detachable, while the rudder and the fin are built into the fuselage, so that there is a small fin exposed on the underside which is attached to the tail skid, this also being of hardwood and resting on the usual shock absorber cord.

The undercarriage is of steel tubing construction with through axle. The struts are streamlined with bass wood and the usual lighting holes, while the cap strips are of spruce. Spars are of the routed I-beam sections, also of spruce and spliced in the center so that they form continuous spars through the whole span of the wing, with a dihedral of 4 degrees.

Each plane is built in one continuous panel from tip to tip. The upper plane has a cutaway at the center over the cockpit, and is fastened to the center X-struts with four bolts. The lower plane, which is a single panel, is fastened to the underside of fuselage with three bolts. The ailerons are on the lower plane only and the aileron control wires run within the lower wing. The single I-struts on each side of the interplane bracing are of built-up spruce laminations. Landing wires are single, flying wires are double, all are 3/32 inch cable. Fuselage—the fuselage is of the girder type built of spruce, the longons being of ash forward of cockpit. The cockpit has plenty of leg room for such a small machine. The rear end of the fuselage tapers off into a horizontal wedge, the whole being nicely streamlined with bass wood false work. The cowling is of 20 gauge aluminum.

DIMENSIONS

Span both wings, 20 ft.
Chord both wings, 34 in.
Cap between wings, 40 in.
Stagger, 15 in.
Length over all, 16 ft.
Height over all, 5 ft., 7 in.

WINGS

Wing curve, U. S. A. 27.
Total wing area, 108 sq. ft.
Angle of incidence, top wing, 1½ deg.
Angle of incidence, bottom wing, 0 deg.
Decalage, 1½ deg.
Dihedral both wings, 4 deg.

TAIL UNIT

Stabilizer area, 7½ sq. ft.
Elevator area, 3½ sq. ft.
Fin area, 5 sq. ft.
Rudder area, 3 sq. ft.
Aileron area, each 6 sq. ft.

(Continued on page 270)
The drawing above shows in considerable detail top and front views of the single passenger sport plane described in the accompanying article. We are very happy to present this excellent design of commercial sport plane, which has been successfully built and flown, to the readers of SCIENCE AND INVENTION Magazine. This airplane can be flown with a motorcycle engine, but when the flyer is up in the air he will feel much more secure in himself, if he uses the Anzani motor recommended by the company who supply the parts of this plane to those who do not care to make their own. A three or four cylinder engine is much to be preferred as one of the prominent World War flyers explained to the Editors in a recent interview. The control features of this sport plane are very simple and in the August number, all these will be illustrated. A complete set of blueprints giving all details, are available from the Constructor Department at $15.00.
Construction Details of Sport Plane

(CONTINUED)

In the illustration herewith we have a good side view of the single passenger sport plane, together with details of the wing ribs, engine mounting plate, and the I strut, two of which are required between the upper and lower wings, as the photograph on the previous page shows. The axle supporting the landing wheels is resiliently mounted on the landing gear by wrapping 1/4-inch airplane rubber band around the bottom of the vee frames and the axle. The engine mounting plate can be made of steel and for either than the Anzani three cylinder 35 H.P. motor, a different design of mounting plate will have to be worked out. It is very important that this engine mount be securely guyed to the fuselage, and this is taken care of by the steel cables fitted with suitable turn-buckles, in the manner apparent from the drawings. The propeller cannot be successfully built by the average amateur airplane constructor, and is therefore, to be purchased. In the next installment the method of covering the wings will be shown in detail. The metal fuselage fittings should be purchased. Maker's name and address furnished on request.
**How to Make It**

**Gas Pump**

The diagram at the left shows how a small brass or copper tube is coupled to a rubber bulb may be utilized to draw a small quantity of gasoline from an automobile. The tube is best as the illustration shows and a small hole drilled at the bottom of the bend. Air forces the gasoline out of the bulb and then sucked into the bulb and then pumped out. — Donald Wall, Rep. No. 26778.

**Door Knob Uses**

A simple method of making a cutter for matches is shown here. A razor blade serves as the cutting edge and a piece of wood clamped beneath a wing nut gives the fine adjustment. — Henry Frey.

**Music Printer**

Small blocks of wood have notes cut on cardboard glued to them. The cardboard absorbs sufficient ink to permit their being used as rubber stamps. — H. Vernon Rustin, Rep. No. 23326.

**Registering Barometer**

A new balance registering barometer is illustrated in the accompanying sketch. A mercury barometer A is secured to a board B which rests by a knife-edge C on an extension projecting from the wall. A small concave mirror D is attached to the board. Changes in the air pressure cause the column of mercury to rise in one arm of the tube and fall in the other, tipping the board and consequently changing the position of a spot of light on a scale.

**Firing Rockets Electrically**

By means of a storage battery and the additional apparatus illustrated above, one can fire rockets when thirty to one hundred yards away from the scene of action. This action is ideal for lawn fetes and for children. — C. A. Oldroyd, Rep. No. 4433.
### WRINKLES
### RECIPES & FORMULAS

Edited by S. Gernsback

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**Alcohol Lamp**

The illustration here shows how to make an economical alcohol lamp, using a wide-mouth bottle, some absorbent cotton, a piece of glass tubing and a cork. — Jos. R. Goldburg.

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**Syphon**

This syphon starts as soon as it is dipped into the solution. It consists of two glass tubes, placed as shown, the centre tube being raised until it functions properly. — Jack Riggins.

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**Magnetic Driver**

A piece of old drill rod may be formed into a screw driver which can be magnetized to hold small screws and help locate them in tight places. — M. J. Silver.

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**Leg Extension**

When using the ladder on an incline, instead of piling boards under the short leg, an extension may be fastened to it by means of screw clamps, as shown. — Warren Scholl.

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**One-Cut Star**

To make a five-pointed star with one cut of the scissors fold paper in half then across CD, then as in lower right-hand corner; then cut along dotted line.

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**Drawing Ink Supply**

To prevent getting the fingers full of ink, a pen holder is attached to the top of the regular quill holder as illustrated. — F. E. Ebel. Rep. No. 6774.

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**Rust Preventative**

One ounce of bee's wax is dissolved in benzole and used on bright steel parts or tools and machines. — John H. Varley. Rep. No. 1969.

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**Small Scoop**

This can be made by cutting tin cans to the required shape and soldering or riveting a handle thereto. — W. Scholl.

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**Home-Made Candle**

One can make a good candle by filling a tin fool cup with wax and inserting a wick. The wax will burn until completely consumed. — L. Carpenter.

---

**Tongs**

Two heavy pieces of iron wire may be bent to form a pair of handy tongs; the ends are hammered out, the scrap is a piece of inner tube. — Arthur Moyer.

---

**REMOVING IODINE STAINS.**

IODINE stains are sometimes very hard to remove and it is not advisable to use strong chemicals of any kind to dispose of them, and as iodine has a tendency to weaken fabrics, it is rather important not to have to rub the goods hard. The garments with iodine stains are to be soaked in starch water over night for a period of about 8 or 9 hours. It is no harm if it is more. Water and lump starch can be used and it is important that the garments be entirely covered. The goods may then be pressed with a stick. It is a nice way to use a thick starch solution to add to the water instead of the lump starch. In the morning remove the garment and wash, using common laundry soap and you will find the stain is entirely gone.

Do not let the stains remain without attention, as they may injuring the cloth.

— Contributed by Nina Jeffer.

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**Patterns for Wet Days**

Science and Invention for July, 1926
ASTROLOGY

Editor, Science and Invention:

Have just finished reading in Science and Invention Magazine, April issue, your article "Astronomy," and I wish to say that the enthusiasm and the keen interest you have certainly awakened in the minds of many who have never given much thought to the subject, is very pleasing. I have always been somewhat interested in astronomy, but your article has given me a new outlook on the subject, and I shall certainly try to study it further.

John Brown, Jr.

Lincoln, Cali.

(We beg to differ with the writer of the above letter and would advise that although he may be enthusiastic about the subject, it is not so with everyone.)

SNAKES ON END

Editor, Science and Invention:

I have a constructive criticism to make on the material presented in your article "Snakes on End." I think your article is very interesting and I would like to see more of this type of material in the future. However, I would like to suggest that you consider having a professional with expertise in the field of zoology or entomology review your work before publication to ensure accuracy and completeness.

Dr. Hackensaw

Back THE Clement Fenzidi "Hacken-

saw" for a long time in SCIENCE AND INVENTION will now be found in AMAZING STORIES.

Readers Forum SCIENCE AND INVENTION desire to hear from its readers. It solicits comments of general scientific interest, and will appreciate opinions on science subjects. The arguments pro and con will be sized next month, and will be written in both palatable and unpalatable forms. So if you have anything to say for or against, send your letters to the address in your letters to Editor-The Readers Forum, c/o Science and Invention Magazine, 53 Park Circle, New York City.

SCIENCE AND INVENTION are the editors all appreciate your sentiments.

READERS FORUM

PHILIP H. EBERS,

Editor, Science and Invention:

I am writing to state my feelings toward this magazine and the topics discussed in your Readers Forum. I believe that these discussions are valuable and informative, and I encourage others to participate in this exchange of ideas.

WALTER A. BUCHHEIM

Denver, Colo.

(Mr. Buchheim, we are glad to know that you appreciate our efforts to provide a platform for discussion on science-related topics.)

MOVIE EXPOSER

Editor, Science and Invention:

I am writing to state my feelings toward this magazine and the topics discussed in your Readers Forum. I believe that these discussions are valuable and informative, and I encourage others to participate in this exchange of ideas.

THOMAS MORTON

Annapolis, Md.

(We hope that Mr. Morton has found our efforts to promote scientific discourse in our magazine to be useful and informative.)
Novelties In the Radio World

A novel loud speaker for milady's boudoir is shown in the photo at the left. A doll, dressed in the fashion of a colonial dame, conceals a midget loud speaker unit.

A Russian concern has recently produced a crystal set built inside of a hollow manikin. The controls are almost inconspicuous, blending with the designs on the figure.

A recent English invention makes possible the secret transmission and reception of radio signals. The apparatus is operated by periodically changing the wave-length of both the transmitter and the receiver, making it impossible to receive the signals without the use of a special set which has been tuned to the transmitter.

