Man’s Greatest Menace

In the pre-historic days man’s greatest enemies were the wild beasts, against whom he fought, and which he destroyed little by little until finally the world became tolerably safe from them. What was left to the human race mostly, however, today is not the wild beast, but rather insects, bacteria and microorganisms too small to be seen by the naked eye.

It has been held by a well-known entomologist that if the insect world were to take it into their heads to eradicate the human race, they could do so in short order. Few people are aware of the fact that the insect world is formidable. It is if not that insects were always fighting among themselves, and if they were left alone to propagate and grow, life on this planet would become intolerable not only for every living animal, but for the human race as well.

It goes without saying that if some of the insects, for instance, the locusts, were to propagate themselves unchecked for only a few years, they would find it possible to devour every leaf upon this planet. The minute our flora vanishes from this planet, for only two or three years, it will mean that the human race must be exterminated. Thus, if the locusts were to eat up our crops, there would be no cereals or roots for the human race to subsist upon. If other plants were to go dry and die, our foods, which they can do very readily, there would be nothing for us to feed upon, and the human race would die of starvation.

But it is not even necessary that crops should be destroyed, because some insects, if they took it into their heads to drive us from the earth, could do so very easily. We only need to remember the titanic battle which the beetles have been waging against all the trees of the world. It is not very much denser much than the human race. There is hardly a square mile upon the earth on which we can not be found literally millions of ants, whereas there is no such density of human beings.

Some ants are quite harmless, and others are not. And there are certain species which have terrific destroying propensities and, according to newspaper despatches from Texas, we read where a destructive body of man-swarming ants were marching on the capital, according to reports from Austin. The Argentine ant is a pest in a class by itself, and is not only highly destructive to all sorts of plants, as it destroys buds, blossoms and fruit, but it is also of great damage to all sorts of poultry, as it kills off the chickens, and is even a menace to human life.

Thus its absence has been reported killed by multitudes of these ants. These ants are so persistent that they overrun houses, go into every crevice, and no adequate means to control them has yet been found. They even swarm into ice-boxes, not at all deterred by the frigidity as long as the ants find something eatable there. This particular ant is the Argentine, and it is a native of Brazil and Argentina, and was imported into the United States at New Orleans on ships from South America.

Anyone who has to do with the fighting of ants knows what a terrific undertaking it is to rid a house of them once they overrun it. Their very smallness makes it almost impossible to fight them with ordinary methods. They then swarm into ice-boxes, not at all deterred by the frigidity as long as the ants find something eatable there. This particular ant is the Argentine, and it is a native of Brazil and Argentina, and was imported into the United States at New Orleans on ships from South America.

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H. GERNERSBACK.
Have You Learned To Typewrite Yet?  Or do you still use the tiring, laborious hand-writing which is practically out of date?  In hundreds of homes there are Olivers for the use of the entire family. Typing is fast becoming universal.

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The coupon brings the Oliver to your office or home for 5 days' trial. Judge for yourself. Keep it or return it.

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A Standard Typewriter for $100?
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We do not mean to ask a ridiculous question—but it is just what you face nowadays in buying a typewriter.

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The coupon brings the Oliver for Five Days' Free Trial. When the Oliver comes, use it as if it were your own. Compare it. Then if you agree that it is the finest typewriter, regardless of price, and want to buy it, send us $49.50 cash. Or if you wish to pay in installments, the price is $55, payable $3 after trial, then $4 per month.

If you want to return the Oliver, ship it back at our expense. You do not risk a penny—we even refund the outgoing transportation charges.

Through the trial you are your own judge—no salesman need urge you. You can imagine that it takes the finest kind of a typewriter to face a trial like this.

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Make this Oliver test. See if you want to save the $50.50, or if you would rather pay $100. The trial costs you nothing. Nor does it obligate you to buy.

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The OLIVER Typewriter Company
613 Oliver Typewriter Bldg., Chicago, Ill.

THE OLIVER TYPEWRITER COMPANY, 613 Oliver Type-Writer Bldg., Chicago, Ill.

Ship me a new Oliver No. 9 Typewriter for five days' free inspection. If I keep it I will pay $55 as follows: $3 at the end of trial period and then at the rate of $4 per month. The title to remain in you until fully paid for. If I make cash settlement at end of trial period I am to deduct ten per cent and remit to you $49.50. If I decide not to keep it, I will ship it back at your expense at the end of five days.

My shipping point is. Do not send a machine until I order it. Mail me your book—"The High Cost of Typewriters—The Reason and the Remedy," your de luxe catalog and further information.

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SAVE $50 50 THIS EASY WAY
A Combination Airplane and Submarine

By Earl C. McCain

This combination airplane and submarine, invented by three men of Pueblo, Colo., may have the effect of revolutionizing modern warfare. This device combines the fundamental principles of both. Patent Office officials have written the inventor that the machine is the first of its kind ever received at the office, and shows real practicability; patents are now pending on this machine.

The machine is only twenty feet in length, tho the wing spread, when being used as an airplane, is thirty feet. The main secrets of the machine are collapsible wings and a folding propeller that fold up as the machine strikes the water to become a submarine. In the air the machine is driven by an ordinary twelve-cylinder Liberty motor, but under water,

(Continued on page 1007)
Power from the Air

For Many Years Electrical Engineers Have Endeavored to Devise Some Means Whereby It Would Become Possible to Utilize the Free Electrical Energy Ever Present in the Atmosphere, But They Were Not Successful, as Every Now and Then an Extra Heavy Surge of Static Current Would Rush Down the Elevated Conductor and Endanger the Lives of the Experimenters, or Else Destroy the Apparatus Connected With It. A German Engineer Has, However, Devised the Somewhat Elaborate Scheme Here Shown in Brief, and He Has Succeeded, at Least so His Report States, in Safely Extracting Several Kilowatts of Electrical Power from the Atmosphere With Metallic Surfaced Balloons, Elevated to a Height of Only 1,000 Feet.

W e have previously treated of the extraction of electrical energy from the atmosphere. The difference of electric potential in different parts of the atmosphere, and the difference between the upper air and earth make it a tempting proposition to obtain power from atmospheric electricity. The power would take the form of high potential difference with a discharge almost of a static nature. It has long appeared rather doubtful to conservative engineers if such a source of power should really be available. Yet when we see the lightning flash, it certainly suggests very high power, even tho the total of its energy may be small, on account of the small duration of the discharge. It is not to the thunder storm that we look for getting power from the atmosphere, as the subject is now being seriously investigated. A German scientist, Hermann Plauson, has publishd a very elaborate work on this subject, and has investigated the use of kites, balloons and towers, for the utilization of the high potentials existing in the air at different altitudes, and has studied out the construction of motors to be operated by the peculiar type of discharge which will be obtained, if the projects are successfully carried out.

We will first speak of the methods used for collecting electricity from the upper air. The author cites several German patents. One of them shows the use of a kite balloon. The balloon is shown floating in the air, kite fashion, and from it hangs a great net or aerial for the collection of electricity. The conductor from the aerial leads to the ground station; quite an elaborate description is given of the net-work which the patentee proposes to have covered with needle points. A windlass takes in or pays out cable for the balloon, and the patentee claims that by sending the apparatus to a height of about one mile he will have 225,000 volts to draw upon. He then speaks of a battery of 20,000 cells in series, which will use up 40,000 to 50,000 volts in the charging. This certainly provides for a reasonably large fall of potential.

But our author discards this idea and first suggests something more permanent. He proposes the erection of towers to be in the neighborhood of 1,000 feet high, or about the height of the Eiffel Tower. At the summit he has his collecting aerial. The appliance consists of a number of copper tubes; within each one he proposes to burn gas lamps, whose products of combustion will reach the aerial, a collecting net-work covering the tops of the tubes. One of his apprehensions is that if rain should wet his connections trouble might ensue, so he proposes a protection at the top in the shape of a great bell-like shield, resembling in his terms "a Siamese pagoda." He also compares the form of the protection to that of a great petticoat insulator. Another of his difficulties is that he must have his tower insulated from the earth. He, therefore describes a complicated foundation for his structure.
Science and Invention for March, 1922

He proposes first to pour in at the bottom of the excavation a foundation of simple concrete. On this he places a layer of asphalt, and then a layer of cast glass, three to ten feet thick, and then comes a reinforced concrete foundation, to which the metallic foot of the tower is to be anchored. The foundation must rise at least six feet above the ground level, and is to be bored in on all sides to protect it from moisture. The author's idea is to erect a number of these towers connected by a horizontal cable, to which the aerials for collection of potentials are secured.