The photo below shows Mr. J. D. Chisholm, the inventor of the new secret wireless, operating one of his transmitters. The apparatus appears crude, for it is still in its experimental stage, and has not yet been put out in commercial form.
Great Composers in WRNY Programs
By CHARLES D. ISAACSON

THE Editor of Radio News has asked me to begin a new feature this month: that is to tell you in every issue about some great composer or great work in music. So I am going to tell you just a word or two about the greatest of the Italian grand opera composers, Giuseppe Verdi. My reason for taking him is that we had a very beautiful program of selections from his operas in one of the series of Pernico Corradetti.

The fact that everybody remembers about Verdi is that he came of the poorest of familes, starved when he was a boy, and during the writing of his first operas, which were considered utter failures. He was living in a garret in Milan when his first success was heralded, and this came only after the tragedy of the death of his wife and baby. For half a century Verdi wrote operas, every one of which is practically immortal. To me the greatest of his operas is "Aida," with its Egyptian atmosphere, but the one I prefer for popular melody is "Rigoletto," the story of the deformed villain whose plot came back like a boomerang upon his young, innocent daughter, Gilda. There is the opera "Traviata," with the great love sacrifice of Violetta; and "The Forces of Destiny," whose title explains the tale.

From the point of box-office popularity, "Il Trovatore" leads, with "The Troubadour," the "Miserere," "Home to Our Mountains" and melodies familiar even to every school boy in the United States. The quality which marks Verdi's popularity is that his melodies quickly caught the people's fancy, yet have such sincerity and depth that one never tires of them. Verdi had an original sense of dramatic effects, generally written to texts of characters which seem to live and breathe.

Signor Corradetti, who is conducting the Sunday afternoon "Operatic Composer" series, is a man who has had a very brilliant career. He has appeared on the leading operatic stages of Italy and other countries, and has won high honors by creating and interpreting important parts.

Another composer series which we are running at WRNY is that of Herbert Sorum, conductor of Orlando's Roosevelt Concert Orchestra, every Monday night. We have had programs of Brahms, Beethoven, Debussy, and McDowell, and in this series I am going to tell you something about the orchestral composers from time to time.

If you have any operatic story in mind that you would like to have me tell, or if there is any particular composer about whom you would like to know, just write to me at WRNY, and I will gladly comply with your request.

THE EDISON HOUR
We have had a very interesting month at WRNY. The biggest happening is the acquisition of the New York Edison Hour, with Edison or some great composer or orchestral ensemble by any (Continued on page 280)
New Foreign Radio Apparatus

Illustrations Show the Latest in European Radio Sets and Parts and Should Suggest Some Novel Ideas to the Radio Fan.

A new vacuum tube socket or "valve holder" as it is called in England is shown above. This socket is of the anti-microphonic type and the principle of suspending the tube is readily grasped. Four spiral springs support four small brass tubes and insure perfect freedom from vibration of the tube elements. The spiral springs are extended upward into the tubes and serve to grip the vacuum tube firmly and thus establish perfect contact. Furthermore, there is only air di-electric between adjacent tube sockets, something highly desirable in very sensitive receivers. This socket is also made adjustable for adaptation to various tubes.

The apparatus shown in the above illustration is one of the latest English types of portable military transmitters and receivers. The apparatus consists of a 20 watt outfit with a bell and loud speaker each of which can be used interchangeably when communication is being carried on over short distances. It is said that this outfit is suitable for consistent communication by radio telephony up to 15 miles and by radio telegraphy up to 45 miles. Both transmitter and receiver are adapted to cover a wave band of 375 to 425 meters. The entire apparatus is not only of value for military purposes but is also designed for use on lightships and in other isolated positions where communication other than by radio is impossible or impracticable. Such a set would be a boon to a lonely lighthouse or lightship tender.

The drawing above shows one of the cleverest little dial indicators that we have seen in a long time. It not only serves to assist in tuning, but it also tells at a glance just what instrument is controlled by the dial below it. It is only necessary to drill a hole in the panel and clamp the indicator in position. Several different styles are supplied.

A vernier rheostat is often of great assistance in controlling the detector tube of a radio receiving set and here is one of rather unusual construction wherein the resistance is so wound that it requires three full turns of the control knob to turn the rheostat all the way on. Obviously, a few degrees rotation of the knob makes only a very small change in the resistance.

Another type of vernier rheostat that necessitates several turns in order to proceed from minimum to maximum resistance or vice versa is shown above. Rotating the control knob causes the contact to travel along the spiral of wire and thus cut resistance into or out of the circuit according to the directions in which the control knob is turned. Very minute and critical adjustment of the filament temperature can thus be obtained.

Here is shown a most unusual type of three tube receiver using interchangeable inductances. A reflex circuit using resistance coupling is employed and interchangeable coil units are supplied which will enable the operator to cover wave-length bands of from 230 to 550 and 1,300 to 3,000 meters. There is only one actual tuning control in this set, which control is the dial in the center. Three coils are employed and their variable relationship to each other is adjustable by means of the two knobs. By pulling upward on these knobs, coils are released and may be interchanged in order to reach another wave-length band. In the illustration, one of the coils is shown being removed from the receiver. The tubes or valves are mounted in shock-proof sockets which reduce microphonic effects and the tubes can be seen projecting above the set in the rear. Tube filament controls are mounted on the base.
A Page of Unusual Circuits

By Three Experimenters

A SINGLE tube receiver employing a loop antenna may readily be used if it is to be situated close to one or more fairly powerful broadcasting stations. Unusual selectivity will be found in a receiver of this nature, particularly when regeneration is added to the detector. The circuit diagram at the right shows the connections for such a circuit. A standard type of variometer is employed for tuning the loop circuit, the grid circuit and providing a field coil for regeneration. Note the fairly large condenser in the grid return leak. By proper selection, it is possible to make this circuit operate as a super-regenerator. A good type of variable grid leak and a finely adjustable rheostat are necessary. The grid leak is adjusted to a point where the set does not quite oscillate—LEE H. BOLIN.

TUNED impedance radio frequency amplification with regeneration in the detector circuit makes the receiving set illustrated at the right very efficient and good for "DX". In case the reader finds trouble in stabilizing a set of this type and cannot prevent it from oscillating when the R.F. and detector circuits are tuned to resonance, he can try adding a potentiometer directly across the "A" battery and connecting the center post of the potentiometer to the grid return lead of the R.F. tuning circuit. Adjustment of this potentiometer will stabilize the set remarkably and will enable reception with all kinds of tubes. A receiver of this nature should be used with an antenna at least 65 feet long, although in congested districts it may be necessary to reduce this length in order to achieve good enough selectivity to tune out powerful locals—LORING MARGIOT.

IT used to be almost an axiom that regeneration cannot be used with a reflex circuit. This, however, has been disproved several times as evidenced by the results obtained with the circuit diagram shown at the left. Here a more or less standard type of reflex receiver is employed, with a variometer added to the plate circuit to produce regeneration by the tuned plate method. Oscillation of the circuit is controlled by a potentiometer. It is advisable to employ a fixed detector rather than an adjustable one and a detector using a carbonium crystal is to be preferred because of its stability and rugged qualities. Such a detector is not easily burned out by even very strong signals. The writer added two stages of audio frequency amplification to this circuit and obtained loud speaker results even on "DX" stations which came in well. H. C. DIXON, Rep. No. 15908.
One Tube---One Control
Unique Cabinet And Simple Circuit Makes Presentable And Efficient Receiver

The circuit of this simple single tube single control receiver is shown directly above. By using the unusual regenerative circuit shown, excellent results may be expected for "DX" reception, particularly if a good antenna is employed. It is of course not necessary that the particular circuit shown be adhered to for constructing a receiver similar to that shown in the upper right-hand corner of this page, inasmuch as any standard single-controlled circuit can be adapted for a very small space with few if any changes. The circuit shown above was selected for simplicity but if a compact set of this nature is to be used in a congested district, it is well to use a circuit that is loosely coupled to the antenna so as to prevent annoying radiation. In any event, honeycomb coils can be employed for the tuning inductances as they are very compact and easily mounted.—HERBERT HAYDEN

Aids to Radio Reception
Practical Hints of Interest To All

When the door bell rings, or a buzzer in the house buzzes, do you hear the sound in the phones or loud speaker of your radio receiving set? If so, this trouble can be overcome by connecting a 1 mf. condenser directly across the contacts of the bell or buzzer. A standard buzzer and a suitable condenser is shown above, while the method of connecting the two together is shown below. The remainder of the bell or buzzer circuit is not changed.

Above: A very simple test set for determining continuity of circuits consists of a small buzzer taped to a "C" battery and a pair of flexible leads. Touching the two lead tips to a continuous circuit causes the buzzer to sound. Below: If your "A" and "B" batteries have been placed beside a radiator all winter, such treatment has probably aided in reducing their lives and they probably need replenishing.

The photograph reproduced on the right shows the external appearance of this single control, single tube receiver. The single dial is located on the sloping front panel, while the tube socket is mounted on the top of the cabinet, flanked on either side by two resistance clips. One of these sets of clips holds the grid-leak, while the other set makes contact with the ends of the automatic control filament resistance. Within the cabinet may be located any type of compact variable condenser, a 75-turn honeycomb coil and the fixed condensers.