The author strongly advocates balloons as collectors of the electric power of the air, because the atmosphere is so well distributed with moisture. These spots indicate areas to be variously coated and prepared to collect potential from the atmosphere.

In the first place he describes the balloon made of thin metallic leaf supported by internal ribs. Steel wires silver-plated, copper-plated, or aluminum-coated, run from the balloon to the pendant or junction ring. To this ring the tethercable is attached and an insulated windlass on the surface of the earth. The balloon is to rise to an altitude varying from 8000 feet to 15,000 feet.

The coating of the spots is to be of the thinnest amalgam, of mercury and gold, silver, or even polonium, perhaps only 1/250 of an inch. All over the face of the balloon are numberless metal points. To prepare the needle-like wires, they are collected into bundles and are treated electrolytically in a bath, so as to be dissolved in part. This gives a sharp point and roughened surface, all adapted for collecting the electric energy. The points may be of copper, steel, or some metal that is resistant to corrosion and rust. As it may be termed, the wires are plated with gold or other of the so-called "noble metals." It is pointed out that polonium or radium salts be added to the plating bath.

Dr. Plason devotes many pages of his book to describing his motor. This is a double-acting synchronous motor and rotor mounted on an insulated windlass on the surface of the earth. One typical arrangement is shown in our illustration. The stator plates and rotor plates are concentric with each other, represented as segments of cylinders. The alternation of negative and positive charged plates produces the rotation. In the connections there is included a safety spark gap to take care of dangerous potentials. Inductances and capacitances are used to divert current. It was found that the plates heated, owing to the Foucault currents, and to overcome this, several methods of subdividing the stator and rotor plates, are described by the author.

The whole subject is quite captivating, and it really seems as if the utilization of the electricity of the air may be almost in sight. It would seem possible to carry out experiments in this direction by means of the Eiffel Tower, but of course the trouble here is that the tower is grounded, and perfect insulation of the collecting surface is absolutely essential.

In our next issue we shall give some practical details. He says that on the Finnish plains he carried out experiments with a balloon filled with aluminum leaf with collecting needles of amalgamated zinc with a radium preparation as an ionizer. The surface of the balloon was covered with a zincatum. It was sent up to a height of 300 meters, nearly 1,000 feet, and was held by a coppefined wire. The current was about 1.8 amperes at an average of 400 volts potential difference was obtained. This was increased by putting into the circuit a large condenser, whose capacity was equal to the surface of both the antenna connections, and the current rose to 6.8 amperes with about 500 volts mean tension. By the use of these two balloons, all over the earth, eventually ran up the power to 3.4 kilowatts.

Ford's New City 75 Miles Long

EVERYONE is familiar with the proposition of Henry Ford, the automobile king, in his efforts to obtain possession of the Muscle Shoals electric plant, built by the Government in Alabama for the war. Mr. Ford has had his engineers draw up some wonderful plans for the future development and completion of this vast plant, and Mr. Ford hopes to make it one of the greatest undertakings in the history of the industry of America.

Among other things, Mr. Ford's proposal provides for the building of a gigantic city 75 miles long, to be located in the Muscle Shoals region. New York City or Manhattan Island, from the Battery to 225th Street and the Harlem River, is 13 1/3 miles long. Compared with Mr. Ford's proposed giant city of tomorrow, long and narrow instead of allowing it to spread out like a great circle, with the consequence that many of the dwellers never get a smell of the country air or see a green leaf.

The Muscle Shoals project, however, is only the start of a greater program, it has become known. This includes the development of water-power facilities in many parts of the country by which persons would be able to live in small communities surrounded at least on either side with all the benefits of rural or suburban life. In other words, this city is to be the harnessing by farmers of every possible creek and brook that crosses their property.

If the Government accepts Mr. Ford's bid at Muscle Shoals, it will cost $250,000 at once. The nitrate works and other plants would be run by steam power pending the time the great dam, that will require about two years to build, has harnessed the water at this point. Then would follow rapid development, in the opinion of Mr. Ford, until within a comparatively few years an industrial center greater than Detroit would have been built up.

Mr. Ford believes the Muscle Shoals plan, if consummated, would be the start toward development of the Mississippi River Valley. The automobile manufacturer believes this valley was "the United States" if the water now going to waste could be fully and efficiently utilized.

Eventually, in Mr. Ford's opinion, the Government could derive enough revenue from these power projects to support itself, thereby revolutionizing the financial system of the country.

Night Speeding of Clocks Stirs Science

Clocks to-day are formally listed in the high life class. They run faster at night than by day.

If the first clock ever made had run correctly, at noon on Thursday it would show 8:13 P. M. Saturday; would have gained 20,993 seconds, or two days 5 hours 13 seconds—since clocks of our present type were invented in A. D. 996 to supplement hour glasses, water clocks and measured candles. The 20,993 seconds include the leap year gains.

At least, so the volunteer statistician says.

However, as the clocks have been corrected day by day, at noon to-day it is noon to-day. The vagaries of the clocks have been discussed by Dr. R. H. Tucker of Lick Observatory, a prominent astronomer, who has given special attention to clocks. He finds that three first-class clocks at Lick Observatory have gained .06 of a second every night for several months. The results are included in the annual report of Dr. W. S. Campbell, director of Lick.

Maybe the Einstein theory is to blame. If so, the report says nothing of it. The clocks were checked from a large list of stars whose positions are known with high precision. The report says meridian transits were recorded .06 seconds of time too early in the sunset period as compared with the sunrise period. Differences of temperature would account for only 5 per cent. of the discrepancy.

Nobody knows the cause, Dr. Tucker is still at work on the problem.

Prof. Charles Burckhalter, director of Ohio's College of Science, expresses his opinion on it, said that Dr. Tucker was the expert of experts on this question, but that the public need not be alarmed, as the discrepancy discovered by Dr. Tucker has been rectified day by day automatically.
THERE is no greater mystery to mankind than the earthquake. It is a phenomenon that has been observed and studied for centuries, yet its exact causes and mechanisms remain poorly understood. The earthquake, which is today no less the dread of man than when it was first discovered, is a manifestation of the earth's internal forces, which are still largely unknown.

Dr. Andrew C. Lawson, a professor of geology at the University of California, has developed a method for forecasting earthquakes. This method involves studying the movement of the earth's crust and the changes in the earth's surface that occur as a result of these movements.

The method involves taking measurements at various locations and comparing them over time. By analyzing these changes, Dr. Lawson is able to predict the likelihood of an earthquake occurring in a particular area. This method has been tested and found to be highly accurate in many cases.

The exact location of an earthquake can be predicted with some degree of accuracy, but the timing of the event is more difficult to forecast. The waiting period before an earthquake occurs can range from a few hours to several years, depending on the location and the size of the event.

In conclusion, the forecasting of earthquakes is a complex and challenging task, but with continued research and development, it is possible to improve our understanding of these natural phenomena and to better prepare for the potential consequences of an earthquake.
SUCCESSFUL experiments have recently been conducted at the U.S. Bureau of Standards, in cooperation with the Medical Corps, U.S. A., in which permanent records of cardiac and respiratory sounds have been made and reproduced by the use of the telegraphophone, so as to be audible through the room with an audion amplifier.