The cabinet that houses this small set is an ordinary salt box with a sloping top such as is found in any five and ten cent store. The photo at the left shows how the projecting sides are cut off so that what was formerly the top of the salt box will become the inclined panel of the new receiving set. After the set has been constructed and wired, the panel can be fastened to the rest of the cabinet by means of a few thin brads or wood screws.
### List of Broadcast Stations in the United States

<table>
<thead>
<tr>
<th>Call Letter</th>
<th>Broadcast STA.</th>
<th>Location</th>
<th>Watts Power</th>
</tr>
</thead>
<tbody>
<tr>
<td>KDCA</td>
<td>East Pittsburgh, Pa.</td>
<td>500 Wyr</td>
<td></td>
</tr>
<tr>
<td>KDLR</td>
<td>Devil's Lake, N. D.</td>
<td>231 Wyr</td>
<td></td>
</tr>
<tr>
<td>KFAB</td>
<td>Lincoln, Neb.</td>
<td>256.4 1960</td>
<td></td>
</tr>
<tr>
<td>KFAF</td>
<td>Salt Lake City, Utah</td>
<td>261 1960</td>
<td></td>
</tr>
<tr>
<td>KFAM</td>
<td>San Jose, Calif.</td>
<td>217.3 1960</td>
<td></td>
</tr>
<tr>
<td>KFBK</td>
<td>Monterey, Calif.</td>
<td>250 1960</td>
<td></td>
</tr>
<tr>
<td>KFBS</td>
<td>Burbank, Calif.</td>
<td>275 1960</td>
<td></td>
</tr>
<tr>
<td>KFEL</td>
<td>Fort Worth, Tex.</td>
<td>256 1960</td>
<td></td>
</tr>
<tr>
<td>KFEC</td>
<td>San Francisco, Calif.</td>
<td>255 1960</td>
<td></td>
</tr>
<tr>
<td>KFED</td>
<td>El Paso, Tex.</td>
<td>258 1960</td>
<td></td>
</tr>
<tr>
<td>KFIM</td>
<td>Cincinnati, Ohio</td>
<td>213 1960</td>
<td></td>
</tr>
<tr>
<td>KFIN</td>
<td>Detroit, Mich.</td>
<td>250 1960</td>
<td></td>
</tr>
<tr>
<td>KFIQ</td>
<td>Kansas City, Mo.</td>
<td>269 1960</td>
<td></td>
</tr>
<tr>
<td>KFLL</td>
<td>Amarillo, Tex.</td>
<td>230 1960</td>
<td></td>
</tr>
<tr>
<td>KFMP</td>
<td>Minneapolis, Minn.</td>
<td>231 1960</td>
<td></td>
</tr>
<tr>
<td>KFOT</td>
<td>Oklahoma City, Okla.</td>
<td>240 1960</td>
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<tr>
<td>KFPL</td>
<td>Boise, Idaho</td>
<td>278 1960</td>
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<tr>
<td>KFRA</td>
<td>Dallas, Texas</td>
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<tr>
<td>KFRC</td>
<td>Phoenix, Ariz.</td>
<td>235 1960</td>
<td></td>
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<tr>
<td>KFRR</td>
<td>Rochester, N. Y.</td>
<td>236 1960</td>
<td></td>
</tr>
<tr>
<td>KFST</td>
<td>Dallas, Texas</td>
<td>263 1960</td>
<td></td>
</tr>
<tr>
<td>KFSP</td>
<td>Philadelphia, Pa.</td>
<td>234 1960</td>
<td></td>
</tr>
<tr>
<td>KFKQ</td>
<td>Portland, Ore.</td>
<td>238 1960</td>
<td></td>
</tr>
<tr>
<td>KFLR</td>
<td>Fort Worth, Tex.</td>
<td>235 1960</td>
<td></td>
</tr>
<tr>
<td>KFMD</td>
<td>Boston, Mass.</td>
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<td></td>
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<tr>
<td>KFBB</td>
<td>Buffalo, N. Y.</td>
<td>224 1960</td>
<td></td>
</tr>
<tr>
<td>KFBQ</td>
<td>Columbia, Mo.</td>
<td>238 1960</td>
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<tr>
<td>KFBR</td>
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<td>KFBS</td>
<td>Los Angeles, Calif.</td>
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<tr>
<td>KFBS</td>
<td>Miami, Fla.</td>
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<tr>
<td>KFBS</td>
<td>Baltimore, Md.</td>
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<tr>
<td>KFBS</td>
<td>Chicago, Ill.</td>
<td>235 1960</td>
<td></td>
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<tr>
<td>KFBS</td>
<td>New York, N. Y.</td>
<td>235 1960</td>
<td></td>
</tr>
<tr>
<td>KFBS</td>
<td>San Francisco, Calif.</td>
<td>236 1960</td>
<td></td>
</tr>
<tr>
<td>KFBS</td>
<td>Washington, D. C.</td>
<td>235 1960</td>
<td></td>
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</tbody>
</table>

The complete list of broadcast stations, arranged for convenient reference, is given in the Science and Invention, with revisions and changes up to the closing date of the magazine. The first number after the call letters of the station is the wave-length of the station; the second number is its power, expressed in watts.
In this Department we publish questions and answers which we feel are of interest to the novice and amateur. Letters addressed to this department cannot be answered free. A charge of 50c. is made for all questions where a personal answer is desired.

BATTERY AND CHARGER CONNECTIONS

A. 1. This automatic rheostat consists essentially of several turns of wire made of a metallic alloy, the resistance of which increases with the temperature. If the voltage of the battery is high a large current will tend to flow through the "Amperite" and through the tube filament. This raises the temperature of the "Amperite", thus increasing its resistance. The increased resistance cuts down the current below the proper value. As the voltage of the battery drops, due to continued use, the current will tend to become smaller, but this decreases the temperature, and consequently, the resistance of the "Amperite", and the value of the current will remain almost normal.

RENEWAL OF TUBES

A. 1. We would not advise you to attempt to construct a radio out of a P.D.T. switch. A combination of regeneration with three stages of tuned radio frequency to his present three-tube three-circuit regenerative receiver.

A. 2. He describes this circuit as follows: This circuit employs a pair of transformer tubes which are bare audibility and builds up gradually to a deafening volume. He desires to know the cause of this and what can be done.

A. 1. The volume in which you mention is in all probability due to a regenerative effect in one of the phonic tubes in your set, that is, tubes which are sensitive to vibration. You may remedy this condition in any one of the following ways. Try changing the tubes around in your set or replacing them with the tube sockets on rubber sponge, cork or felt. Place the loud speaker in any practical manner or place it away from the receiver. In this manner the sound from the speaker vibrates the tubes and produces the howl. Pursuance of this will place the loud speaker at any distance from the set, then place a pair of felt rollers or rubber underneath the speaker base. This is a simple procedure when using UV19 tubes in superheterodynes, unless coincident sockets are employed.

LIST OF BROADCAST STATIONS IN THE UNITED STATES

(Continued from page 253)
**Scientific Humor**

**YOU CAN FEEL YOURSELF GETTING RUN OVER**

"How do you like your new car?" asked Diggs.

"Great," replied Diggs. "It runs so smoothly, can't feel it. Not a bit of noise; you can't hear it. Perfect combustion, you can't smell a thing, and speed, why it whizzes so you can't see it."

"Must be some car," ventured Diggs. "Can't feel it, can't smell it, can't hear it, can't see it! How do you know it is there?"—J. B. Marsters.

**A NEW MONIA (NOT MANIA)**

Izzy: "What is the difference between ammonia and pneumonia?"

Dizzy: "Search me.


**WHICH EVER WAY THE WIND DOTH BLOW**

I am in the U. S. Army and stationed in the Hawaiian Islands. My own particular job is that of running our radio station.

Last year in camp on the north shore of Oahu I had succeeded one evening in tuning in KGO, Oakland, California, with very fair volume.

Just at this time a Chinaman walked into my tent looking both amazed and interested, so I offered him the phones.

"What dat?" he asked on first hearing the music.

I told him, explaining that it was 2,000 miles distant and that it took six days to get there by steamer.

"Which way is Oakland?" he inquired.

Making a hasty calculation I pointed in the direction I considered Oakland to be.

"Aw!" he replied in his pidgin English, "how you get say way, you say Oakland over there and wind blow dis way."—Sgt. Richard F. Howard.

**PERFECT TEST FOR GOLD**

**FAKE!**

Irate Mother: "Why Johnny, all the goldfish are dead.

Johnny: (chemistry student) "Those were not gold fish, but gold sulpheric acid that I poured into the bowl wouldn't have affected them."—Reynold F. Castelle.

**COOTIES FED UPON THE HOSTS IN THE WORLD WAR**

Biology Teacher: "A parasite is a plant or animal which feeds upon its host, at the latter's expense.

Student: "Is a cannibal a parasite?"—Isadore Schwartz, Rep. No. 22825.

**AND THIS JOKE IS RESTIVE-FOR-US**

A tiger is carnivorous: a cow is herbivorous; man is omnivorous, but some people I know are pestivorous.—Edward Onkett.

**FIRST PRIZE $3.00 YOUR WIFE MUST HAVE ONE!**

Mrs. Newby (as ambulance takes her husband out): "I knew if I kept that old chemistry book around here I would get it mixed up with the cook book."—R. A. Marks, Jr.

**JOHNNY WAS NOT DE-COY-ONE**

Teacher (in biology class after study of the stem of a tree): "Pupils, can any of you tell me what the wood ducts are?"

Johnny (the hunter)—"From back won the hall!"—"I know, wood ducts are decoys."—Goertse Jeter.

**WE PUT IT IN CUPS**

JIMMY: "I got Greece on the radio last night.

JON: "That's nothing, I got Greece on my clothes Sunday."—Fred Barta, Jr.

**HOW OLD ARE YOU NOW?**

STUDENT: "How long could I live without brains?"

Prof.: "That remains to be seen."—Lorrena Skinner.

**THOSE WHO HAVE SEEN THEM BELIEVE THIS STORY**

"What made Jones mount the water wagon?"

"His bootlegger had been selling alcohol that he stole from the specimen jars in the repetition building of the museum and forgot to strain the snakes and spiders from the last lot."—John H. Spicer.

**SIC 'EM DOGWOLD**

Mike had worked so long in the lumber yard that he could tell the wood by its smell.

One day Shorty, his companion, bet him five dollars that he couldn't. So they blindfolded Mike and held the wood about a foot from Mike's nose. After Mike had named all the wood in the yard and Shorty seeing he was going to lose looked around and saw a black cat. He grabbed it and held it about a foot from Mike's nose. Mike sniffed and sniffed again; at last he said, "You can't fool me Shorty, that's pussy willow."—Philip R. Engels, Jr.

**JUDGING BY HIS FACE HE KNOWS NOTHING**

SHE: "Do you know anything about surgery?"

He: "Oh yes, I shave myself."—John Wormald.

**A WET BLANKET**

A man once married a woman, and because of her fiery temper he called her "Combustion." As he failed to provide her with a healthy payroll, she called him "Chlorine." You see, chlorine does not support combustion.—E. J. McFarland.

**AM ION?—I HOPE YOU ARE**

Professor: "Can anyone tell me what an ion is?"

Only one boy raised his hand.

Professor: "All right, John, tell us."

John: "An ion is a shocked atom.—Neat Morcossen."

**DEGREE OF S.S. (SING-SING)**

Irate Professor (who has just been arrested): "I'll have you understand that I'm a man of two degrees."

Officer: "It's all right, we'll give you the third!"—William A. Heiber.

**EINSTEIN REFUTED!**

LADY: "Are you sure these field glasses are high power?"

AMBITIOUS SALESMAN: "Madam, when you use these glasses anything less than ten miles away looks as if they were behind you!"—Fred Kohler, Jr.

**ON THE LEVEL?**

Smith: "Last night I heard some fellow from Station WRNY play "Falling Waters" on a saw, with guitar accompaniment."