A carbon telephone transmitter of ordinary type with a rubber adapter substituted for the mouth-piece was used for the stethoscope. The currents from the telephone transmitter were amplified by means of a five stage audion amplifier, which was connected to the recording element of a steel wire telegraphophone. The magnetic records of the cardiac and the respiratory sounds thus obtained were made audible by connecting telephone receivers to the telegraphophone in the usual manner. The telegraphophone currents were also amplified by means of a three stage audion amplifier which was connected to a loud-speaking telephone. In this way the sounds were made audible throughout the room.

This method of obtaining permanent records of cardiac and respiratory sounds and of reproducing them offers interesting possibilities in the study of normal and pathological conditions of the heart and lungs and their demonstration to an audience for purposes of instruction.

The accompanying diagram shows in a clear and understandable manner how the heart beats and the respiratory sounds are picked up by a microphone placed over the chest region, then how the fluctuations in the current caused by the varying pressure on the carbon grains in the microphone are led into an audion amplifying cabinet. A storage battery supplies the necessary current for lighting the vacuum tubes or audions in the amplifier, and also supplies the necessary current for the microphone circuit. When the intensified current pulsations, corresponding to the heart beats or to the respiratory sounds, emerge from the audion cabinet, they pass into the recording magnet coils of the steel wire telegraphophone, as shown in the diagram. The fluctuations in the magnetism at the poles of the recording electro-magnet thus created cause local magnetizations in the steel wire as it travels past the magnet poles, each of these magnetizations in the wire corresponding to a variation or pulsation in the microphone current.

Later when the steel wire is moved by the reproducing electro-magnet poles, the magnetized spots which have been induced on the wire, and which are practically a continuous variation in polarity, cause magnetic changes in the iron of the reproducing magnet, and these in turn cause currents to be set up in the coils surrounding the iron core. These reproduced telegraphophone currents are then amplified by means of a three stage audion amplifier, connected to a loud-speaking telephone as shown. Thus it has become possible for a number of physicians, in fact a whole roomful of them, to listen to the heart beats or respiration of a patient, even though the record of these sounds may have been taken a thousand miles or more away, and the steel wire shifted by mail or express to the expert for diagnosis of the case.

A Few April Features


- Second Popular Article on Home Radio. By Armstrong Perry. Crystallization in a Plane—How Chemicals May Be Identified Under the Microscope. New Caroline Engine Plow and Stump Cutters. By E. M. Stevenson. Food Adulterants Detected Microscopically. By Prof. Leon Augustus Hausman, Ph. D. The April issue of Science and Invention will be a special "Radio Number," and will contain numerous articles on homemade radio sets, including both audion and crystal detectors, also the names of the winners in the $300 Radio Receiving Set Contest.

Steel Wire Records Heart Beats
To the Center of the Universe in Eight Hundred Million Years

Our solar system is moving through space, the relative positions of the sun and its encircling planets being unaffected by the translation of the system as a whole. As a result the various planes describe paths thru space having the form of spiral or corkscrew curves, while the sun, the center of the system, is moving, apparently, along a straight line.

The rate at which we are traveling thru the sidereal system to which our sun belongs is about twelve miles a second, one million miles a day, or four astronomical units a year, the astronomical unit being the distance from the earth to the sun, or approximately ninety-three million miles.

In one year, therefore, the sun advances a distance equal to twice the diameter of the earth's orbit.

How far have we traveled, one may ask, since the pre-Cambrian or earliest geological period of at least one billion years ago, whither we are going and how long will it be before we reach our journey's end, if indeed there is an end to this mysterious journey upon which we have embarked?

The latest astronomical evidence seems to indicate that the system of stars to which our sun belongs is far more extensive than was formerly supposed, that the Milky Way or Galaxy, crowded with countless stars, is some three hundred thousand light years in diameter, instead of about thirty thousand, as was formerly supposed, and that it plays the part of a sort of equatorial region in one enormous spherical universe. Whether there are other distinct systems of stars or universes shut off from our own by some medium impenetrable to light we do not know.

As we travel forward the plane of the Milky Way, which is the fundamental plane in our system of stars, crowed the great majority of all the stars, including our own sun. It is believed that the stars are distributed in this plane in a great spiral formation similar to that of a spiral galaxy nebula with a strongly condensed nucleus at the center and with spiral arms projecting outward from this central nucleus in opposite directions. Along these arms it is believed the individual stars move to and fro toward and away from the central nucleus, which is believed to lie in the general direction of the star clouds of the Milky Way in the constellation Sagittarius.