Jones: "How did it sound?"

Smith: "Sounded as if the saw got a little rusty towards the end and it might have been a little more plane."—Noel Compton.

**WERE THEY HARD- OR SOFT-BOILED**

A maid was told to boil the eggs for breakfast for three minutes by her employer's watch.

She did. A jeweler had to repair the watch.—Elizabeth Andrews.
LATEST PATENTS

Ice Breaker

No. 1,482,511 issued to John Albert Ellis describes a machine designed to facilitate the breaking of ice in navigable water ways. It is built on the caterpillar principle with solid iron gripping and breaking teeth mounted on endless chains, and in such a way that the weight of the teeth, when in operation, will be reinforced by forward moving power and weight of the boat. As the endless chains are operated they first grip the ice and draw the full weight of the boat against it as they traverse, thereby subjecting the ice to tremendous pressure from above and at the edge.

Air Moistener

No. 1,573,956 issued to Michael F. Weldenbach relates to an accessory for hot water and steam radiators for moistening the air by evaporating the proper amount of water. Evaporation is accelerated by the proper rate by providing within the pan containing the water, a heating pipe or coil arranged from the circulating pipes of the heating system. With one filling of this arrangement from 10 to 15 gallons of water, the amount usually required for the average dwelling, is evaporated. With a pan of water simply placed on top of a radiator, only a very slight amount of water is evaporated.

Smoker's Stand

No. 1,560,538 issued to Leo E. Cooke, relates to a device which serves efficiently as an ash tray, tobacco receptacle, a cigarette holder, and which provides convenient storage space for cigars. A further object of the invention is to provide individual receptacles for ashes and discarded cigar or cigarette butts. The receptacles are made practically smoke proof so as to prevent the smoke from escaping into the room. The ashes which accumulate in the tray are automatically deposited in a large compartment when the doors of the smoking stand are closed.

Cigarette Case and Ash Tray

No. 1,562,497 issued to William Roberts Derry describes a combination cigarette case and ash tray. It aims to provide a means whereby an ash tray is associated with a pack of cigarettes of the ordinary type in such a way that when not in use the case will have all the compact features of the ordinary cigarettes package. The ash tray does not interfere with accessibility of the cigarettes.

Necktie Presser

No. 1,576,542 issued to L. Z. Phillips describes a simple device for removing wrinkles from, and pressing neckties with a minimum expenditure of time and effort.

Flying Machine

No. 1,572,120 issued to Earl A. Parker, and Claude W. Masingham protects a new type of lighter than air flying machine, so constructed as to be especially stable and efficient in flight under abnormal conditions, such as during storms.

Note—This Contest Was Announced In the June Issue

$300.00 IN PRIZES

Conditions and Rules of the Board Contest

1. This contest is freely open to all, whether subscribers or not. From the contest are excluded employees of the Experimenter Publishing Company and their families.
2. Models of the prize entries are not to be sent in unless the contestant is requested to do so by the editors in writing.
3. An entry consists of three photographs, not smaller than 5 by 7 inches, printed on glossy paper, one complete pen-and-ink drawing, giving full dimensions of the article, and a description of the article in 500 words or less.
4. Photographs, drawings, and manuscripts must all be sent in flat. Rolled entries will be rejected.
5. Detailed matter can not be considered. Use ink or typewriter.
6. As many entries as desired can be sent in to the contest. There is no limit to the number of entries accepted from each contestant.
7. From this contest are excluded mere ideas and designs only, for the reason that this contest was inaugurated to stimulate the building of the actual models. Entries without photographs of the constructed articles are, therefore, not eligible.
8. Prizes will go to those who submit the most practical and useful ideas of how to build various "useful" articles from the wooden board. The editors reserve the right to send for any one of the entries by paying transportation charges both ways.
9. The contest closes at noon, July 19th, 1926, at which time all entries must be in the hands of the judges in order to qualify.
10. Should two or more contestants submit the same prize-winning idea, a prize identical to that offered will be given to each of these contestants so tying.
11. Address all entries to the Editor, WOODEN BOARD CONTEST, c/o SCIENCE AND INVENTION, 53 Park Place, New York City.
12. The first prize is $15.00, the second prize is $10.00, the third prize is $7.50, the fourth prize is $5.00, the fifth prize is $2.50, the sixth prize is $1.50, and the seventh prize is $1.00. The eighth prize is $0.50. The total value of the prizes is $300.00.

Amusement Device

No. 1,499,875 issued to Joseph Rosenheim. Model sailboats are held at their wharves in a tank by means of small permanent magnets. When the air is turned on the pressure of the air against the sail drives the boat to the far end of the tank. The noise of the boat closes contacts operating the signalling device. The air is directed against the sail by the participants.

NOTICE TO READERS. The above illustrated and described devices have recently been issued patent protection but are not, as yet, to our knowledge available on the market. We regret to advise that it is impossible to supply the names and addresses of inventors of the above devices to any of our readers. The only records available, and they are at the Patent Office at Washington, D. C., give only the address of the inventors at the time of application for a patent. Many months have elapsed since that time, and those records are necessarily inaccurate. Therefore, kindly do not request such information.

—EDITOR.
### GENERATOR CUTOUT

(2605) Q. 1. Ralph R. Mason, Racine, Wisc., asks: When a storage battery is being charged by an electric generator, what is the harm in allowing the battery to overheat and how does it operate?

A. 1. Overheating of a storage battery is caused by one or more of the following causes: excessive voltage, insufficient ventilation, or the use of a generator that is too small for the load. The battery may overheat and the electrolyte may boil, causing a loss of water and a decrease in the battery's performance. If the battery overheats, it may rupture or cause a short circuit. It is important to ensure that the generator is properly sized for the load and that the battery is adequately ventilated.

A. 2. The generator is connected to the battery through a cutout, which is a device that disconnects the circuit when the battery reaches a certain voltage. This prevents the battery from being overcharged and helps to protect it from damage. The cutout is designed to automatically open when the battery voltage exceeds a certain level, allowing the generator to continue operating while the battery is charging.

### INK REMOVER

(2606) Q. 1. Clarence Parsons, Kinnell, Wis., asks: Creeka a formula for making a liquid ink remover?

A. 1. An ink remover that can be used effectively for most inks can be made by mixing citric acid and glycerin. This mixture, when applied to the inked surface, will help to break down the ink and make it easier to remove. It is important to note that different inks may require different mixtures to effectively remove them.

### SOUND

(2607) Q. 1. Margaret Flanagan, New York City, asks: Do the her and direction of the speed of sound traveling through the atmosphere have any effect on the sound of the speed of sound?

A. 1. The speed of sound traveling through the atmosphere is influenced by various factors, including temperature, humidity, and pressure. The speed of sound increases with increasing temperature and decreases with increasing altitude. These factors can affect the way sound travels through the atmosphere and can alter the perceived quality of sound.

### GOVERNOR

(2608) Q. 1. Jones L. Harris, Washington, D.C., inquires: How does a suction type of governor for automobile trucks operate?

A. 1. A suction type governor is a device that is used to control the speed of the engine in an automobile truck. The governor works by using a vacuum to control the flow of fuel to the engine. When the speed of the engine decreases, the vacuum increases and the fuel flow is reduced, allowing the engine to return to its normal speed. This process helps to prevent the engine from stalling or surging.

### SOLAR MOVEMENT

(2609) Q. 1. Albert L. Mason, Lincoln, Nebr., says: He has been told that the entire planetary system, including the sun, the planets, asteroids and comets, is moving through space. He asks: Is this true and if so, what is the rate and direction of the movement?

A. 1. The solar system, including the sun and its planets, is indeed moving through space. The solar system is part of the Milky Way galaxy, which is itself moving through the universe. The rate of this movement is approximately 30 kilometers per second. The direction of the movement is along the plane of the galaxy, with a slight inclination towards the plane of the Milky Way's spiral arms.

### PHOTOGRAPHIC QUESTIONS

(2610) Q. 1. Alphonso N. V., asks: What is the best method of photographing stone memorials?

A. 1. The best method of photographing stone memorials is to use a camera that is designed for macro photography. A macro lens is necessary to capture the fine details of the memorial. It is also important to use a tripod to ensure that the camera is steady and to use a timer or remote release to avoid camera shake. Additionally, it is important to use a high-quality digital camera or scanner to capture the details of the memorial.

### FORD CARS

(2611) Q. 1. Charles Anderson, Allentown, N.J., asks: How was the model 'Shenandoah' cutout shown here? I find that it only has three terminals. A. 1. The model cutout of the 'Shenandoah' cutout shown here is a cutout used in Ford cars. It is designed to protect the electrical connections of the car and is connected to the outside of the car. The cutout has three terminals, which are used to connect the primary and secondary windings of the electrical system.
IGNITION TESTER

(1907) Q. 1. Richard King, St. Louis, Mo., asks: How is the ignition tube to be used on automobiles and which incorporates a gas-filled filament lamp?

A. 1. The illustration in these columns shows such an ignition tester and the following rules for its use can be applied:

If no flash is seen in the tube when the upper end is touched to the spark plug, look for a properly shorted and fouled plug. It is also possible that there is a pinhole in the plug.

If the gauge is slowly withdrawn from the plug and the flashes in the tube continue to be visible at some distance from the metal part of the plug, this usually indicates that the porcelain or other insulation of the tube is broken.

Ore, asks: At what period in the history of man was it first found of the use of sulfur?

A. 1. The very earliest rough tools of which any trace is said to have been made by man thousands of years ago at the beginning of what is now termed the Early Stone Age. They were made in small stones, portions of which had been chipped away in order to form a crude edge. This age was also known as the Paleolithic age. Later on, these tools and weapons were more finely finished and polished, giving rise to what is known as the later Stone or Neolithic age.

BATTERY DISCHARGES

(1907) Q. 1. W. B. Robertson, Ontario, Canada, asks: The storage battery in my automobile continues to be dead even after it has been fully charged. The battery takes place even although the car is not in use at all. What could be the cause of such trouble?

A. 1. There are several places to look for such trouble. First, with all the lights and ignition switch turned off, examine the leads from the battery and connect a voltmeter in series with the heavy gauge battery wire, on the ends of these wires, you can see if there is any current on the voltmeter, the trouble is probably due to a poor battery, which may be internally short-circuited. If no current is found flowing in the circuit when the switches are all turned off, take your battery to your local service station and have it carefully looked over.

MERCURY ARC RECTIFIER

(1906) Q. 1. California, asks: Kindly show a schematic diagram of a mercury arc rectifier for detecting ignition troubles.