The small or dwarf stars, as they are called, of which our star—the sun—is one, are far fewer than the giants of great mass and are apparently drifting toward this more condensed center of the sys-

The Solar System is not flat in the Heavens, as was thought formerly. On the contrary, the Sun with its Planets Moves Quite Rapidly Thru Space, and it takes 18 years to traverse a Like Distance, as that Represented by the Diameter of the Orbit of the Farthest Planet, Neptune.
of the system. From the extremely short period for which we have observations of the sun's motion with respect to the stars, it is impossible to determine whether our sun is moving along a straight line or in a closed orbit. From other considerations, however, it seems fairly certain that the stars are not moving in closed curves, but are drifting to and fro in or parallel to the plane of the Milky Way along spiral arms that originate in a central nucleus of closely condensed star clouds and branch out from this center of the system in diametrically opposite directions.

The age of our sun and of the solar system is now believed to be of the order of one thousand billion years. Newly discovered facts regarding the source of the radiant energy of the sun show that we do not have to attribute its output of light and heat to gravitational attraction alone, which would limit its age to about twenty million years, an absurdly short period within which to crowd all the great geological changes that have taken place in the past history of our planet. The revolutionizing discovery that atoms of other elements are being built up from the hydrogen atom with a liberation of energy that is enormously greater than we would have dared to assume in our wildest speculations permits us to extend the period during which the sun has been giving forth light and heat at its present rate to something like one hundred billion years. It is now believed that within the interior of the sun atoms of more complex elements are being formed from atoms of simpler elements with the release of inconceivably great quantities of radiant energy. It is known, for instance, that the energy liberated in turning a gram of hydrogen into helium is about five million times as great as would arise from burning the same amount of hydrogen in oxygen.

The one billion years that have elapsed since the earliest geological days is but a comparatively short period in the history of the development of the solar system. If in the past billion years we have traveled one-fifth of the distance across the sidereal universe it is conceivable that in the period of the development of the solar system prior to that time the sun and its attendants may have traveled many hundred thousand light years along the spiral arms of the Milky Way. An age of one thousand billion years would imply a journey of over sixty million light years for our sun, assuming that it has always moved at its present rate, which is doubtful, however, for in its days of maximum brightness, long before it contracted to its present state of a dwarf star, our sun probably moved far more slowly than it does today. Yet whatever its velocity may have been billions of years ago, we may feel certain that our sun has covered a distance of many million light years.

(Continued on page 1006)
The Ninth Spool

By CHARLES S. WOLFE

The swarthy little man at the Chief's side was controlling himself with an effort visibly painful. Twitching lips and trembling hands spoke eloquently of nerves on the verge of a snare. I threw aside my book and the twang of Fenner's banjo dropped to an almost inaudible strumming. Fingers moving nervily over the frets, he arched questioning eyebrows at Davidson.

The Chief answered the unspoken question with a gruff introduction. "Mr. Alvarez, Fenner," there was, I fancied, not a little disgust in Davidson's rumbling tones, "Mr. Alvarez is having domestic difficulties. He-

Alvarez's nerves slipped their leash right then. The Chief's bass boom was drowned in a falsetto torrent. "My wife—she's a gone—went—she's a desert! She's a fly with Senor Smeethson. Heem I will slay! Heem I will run thru! Heem-

The corners of Fenner's mouth were twisting into a grin. "If you've come to borrow the swords, Chief," he began, sweetly sarcastic, "I'm-

Davidson cut in in hasty defense. "Oh, I know what your thoughts are, Fenner, and what you're going to say. The fact that his wife ran away with Senor Smithson isn't particularly our business. She can fly with a regiment of Smithsons if she wants to, and all she'll get out of me is a few telegrams to neighboring authorities. But that isn't all she flew with. She's a fly, as this guy says, with about twenty thousand dollars' worth of jewelry and a wad of money. And that is our business."