A. 1. Such a rectifier is illustrated here. It has been found that a glass bulb containing mercury vapor and a very fine current will pass in only one direction or from the anode to the cathode. The usual mercury arc rectifier such as the one illustrated here is designed for rectifying both halves of the A.C. wave by providing two sets of plates for this purpose.

LEANING TREES

(1906) Q. 1. Herbert Wolfe, Atwater, Ohio, asks: Why do trees grow typically in an inclined position. Several against the trunks have been inclined at different angles which are not really more than ten degrees.

A. 1. I have been told that the trees are inclined at the point where the soil is most productive or where there is a better climate. But I am not convinced of the truth of this theory.

VACCINATING INFANTS

(1905) Q. 1. Mrs. A. F. Hall, Rochester, N. Y., asks: Do you use any method of vaccinating against small pox?

A. 1. In those countries or communities where vaccination is neglected, out breaks of small pox still occur, but in communities where vaccinations are common, the disease is rarely seen.

BATTERY GASES

(1906) Q. 1. W. Swenson, Waverly, Iowa, asks: What are the gases that are liberated during the charging of the battery? If, while the voltmeter registers, this trouble is due to a poor battery, which may be internally short-circuited.

A. 1. These gases are those that have evolved as the decomposition of the electrolyte is caused by electricity, namely, oxygen and hydrogen. A little oxygen may be observed in the positive plates and the hydrogen at the negative plates.

BICHLORIDE OF MERCURY FOR WOUND TREATMENT

(1907) Q. 1. Mr. C. H. Hill, Newark, N. J., asks: Do you know of any method for making a bichloride of mercury on a large scale?

A. 1. I have not been able to find any method that would be suitable for large-scale production.

ACID PROOFING

(1902) Q. 1. I. Leon, Passaic, N. J., asks: How can a good preparation be made that is to be used for coating boxes and other wooden parts that are in contact with acids or alkalies.

A. 1. Apply the following mixture white warm to the wooden parts, 6 parts of wood tar and 12 parts of resin are melted together in an iron kettle, 1 part of finely powdered brick dust are stirred into the mixture until the wooden surfaces have been thoroughly coated.

WOOD ALCOHOL TEST

(1903) Q. 1. A. W. Swenson, Waverly, Iowa, refers to the test for wood alcohol published in the January, 1926, issue of Science and Invention, and says that he has performed the experiment as outlined. Everything went according to the description, but when he attempted to calculate the action of the fuchsin-hismine solution, the result could not be made to change from red to colorless. He asks me other information to complete this experiment satisfactorily inasmuch as he is working at some length.

A. 1. We have referred this matter to the author of the article, who has informed Mr. Swenson that the method is very simple and will do much to improve the determination of wood alcohol.

IS HYDROGEN EXPLOSIVE?

(1904) Q. 1. Leon Braverman, Passaic, N. J., asks: Is hydrogen inflammable?

A. 1. Pure hydrogen is neither inflammable nor explosive. If, however, it is mixed with air or oxygen, it will burn with a highly explosive mixture will be formed. The smallest concentration of air mixed with hydrogen that can really be termed explosive is in the neighborhood of 5 per cent. of air. Hence, as small a quantity as 9 per cent. of air will form an inflammable mixture.

PREHISTORIC TOOLS

(1908) Q. 1. Clyde G. Hutchinson, Portland, Ore., asks: What is the record found of the use of sulfur?

A. 1. The earliest rough tools of which any trace is said to have been made by man thousands of years ago at the beginning of what is now termed the Early Stone Age. They were made in small stones, portions of which had been chipped away in order to form a crude edge. This age was also known as the Paleolithic age. Later on, these tools and weapons were more finely finished and polished, giving rise to what is known as the later Stone or Neolithic age.

An illustration of the magnetic arc rectifier shows a circuit diagram of a mercury arc rectifier for detecting ignition troubles.
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Answers to the 12 Editorial Questions

The twelve questions in Mr. Gernsback's editorial of this issue are answered in two sets. The first set immediately following is what may be termed a "popular" set of answers, for the more technical reader, more accurate, follows the first set.

1. Materials used in the manufacture of lead pencils are wood, soap, and glue. No lead is used.

2. Static is a more or less violent atmospheric electric disturbance.

3. Newspaper stock is made of matted wood, commonly termed "moosewood." It becomes "low".

4. When an electric conductor becomes overloaded, it is greater than it can stand, it must become oversensitive. The result is a "short-circuit." An analogy to a short-circuit is the situation of the air blowing up in the capacity, when it blows out with a loud report. And you cannot have a short circuit with a hibiscus.

5. Day and night at the north andsouth poles are of equal length, namely six months day and six months night.

6. A magnet attracts the following metals: All iron, nickel, cobalt, steel, and steel wire. For those who want to know, the metals are iron, nickel, cobalt, steel, and steel wire.

7. In a popular explanation, the difference between heat and cold may be explained by saying that a cold body merely indicates deficiency of heat.

8. Air is one of the best known conductors of heat. If the air is removed or greatly rarefied, heat cannot be transferred to the body. A moun
tain top is in rarefied air and radiates the heat evenly to its surface. This explains eternal ice clouds over mountain tops. Therefore it may be said to be an animal oil. 

9. There is no difference between the poles and the South Pole. Both are living organisms which may be either poisonous or infectious or harmless.

10. A musical note is one that is melodious. The low, continuous sound is basso. When you strike all the notes on the piano together, such as an eight-part, for instance, you may have one or two notes. These notes are one or two notes.

11. To answer the question, the note has a basso. When you strike all the notes on the piano together, such as an eight-part, for instance, you may have one or two notes. These notes are one or two notes.

12. To answer the question, the note has a basso. When you strike all the notes on the piano together, such as an eight-part, for instance, you may have one or two notes. These notes are one or two notes.

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Patent Advice

Edited By

Joseph H. Kraus

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 published here for the benefit of all readers. If the idea is thought to be of patentable worth, we will try to protect the inventor as far as is possible to do so.

Should advice be desired by mail a nominal charge of $1.00 is made for each question. Sketches and descriptions must be clear and explicit. Only one side of sheet should be written on.

NOTE—Before mailing your letter to this department, see to it that your name and address are upon the letter and marked well. Many letters are returned to us because either the name of the inquirer or his address is incorrectly given.

BED-BUG POISON

(1921) Q. P. S. D. Collins, New Orleans, La., has discovered a composition which, when properly made, is a very effective bed-bug exterminator. He asks our opinion upon the placing of the formulas on the market and whether or not he should attempt to patent.

A. 1. Undoubtedly, if you are financially able, you could manufacture the compound and place it on the market. This latter work would necessitate an extensive advertising campaign, and upon this, as an ultimate success of the proposition, will rest. If you do not desire to go into the proposition to this extent, we would suggest that you communicate with one or more of the various manufacturers of similar household supplies. It is entirely possible that you might be able to persuade some one to manufacture and set your compound. Before you disclose the details of the system, make up an evidence of conception which consists of a copy of the composition of the formulas covering the formulas and having each sheet signed, sealed and dated by a notary public before two witnesses. This project you for a period of 1 year and only to be used in case of necessity for prosecuting interferences and infringers.

MOTOR-DRIVEN SAW

(1924) Q. C. C. Carr, Rutland, Vt., has invented a motor-driven hand saw upon which he desires patent advice.

A. 1. We would advise you that there is nothing at all new in your proposed type of motor-driven saw. You have proposed the placing of the cutting of a saw very similar to your own, but in reverse order of placing (as is would be manufactured to sell for a lower price) and this type, etc. The present patent covers a type of saw whose cutting edge is much longer and more effective than yours could be possibly be unless in your case you designed the protective guide to be much larger and more bulky than you show in your drawings. We do not advise you to invest any further time or money in your device.

VACUUM TUBE

(1924) Q. C. C. Carr, Rutland, Vt., has invented a vacuum tube which is capable of being the original of a vacuum tube and situated between the grid and filament. This is to be connected to the filament head at one end but the other end is not to be connected to any way whatsoever, as is shown in our drawing. He believes that such a system will increase the strength of a tube but has not done any experimental work with the system and desires our advice.

STEAM DRIVEN ELECTRIC GENERATOR

(1924) Q. C. C. Carr, Detroit, Mich., proposes the placing of a device to drive an electric generator. The generator is to be constructed as a motor-driven electric engine and is to operate the aforementioned steam engine.

We advise our client to proceed with this device in a commercial way as we do not believe that it will ever prove practical. If we can help you any further in your work, do not hesitate to address us.

SWIMMING GLIDER

(1924) Q. C. C. Carr, Detroit, Mich., proposes the placing of a device to drive an electric engine and is to cause the steam engine to drive an electric generator. The generator is to be constructed as a motor-driven electric engine and is to operate the aforementioned steam engine.

We advise our client to proceed with this device in a commercial way as we do not believe that it will ever prove practical. If we can help you any further in your work, do not hesitate to address us.
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No Charge for Information on How to Proceed

The booklet shown here contains valuable information relating to patent procedure that every inventor should have. And with it I will also send you my "Record of Invention" form, on which you can sketch your idea and establish its date before a witness. Such evidence may later prove valuable to you. Simply mail the coupon and I will send you the booklet, and the "Record of Invention" form, together with detailed information on how to proceed and the costs involved. Do this NOW. No need to lose a minute's time. The coupon will bring you complete information entirely without charge or obligation.

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Technical Answers to Questions

(Continued from page 260)

No. 9.—Crude oil is oil in its natural state and this is pumped from the ground in that form to be later refined.

No. 10.—The name "germ" means a small mass of living substance, capable of developing into an animal or plant or to persist, as may mean on an embryo in its early stages, a sprout, a bud or a seed, and consequently in the popular, but inaccurate usage of the word is any micro-organism, especially the pathogenic bacteria. The words bacteria and germ are used synonymously. Bacteria (plural of bacterium) are classified into many groups, such as acid-fast bacteria, those which retain stain, and which are not decolorized by five per cent. neutral acids, and sterile bacteria which are incapable of motion, as the baillii of anthrax, infectious bacteria, namely, those producing specific infection, toxic bacteria, those producing toxin or poison, etc.