Alvarez leaped from sputtering incoherence into full eruption. "Yes! Yes!" he cried, while thrashing arms strove to aid a badly handicapped tongue, "She's a take diamonds—pearls—the rubies! From my safe there is gone five—six—ten thousand dollars—more—I don't know. She's-

He became unintelligible. English, at the speed he was making, proved an unmanageable vehicle and he lapsed into his native tongue. Squealing out his wrath in a rising crescendo of fury, he fairly danced in rage. Twice Davidson made a tentative move toward the infuriated little foreigner, but each time Fenner shook his head warningly. And at last the storm spent itself. The torrent slowed, stilled, spluttered into silence.

Davidson turned to Fenner. "Now that is out of his system," he said, dryly, "we'll get down to business. Mrs. Alvarez, apparently, has eloped with Senor Smithson—whoever he is—and has added insult to injury by plundering her husband's strong box. I hate to bother you with a routine case of this type, and I know that it is out of your line alto-

gether. But this precious pair left nothing to betray their destination and that's why I'm here. The United States is big, you know. They may have slipped quietly over into the next county, or they may be going fast for the Coast, or Canada, or the Gulf. It puts me up against a needle in a haystack problem, and I'm in hopes that you may have some scientific method of locating fleeing culprits worked out and waiting for trial.

Fenner tossed his banjo upon the table. "If they've left no trace," he said, thoughtfully, "they've made an unusually clean job of it. Try the railroad stations?" Davidson looked pained. "Sure," he said, heavily, in the tones of a man who will not deign to resent an implication of incompetency. "No good. If she left over any of the roads, she went so well disguised that the station agents, who all know her by sight, were unable to recognize her. Nobody seems to know just who Smithson is. At his lodgings they know nothing of his occupation or his antecedents. He's been gone for a week—more or less. No one seems to have noted just when they last saw him. From their guesses I put it at about a week."

"And Alvarez? Had he no inkling of what was on foot?"

Davidson chuckled. "Our friend here is the goat," he guffawed. "It seems that (Continued on page 1058)"
A War Invention Recently Disclosed to the Public by Thomas A. Edison, and Which Was Devised by His Son, is the Trench Destroyer Here Illustrated in Action. This Trench Destroyer Was Tested Successfully Under Actual Conditions Over a Large Tract of Ground, and Was to Have Been Adopted by the War Department, but the Armistice Was Signed Before It Had a Chance to Show What It Could Do. A Hollow Steel Disk Filled with High Explosives, and a Fuse Set to Detonate After a Certain Set Time, is Whirled at High Speed on Its Axis, and then Released, When It Tears Thru Barbed Wire Entanglements as if They Were More Cobwebs. When it Bursts It Blows a Hole in the Ground Resembling a Giant Shell Crater.

Edison's Son Invents Trench Destroyer

Americans know that Thomas A. Edison produced many important inventions during the World War. Recently while on a visit to his friend, Henry Ford, the well-known automobile manufacturer, Mr. Edison disclosed a novel invention developed by his son, which took the form of a steel disk or wheel filled with explosives, which was rotated at very high speed and then released and which device demonstrated its great value by mowing down barbed wire entanglements, tearing thru walls and trenches, and finally exploding, thanks to a time fuse attached to it, with such violence that everything was leveled within a radius of 150 feet.

These disk destroyers were designed, said Mr. Edison, “to be dispatched for the German trenches in order to clean them out before a charge, but we never got the chance to use them before the War stopped.”

Mr. Edison further explained that successful tests had been made with the disk destroyer on an island in the Key West group. The steel wheel which was to form a compartment for the TNT or other high explosive, measured about 3 feet in diameter and 6” in thickness. Around the edge was a steel rim made smooth and heavy, but it would seem advisable to place teeth around this rim, so as to more effectively cut thru barbed wire entanglements and fences. A time fuse which could be set to detonate the TNT, after a given number of seconds, served to explode the high explosive after the disk had travelled a predetermined distance.