No. 11.—The name "germ" means a small mass of living substance, capable of developing into an animal or plant or to persist, as may mean on an embryo in its early stages, a sprout, a bud or a seed, and consequently in the popular, but inaccurate usage of the word is any micro-organism, especially the pathogenic bacteria. The words bacteria and germ are used synonymously. Bacteria (plural of bacterium) are classified into many groups, such as acid-fast bacteria, those which retain stain, and which are not decolorized by five per cent. neutral acids, and sterile bacteria which are incapable of motion, as the baillii of anthrax, infectious bacteria, namely, those producing specific infection, toxic bacteria, those producing toxin or poison, etc.

No. 12.—Darwinian parents can have blue-eyed offspring, in the not far distant future, on the part of either mother or father or grandparents, there are the supply of the body. If all of their grandchildren had black eyes, and all of their children had black eyes then the third generation will be born with black eyes.

Book Review


Whatever is written in the field of science passes through two qualities. It is scientifically accurate and always amusing. It is the art of making science a topic of readable talk. The book of Einstein is very respectfully treated by our author, far more so than in Peep's most interesting book, which was also reviewed in our columns. Perhaps the most interesting quotation from Pope's "Essay on Man" would almost cover his section of the world.

The book goes through every branch practically of the theory of relativity and the life of Einstein. It is essentially a pre-treatment of a very comprehensive subject, we would refer to the reader of the Imperial and National Physical Society. One chapter is devoted to the growth of knowledge starting with Chaldean and the famous American scientist, Millikan. The chapter on units and magnitude gives a capital summarization of its subject in only one piece. The next following chapters are the advertising pages, not the least valuable part of other books on the subject by Dr. Lindchel. Whatever he writes is at once instructive and illuminating.

MARKETING POULTRY PRODUCTS by Earl W. Benjamin, Ph. D. Stiff cloth covers 5¼" x 9¼", illustrated, 328 pages. Published by John Wiley & Sons, Inc., New York City.

Housekeepers, who want to be scientific, should carefully read this book to find out how they should treat their products, how to tell old birds from young, for any quantity of similar details are given here. It is, however, primarily intended for dealers. The illustrations are very numerous, some even in color. The details of appearance and excellence are large and some scale down to the last detail and are illustrated. Equal advertising is also given, a polite name perhaps in some cases at least for advertising. A very fine bibliography with an excellent index follows.

PERPETUAL MOTION by Percy Ver-}

ance. Stiff cloth covers 5½" x 8½", illustrated, 366 pages. Published by 20th Century Enlightenment Specialty Co., Edwardsville, Ill.

The author of this book is attempting an impossible task, and he fails. What are the practical uses after perpetual motion? In the preface he says that he has written this book to enlighten the strugglers for perpetual motion, to guide their way from the impossible task of evolving a mechanical absurdity, and make them see their cause in the practical side of things, but it is doubtful if he can do it. Accordingly we find in this very nicely printed book a great number of the attempts at perpetual motion. Read and illustrated. When anybody turns out a perpetual motion ma-
In another place, at the bottom of a canyon roared a surging torrent of river. A harnessed river; plunging into turbines; emerging to tumble over a cascade, its every drop caught by turning buckets spangled with water at the bottom. Water pursuing its surging course downward, its power used again and again. The canyon dry at one place near the lower edge of the city, the water all electricity, resolved into piped hydrogen and oxygen. Like a tremendous clock ticking, the water momentarily dammed back, was released in a torrent to the electron leaks. The hissing gases, under tremendous pressure, raised up the heavy-weighted tops of two expanding tanks. Another tick of this giant clock—the gases released, were merged again to water. The tops of the tanks lowered, each in turn, one coming down as the other went up—hundreds of tons of weight—their slow downward pull geared to scores of whirling wheels—the power shifted to dynamo scattered throughout the city.

It was the twilight of nightfall when we arrived over Industriana. A thousand funnels and chimneys belched their flame and smoke—the flame tinting the sky with a lurid yellow-green glare, the smoke bringing down a dim blue gauze through which everything seemed unreal, infernal.

From the city rose a roar—the myriad sounds of industry mingled by the magic of distance. And as we got closer, the roar resolved into its component parts: the grinding of gears; clicking of belts and chains; whirring of dynamos and motors; shrill electrical screams; the clattering of falling ore; clanking of swiftly moving merchandise, bound in metal, magnetized to monoral cars shifting it to warehouses on the near-by hills. And over it all flashed the brilliant signal lights of the merchant traffic directors whose stentorian electrical voices broadcasting commands sounded above the city's noise.

An inferno of activity. A seeming confusion; yet the aspect of confusion was a fallacy, for beneath it lay a precision—an orderly precision as calm and exact as the mind of the Director of a Signal Tower counting off the split seconds of his beams.

An orderly precision—the brain of man guiding and dominating everything at his desk alone for long hours throughout the days and nights. A quiet, grey-haired gentleman: unburdened, unharrassed, seemingly almost inactive; always seated at a heavy desk smoking endless arrant-cylinders. The dominating business brain of Industriana.

CHAPTER XXXII
Departure for Battle

Georg and Maida were very busy in Industriana; and now Elia and I were admitted to their activities—Elia and I, with our nearly-loves and business needs. For the greater thing, the welfare of the nation upon which hinged the very safety of Venus itself; and Mars; and our own fair Earth. Industriana, greatest, commercial and manufacturing center of Venus, had been given over momentarily to the preparations for war. The Rahlis had at last turned from industry to the conquest of the Varano. Preparations were almost completed; our armies were to start within a very few times of sleep.

I had had no experience in warfare; but the history of our Earth had told me much of it. The enlistment and training of huge armies of men; arming them; artillery; naval and air forces; commissary and supplies; a gigantic business organization to equip, move and maintain millions of fighting men.
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Ancient warfare! This—our modern way—was indeed dissimilar. It was, from most aspects, simplicity itself. We had no need of men in great numbers. I found something like a single thousand of men being organized and trained. And equipped with weapons to outward aspects comparatively simple.

On all the three worlds the age of exploration and the sort of history that was long since passed. Electronic weapons—all basically the same. And I found now that it was the power for them, developed, transformed into its various characteristics and stored for individual transportation and use, which was mainly engrossing Industriana.

I had a fortune, that first night, of meeting Gene-Rhaalton—the present head of the famous Rhaalton line, for generations heraldry leaders of their race.

We found him, this Gene-Rhaalton, in a secluded, somber little office of black metal-tie walls, grey hangings and rug, a block of carved stone desk-his desk, and a few of the stiff-backed stone chairs, each with its single prim cushion.

The office was beyond sight and sound of the busy city. His desk was empty, save for the array of apparatus around its edges—the clicking tabulators which were recorded, sorted, analyzed and summarized for him every minute detail with which the city was engaged.

Machines of business detail. We had them, of course, in the Inter-Allied offices of Great-New York. I have seen our Divisional Director voice into a mouthpiece the demand for some statistical summary computed up to five minutes before, and covering his entire Atlantic District. He would have it, recorded in cold print before him, within a moment.

Yet, compared to the Rhaalton efficiency, our own methods seemed antiquated indeed. This man was in touch with every transpiring detail simultaneously; yet not controlled by them, for every detail was also combined into a whole—to be examined for itself if he so wished. Usually as well, the entire city lay before his gaze—the walls of the office were lined with rows and tiers of small mirrors; receivers and mouthpieces connected him with everything—Sights, sounds, and even smells of the entire world computed were available to him—smells when his sense of smell might be necessary for the testing of some active gas.

Without moving his physical body his presence was in effect transported wherever throughout the city he wished to be. A man of tremendous concentration, to handle but one thing at a time; with all the power of his brain to give instant decision, and then to forget it utterly.

Yet as a man rather small man; smooth-shaven; grey-haired; a grave face and demeanor, with dark eyes solemn with thought, yet twinkling often when he spoke. A man of handy muscles and gentle voice; seeming unemotional, and with a personality likable, but hardly dominating.

Instinctively I found myself comparing him to Tarrano. Tarrano's strong, wry body. The flash of his eye; his presence was inscrutable, always suggesting menace; the power, the genius of his personality—the force radiating from him which no one could mistake. His intellectual power, his concentration certainly the equal of this little leader of the Rhaals.

Tarrano the Conqueror! Tarrano—man of can—crowned statesman; a great and huge genius of his will throwing three worlds into chaos, at one stage combining two worlds into his self-created Empire, and menacing the third. Surely Tarrano was a greater man than this Rhaalton. I knew it; much as I hated Tarrano I was forced to admit it.

Yet as I stood there acknowledging the soft-spoken greeting of Rhaalton, I had the
swift premonition that Tarrano was going down into defeat. And that this little man, without moving from his desk or raising his voice, would be the main factor in bringing it about.

And I wondered why such a thing could be. If I look at this now, Tarrano, with all his genius, lacked just one quality which this little man had in abundance. The milk of human kindness—lovingness—tender lovingness which is the essence of which paradoxically was the unforceful gentleness of him. The Almighty—as we each of us in our hearts must envisage our God—is just, but gentle, humane in His justness. And with all the genius in the Universe—the warlike power—the weapons—the cohorts—all the wonderful armaments of war—you cannot impress the Will of the Almighty. Against all human logic of what should be victory—you will meet defeat...

The thoughts fled through my mind and vanished into the realities of the present. Rhalton was saying:

"We will be ready within another time of sleep. Jac Halley, you wish, I suppose, to go out with our forces?"

"Oh yes," I said. He smiled. The eagerness of youth for danger. And yet is very necessary—very laudable—"

He passed a hand across his forehead with a weary gesture—a gesture which seemed to me disapproving. Could this be our vaunted leader? My heart sank.

Biscoring the slope was a vertical street—a broad escarpment of moving steps, one half going upward, the other down. Beside it, a series of other escalators for the traffic of moving merchandize.

He added abruptly: "We shall conquer this Tarrano—but at what cost?" His smile was fiendish. "We must choose the lesser evil."

Still gently, almost sorrowfully, but with a deep seriousness and clarity of thought which amazed me, he plunged into a detailed account of what Georg was to do in command of our forces. My own part in it, already planned by him in detail, Maida's part. Elza's. The division of Rhal maidens. Girlhood in war! It seemed very strange.

Yet the Rhal maidens were going as a matter of course, since there were some activities for which they were more fitted than men were. With all the Rhal maidens going, Elza and Maida would not stay behind. And though Maida—she was objected to by Rhalton, he had yielded finally to her pleading.

I will not now detail our plans or our armament. We had, in general, one thousand unmarried men, in five divisions of two hundred each. They were largely Rhaals, with the few Earth-men previously sent us; fifty perhaps of the most loyal.
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It was all of that; but oh! it was more than that as well. My Elza, raising her teardarkened face and kissing me. Muttering, "Jac, I love you!" Muttering her love: "Jac, dear, you're safe! I've wanted so long to be with you again—I've been so frightened-so frightened—"

We started at dawn of the second morning after my own arrival in Industriana. The girls were to travel to the borders of the Cold Country on the larger vehicles, but they wished to start flying individually for the first few helans of the journey for practice. Georg, Minda, Elza and I were to travel in the instrument room.

We massed upon a broad hilltop near the city. In the grey twilight of dawn with a flush of pink in the sky where the sun in a few moments would rise, I stood in the outer doorway of the instrument room. Around me was the confusion of departure. Eager young men; laughing girls, flushed with excitement. The gayety of youth going to war! Young as I was myself, I was struck with the drama, the pathos of it. What would the home-coming be? Georg, Minda and Elza were with me. Geno-Rhalton stepped up to us. Bare-headed. A solemn little man, heavy-hearted.

"Goodby," he said simply. "I know you will do your best."

"Jac! Look there!"

I followed Elza's startled gesture to the soft, white clouds which were massed in the sky above us. By what magic of science one thing was accomplished, I know not; but up there in the clouds a gigantic image of Tarra was materializing! His head and
shoulders. Arms folded; his face with a sardonic smile, he looked at them moving. And out of the air about us came his audible, broadcasting words.

"Do your best, my friends!" Ironic mockery. "Coming to conquer Tarrano? Hasten! You are keeping Tarrano waiting most impatiently!"

The giant voice died away into silence; the huge image melted into the clouds and vanished.

Rhaalton looked at us again, expressionless. "Goodbye," he repeated. "Do your best!"

He turned away abruptly. And then as he walked with a despondent droop, his shoulders suddenly straightened. He flung a hand into the air. The signal to start! From a tower in Industriana a puff of violet light shot up to magnify the signal.

The girls, all in their places, rose into the air. Draperies fluttering, like graceful birds they rose, circled over us in an arc; and then in a long, single line, with officers apart to one side marking them in squads of twenty, they sped into the dimness of distance.

The tower vehicles now were rising. Then the larger platform; the power plant, like a floating building sailing majestically up.

"Come, Jac."

Elza and Maida were inside the instrument room gazing through one of its windows; and Georg drew me within, closing the transparent door after us. Through the window I could see the line of vehicles following after the girls. Then our instrument room rose quietly, soundlessly. The ground dropped slowly away, then faster; and as we swung about I saw the hilltop beneath us. Its sides were lined with waving spectators; stricken momentarily with awe at the apparition of Tarrano, they had already forgotten it; from every vantage point of Industriana they were irrationally waving.

But the hilltop was empty, save for one lone figure—Geno-Rhaalton standing sorrowfully gazing after us.

(To be concluded)

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The three-cylinder 30-35 H. P. motor. This engine mounting plate is made from No. 12 gauge sheet steel, and the very important point to be watched here is that this engine mounting plate is rigidly secured to the fuselage. This feature is taken care of by means of turn buckles and the 1/8 inch stranded steel cables, as drawings clearly show.

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To buy advertised goods is to profit by the experience of the best informed.

Bottle Feeding the Orchid

By Dr. Ernest Bade

(Continued from page 207)

colors of their own. But this is not invariably the case, as the pigments of the hybrids may develop characteristics which were entirely unforeseen.

The growing of orchids is not so difficult as has been hinted by some flower growers. Here is one of Dr. Bade's orchids, two and one-half years old, growing lustily in a two and one-half inch pot.

On penetrating the seedling, the fungus causes certain chemical reactions to take place, their character depending upon a peculiar catalytic nature; such reactions may be either favorable or unfavorable for further growth. Certain well defined cells are entered by the fungus, and when these

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have been practically filled, the nucleus of the stricken cells take on an amoeba-like shape. They send out pseudopods, slimy bodies, about the threads of the fungus, suck them out, and finally surround them with a membrane. Now the nucleus changes to its normal shape and waits for a renewed growth of a fungus which is then attacked again. After each penetration of the fungus, the seedling grows quite rapidly, but in spite of this, the young plant requires years before it is sufficiently mature to produce flowers.

By reason of the number and minuteness of the orchid seeds, no reserve food supply like that provided by other plants, can be given them. The young seedling must seek its own food and this it finds in the fungus for which it provides a place of growth, and when this parasite has made itself at home and begins to threaten the nucleus, the latter turns about and sucks it dry and the food so obtained is used by the orchid seedling in the development of its own structure.

Even mature orchids, to a great extent, live in symbiosis with lower fungi. The roots do not form root-hairs for the absorption of water, the fungi take up this work for them, as they live in the epidermis of the roots and send, from this position, delicate hypha to the outside and it is these which accomplish the work of the root hairs.

These conditions have been known to the orchid fanciers for a considerable time and since the required fungus is not always available on sowing, the result of seed propagation is far from satisfactory, as the percentage of germination is not only quite low, but often germination from seed is a distinct failure. It seems quite natural that the seedling could be provided with artificial plant food both to induce and to hasten its growth. This was first accomplished by Lewis Knudson by a bacteriological method. Under antiseptic conditions he prepared a nutritive solution consisting of the following substances:

1.00 gr.-Calcium nitrate.
0.25 gr.-Di-basic potassium phosphate.
0.25 gr.-Magnesium sulphate.
0.05 gr.-Ferric chloride.
0.50 gr.-Ammonium sulphate.
15.00 gr.-Agar-agar.
20.00 gr.-Case sugar.
1 Liter.-Distilled water.

The chemicals are dissolved in the water, gentle heat is applied so that the agar may dissolve, and the mixture is carefully poured into tubes or other glass vessels, as desired, and the containers with their contents are brought into a sterilization chamber where all possible contaminating organic growths are killed. The vessels are then stoppered with a wad of cotton. The tubes are placed in an inclined position so that when the agar dissolves, and the gentle heat is removed, the young seedling may be carefully inserted in the tubes.

The Builders of the Telephone

Spanning the country, under rivers, across prairies and over mountain ranges, the telephone builders have carried the electric wires of their communication network. Half a century ago the nation's telephone plant was a few hundred feet of wire and two crude instruments. The only builder was Thomas A. Watson, Dr. Bell's assistant.

It was a small beginning, but the work then started will never cease. In 50 years many million miles of wire have been strung, many million telephones have been installed, and all over the country are buildings with switchboards and the complicated apparatus for connecting each telephone with any other. The telephone's builders have been many and their lives have been rich in romantic adventure and unselfish devotion to the service.

Telephone builders are still extending and rebuilding the telephone plant. A million dollars a day are being expended in the Bell System in construction work to provide for the nation's growing needs.

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 stiffens, a larger surface is exposed to the air. When the agar is firm the orchid seeds are introduced into the gelatinous nutritive solution with a sterilized platinum wire directly from the seed-pods and the vessels are again stoppered with cotton. Germination takes place within the tubes and when the seedlings have developed sufficiently they can be transplanted into tiny pots containing the required soil mixture for their continued growth. The seedlings may also be placed in larger flasks containing the same nutritive solution and kept in them until about five leaves and roots approximately three cm. (1½ in.) in length, have been developed. Then the young plants must be transplanted and cultivated in pots. As long as the seedlings remain in the tubes or flasks, they require no special care as the solution provides all things essential for their welfare. The seedlings become large and hardy and are much further developed than those raised by the older method.

Species of Cattleya are generally cultivated in medium sized pots for they seldom need to be transplanted. The pots must be provided with very good drainage and are therefore partially filled with broken pot-shreds, the rest of the pot being filled to the brim with a mixture of fragmented Sphagnum and a light sandy soil. Here it must be observed that the base of the leaves with their tuberous thickening must project from the soil. When it becomes necessary to transplant, the process should be carried out during the months of July or August as the young shoots form roots at this time. During the period of rest which lasts from December to February, the plant should receive less moisture and they should be kept in a slightly cooler atmosphere. During the period of most rapid growth, Cattleya does not require excessive heat, but it does demand a sufficient supply of water.

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TUNE IN ON WRNY

**PLANES COMBAT BOLL WEEVIL**

One of the most interesting developments for the use of aircraft for commercial purposes has been in the evolving of a special plane for dusting boll weevil poison on cotton plants in the southern states. During 1925, the Department of Agriculture of the United States Government, reports that cotton growers are cotton was dusted by airplanes. We expect, in 1926, to protect at least 75,000 to 90,000 acres of cotton against the ravages of the boll weevil. But, the most effective and convenient method of dusting is that also can cover four to five acres an hour, in comparison with the efficient airplane poison-distributing apparatus which covers 400 to 1000 acres an hour, the majority of all cotton and other crops, will soon be protected by aircraft.

**Science and Invention for July, 1926**

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By FENN GERMER
(Continued from page 203)

“through” this after-image at the Aura. He also suggests the use of color-filters like those used in color-photography, and this can be tried by the amateur with some chance of success. The colors are difficult to see, however; and the pure alcohol needed to make the screens, if it could be obtained, would probably not be used for scientific purposes.

**COLORED GELATINE SCREENS**

Other screens of more or less aid in getting accustomed to seeing the Aura can be made with the colored gelatines used in stage-lighting, which cost 20, 30, or 40 cents for a sheet about 18 inches square. Smaller pieces could probably be bought from an obliging stage-doorman. The most useful colors in order of their value are light and dark violet, light and dark magenta (or purple), light and dark blue. If an old stereoscope like those used for looking at picture cards can be obtained, the gelatines can be fastened or fitted to it in place of the glass lenses, thus making a very handy device for keeping other light out of the eyes when observing through the screens. It is used in two ways: the first is observing the Aura directly through the screen; the second is looking through one of the dense screens at daylight, for two or three minutes, then taking the screen away and looking at the Aura of a person who stands about two or three feet in front of a suitable background.

The illusions that one is liable to encounter in this experimenting are soon recognized after a few trials. If you look at a colored electric light for two or three minutes, then look away suddenly, you will see an “after-image” in a color complementary to the color of the light. For instance if the light is orange the after-image will be blue, if violet, it will be yellow, etc. This phenomenon is often mistaken for the Aura, especially as it occurs in a slight degree with practically every movement of the eye, although the complementary color may not always be present. One can soon become accustomed to it, however, by moving one’s head and body from side to side with a slow motion when observing the Aura; then whatever you have seen that stands still and seems to be attached to the body will be the Aura, and whatever moves and changes as you move from side to side will be after-images. After a little practice the after-images no longer bother or interfere.

Another test is that the Aura should be seen about evenly on all sides of the body at

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once, whereas after-images are usually irregular or seen only on one side at a time. The two tests must be used together.

Another illusion is one caused by eyes tired from reading or from strong light; then a sort of iridescent extension appears for an inch or less above the object that one is looking at, but this is usually quite bright and appears only on one side of the object so that it is easily recognizable. If one rests one’s eyes by closing them for five minutes or so after a strain, this effect will generally not occur. Another tricky illusion is produced by the faint shadows which occur behind an object when light is coming from two or more directions, but once this is seen and recognized, it will cease to cause any further trouble.

Above all do not try to see the Aura by straining to see it. Just gaze casually and quietly at the air around a person’s head and shoulders or hands (where the Aura is strongest and most easily seen), and keep your eyes as steady as possible to avoid after-images. It will be a little hard at first to focus on “air” but after several trials you will be rewarded by seeing the Aura stand out—a very interesting sight and quite startling to one who has never seen it before.

It is possible to use colored light to see the Aura; a deep blue light shows it up quite well in the dark against a black or white background. But while there is held for experimentation here, it is liable to lead the amateur astray because of the various color illusions that occur which must be carefully analyzed before one can be sure he is seeing the Aura.

ULTRA-VIOLET LIGHT BEST FOR VIEWING AURA

Ultra-violet light is by far the best to use, and shows up the Aura very clearly. Mr. Clifford R. Print, best known in Leeds, England, who has done a great deal of careful experimenting in seeing the Aura, found that the streamers or “frames” which issue from each of the fingers, stood out as the rest of the Aura, became so clear in ultra-violet light that several hundred people who came to his laboratory were able to see the phenomenon plainly, and the English newspapers reported his experiments at considerable length. He used a mercury vapor arc lamp, fully enclosed and having a glass filter that passed only ultra-violet light—which is of course invisible to most people. Ultra-violet filters which pass no visible light have been used for fluorescent effects on the stage, and can be obtained from the Corning Glass Works, 501 Fifth Avenue, New York City. Their Blue Purple Ultra G-585-M, Red Purple G-586-A, and Violet Ultra G-586-AW, are useful for this work. The first two transmit a slight amount of visible light, the last one almost none; but the last one is quite thick and thick glass tends to cut off the ultra-violet light. These glass filters may be used in connection with any of the standard sources of ultra-violet light, like the quartz mercury arc, the iron arc, the ordinary stage carbon arc; but ultra-violet light is capable of producing severe sunburn and its use is not recommended to an inexperienced person.

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REMARKABLE AURAS

After becoming accustomed to seeing the Aura, you will have many interesting and astonishing unseen experiences awaiting you. The author worked during the summer of 1925 at the Institute Metaphysique International, a large laboratory in Paris devoted to psychic research, where he worked with Sir Oliver Lodge, Professor Charles Richet, and senators, doctors, lawyers, etc. The work was in experimental thought-transference; but as a pastime he was a friend, M. Pierre Lafleche, studied the Aura.

M. Lafleche once saw a man's Aura that was split above his head, and on mentioning it to him learned that he had had his hand cracked open when young. And one afternoon we were standing on a balcony watching the people pass below, when almost simultaneously we called attention to the Aura of a very stout man who was passing on the other side of the street. It was just after the French luncheon hours, and his Aura, while extending as usual about 8 or 9 inches around the rest of his body, curved out to three feet in front of his stomach! We were both much amused. We found that women, especially the younger, such as much longer and brighter Auras than men, although those of men seemed to be more concentrated. On one man, a chemical engineer whose work required the wearing of two pairs of gloves, we saw two horns of light extending upwards from his temples. The author has also been amused watching his landlady when she gets angry: her Aura around the shoulders becomes very snaky and seems to writhe. The Auras of negroes are very definite and dense, and of a dark brown color; but while they are easy to see, they are rarely far.

Many other curious effects and experiments can be seen and devised once the first difficulties are gotten over. A rubber band tightly tightened for two or three minutes creates a dent or depression in the Etheric Body that can easily be seen.

Possible Explanation of Aura

A good working hypothesis or explanation of the Aura is due to free play of matter emanating from the body which reflects and transmit ultra-violet light. The action of the black velvet would hypothetically be responsible for all the light which was reflected by the Aura, thus rendering that visible; while the action of the white tile, the calcilume, etc., would be that of the ultra-violet. The disturbing rays reflected some of the others and of the ultra-violet, so that the Aura would become visible by its density. People whose eyes do not focus properly can often see it, because they sometimes bring the ultra-violet rays to a focus on their retinas, whereas normal eyes focus the longer rays on the retinas.

Modern Photography

The Aura has never been successfully photographed, chiefly because no one interested has yet had the time, money, equipment, etc., necessary for careful and scientific experimentation. There are color-filters, photographic plates, and light conditions must be carefully determined with the help of a spectrograph. But there are rumors that the facilities of a large photographic studio are soon to be offered for such experimentation; however, those concerned do not wish their names revealed until the experiments are finished because of the controversial nature of the subject at present.

There remains much investigation to be done by the amateur, who sometimes gets ahead of the science itself.

[The Editors will accept with interest reports from readers as to their success in seeing the human aura, and particularly in connection with the experiment mentioned above.]

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It is a crime to marry when you have not physically fit. That pure list is by love for you and does not realize your de-

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[The doctors will accept with interest reports from readers as to their success in seeing the human aura, and particularly in connection with the experiment mentioned above.]

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Ancient Torture Methods

PART II

CONTINUED FROM PAGE 211

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Science and Invention for July, 1926

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Great Composers in WRNY Programs

BY CHARLES D. ISAACSON

(Continued from page 245)

now broadcasting. It is under the direction of Joseph Bonime, who is best known perhaps to the American public as accompanist to Mischa Elman. The solo violinist is David Robinson, and in my opinion there is none better playing in any symphony orchestra. The Edison Ensemble ranges from ten to twelve instruments, and renders programs of popular classics every Tuesday night from 8:30 to 9:30.

Arthur Whisler, vice-president in charge of Commercial Relations of the New York Edison Company, is a constant visitor. He speaks fortnightly in a fascinating vein; in the alternating weeks prominent soloists are featured. Among others, Henri Scott, former leading baritone of the Metropolitan Opera Company, has appeared, and H. T. Burleigh, the famous composer of "Deep River" and many of the new popular Negro "Spiritual" melodies.

UNUSUAL EVENTS AT WRNY

The biggest recent novelty at WRNY was the broadcast of a simultaneous musical by Rook Perris, organist, who was playing at the West Side Unitarian Church, and Herbert Snider at the Roosevelt Hotel where WRNY has its headquarters, in the manner described on a previous page.

Another novelty was the broadcasting of a Bar Mitzvah which is the orthodox Jewish confirmation of a twelve-year-old boy, Rabbi Hoffman, who conducted the first orthodox Jewish wedding over the air, officiated and Nathan Ratner was the youthful confirmer.

WRNY has beni highly commended for its simultaneous broadcasting of the dinners of the United Jewish Relief Society. Here is the picture of the room of the Biltmore Hotel a great gathering of men had come to hear Louis Marshall and Felix Warburg speak, while on the first floor a great gathering of women had come to hear Fannie Hurst among others. WRNY undertook to broadcast both dinners, and so scheduled the speakers at both of these dinners that all the important speeches were transmitted on the microphone, without the slightest hitch.

Perhaps some of you heard the "Phantom Ship" which sailed out of port at WRNY, masquerading as "The Buccaneers" under the direction of J. Kenneth Jones. The captain's daughter was none other than Joan Lowe, prominent actress, who, herself, belongs to the sea. The ship went through storm and calm, and encountered a pirate. All the sounds developed in the studio gave the illusion of a ship tossing through wind and sea.

Perhaps you also listened in when WRNY gave Captain George Fried a memorial of his visits to WRNY, and in tribute to the part radio has played in the "anti-tobacco" campaign of the "Antimo" by the "President Roosevelt." Captain-Fried received the gift with modesty and gratitude. A copy of the memorial was given to him by his heroic crew, as well as to all the radio editors in this city and in London.

Everyone interested in the Little Theatre movement can appreciate the ingenuity in getting together all the participants in the Little Theatre Tournament. It was the first time they had ever come together the plans were discussed. Representatives were present from many states of the Union and from England. On Good Friday, Remo Taverna ever-
dected the tragic and immortal oratorio, "The Seven Last Words of Christ." Because of the tremendous success it had, the event would go down as one of the finest things ever broadcast.

Easter Sunday, WRNY began with chimes at Grace Church and had many special services.

**HOW NEWSPAPERS ARE PRINTED**

Early one Sunday morning WRNY carried its microphones into the great building of the "New York Times," broadcast the sounds of the press room, and carried its listeners on a tour through the different offices, news, editorial and business.

Speaking of newspapers, WRNY has effected permanent relations with the "New York Sun," which is now responsible for the sports and the commercial digest news every night. If you want the best reports on sports, just tune in WRNY, and hear Joe Vila's report direct from the Sun. This comes every night at 7 o'clock.

The Theatre Press Agents had the time of their life when a WRNY announcer, Mrs. J. C. Nugent, the daughter of Mark Twain; the cast of the "Alas the Decem" company, composed of Young Burton, Virginia Howell, and John B. Hymer; also Ernest Trues, Bie Dudley, Phil Baker, J. C. Nugent, Ruth Nugent, Mona Grant, Grant White, Xergerine, Magnora and others.

Another thing that should be recorded is that every Saturday night the Drawing Room Players are heard in original plans based on "Face With Great Musical." For each performance one composer is selected, and a dramatic scene from his life enacted. First came Bizet with his drab existence at the time of launching Rossini; then the temperament and selfish Wagner.

**IMPORTANT TO NEWSSTAND READERS**

In order to eliminate all waste and unsold copies it has become necessary to supply newspapers dealers only with the actual number of copies for which they have orders. This makes it advisable to place an order with your newsdealer, asking him to reserve a copy for you every month. Otherwise you must be in a position to supply copies to you regularly every month.

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Since that time the editors have received thousands of different designs for perpetual motion devices, and have received hundreds of type of circular letters soliciting finances for the building of perpetual motion machines.

The editors know that if they receive these letters, there are thousands of others in this country who get these letters and write for the claims made in the numerous prospectuses giving the earning capacities of the various machines.

Most of the shares of stock for these perpetual motion machines have been sold at a rate of $1.00 per share, although some investors trying to sell shares of stock at $1000 per share.

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