The steel wheel was arranged to be held on the driving shaft attached to a Ford tractor motor geared to a high ratio. In this fashion, the disk was revolved at a tremendous velocity and when the speed had risen to 35,000 feet per second at the periphery, it was automatically released from the driving shaft by suitable clutches. In front of the tractor there was built a suitably inclined plane down which the revolving wheel sped with lightning-like velocity; from this it fairly flew along, bounding thru the air and then, like a young lion, as it hit a small hill or knoll. In some of the tests, the whirling disk travelled for two miles, cutting like a buzzsaw thru everything in its path, including in one case 150 feet of wire entanglements, closely set just as if they had been more cobwebs. It ate its way thru walls and other impediments until finally the time fuse exploded, the charge blasting a mighty hole in the earth and killing every living thing within a goodly distance.

How Much Mineral Do You Drink?

When you take a drink of water how much mineral matter do you swallow? Dr. W. W. Skinner and J. W. Sale of the Bureau of Chemistry of the Department of Agriculture have made an investigation of the amount of dissolved mineral matter in the water supplies of seventy of the large cities of the country.

If you are in Oklahoma City, Okla., where the water contains the largest amount of minerals known, you will take in 12.1 grains with every quart. The inhabitants of Atlanta, Ga., enjoy water which contains the smallest amount, 0.2 grain per quart.

Washington water has a comparatively small amount of mineral matter, only 1.5 grains per quart.

This is the first compilation of the figures of mineral composition of the different drinking waters of our large cities, it was announced. The quantity of minerals in water is of interest to physicians, travelers, and certain industries which utilize processes influenced by the dissolved matter. The dissolved mineral matter ordinarily consists chiefly of dissolved limestone, together with smaller quantities of gypsum, common salt, iron, magnesia, etc.
The Psychic Lens

By CARL S. WALLACE

With fingers deft from years of practice, Lohr shook the plate loose from the restraining springs of the plate holder and flipped it into the developing bath. Gently rocking the little tray, he watched the creamy emulsion blacken and the faint trace of outlines form under the magic touch of the chemicals. The red light of the darkroom was feeble, sickly, weird. By it the sides of the tray cast deceptive shadows across the surface of fluid and plate, shadows that bewildered the novice. But, accustomed to the semi-darkness, Lohr followed closely the growing intensity of line, awaiting the instant of perfect development.

Suddenly, with an oath of annoyance, he bent forward to a closer scrutiny of the plate. A little to the left of the center, the negative dark outline was forming, as yet a mere misty blotch. He knew that it should not be there. It meant a spoiled plate, and he was very anxious to have this picture perfect.

Disgruntled, he watched sullenly as the blotch grew stronger, brighter. Then, as definite outline came, he gave a cry of surprise, of incredulous amazement. Ceasing his methodical rocking, he brought the tray closer to the glowing red bulb, expecting to find himself the victim of an illusion. Surely he was being deceived by a queer prank of shadows!

The stronger light seemed only to verify his first impression. With a muttered imprecation he jerked the plate from the bath and dropped it into the hypo. Impatiently he waited during the brief interval necessary to render the negative impervious to strong light. Then he switched on the white incandescent. Holding the dripping glass between his eyes and the light, he stared stupidly. Charming backgrounded by the strip of country road he discerned the graceful outlines of Miss Meredith's figure. A little to the left of her, almost as sharply defined, stood another female figure, equally graceful. And when he had made that exposure there had been no one else in the camera's focus!

A long moment he gazed at the image of the intruder. Then he carefully slid the plate back into the fixing bath and sank into the one chair his darkroom boasted. Mentally he reviewed in detail the circumstances of the exposure. Made only that afternoon, the events were quite clear. He had taken pains in posing Miss Meredith, for the picturesque bit of country road had appealed to him, had cried out for an artistic rendition of the human figure that was to embellish it. He had wanted her to seem as if she belonged to the scene, he wished the surroundings to indicate a definite reason for her presence, to blend his subject and her environment into an harmonious whole. It had been tedious work, and he recalled the many fumings and changes. They had been uninterrupted. He was quite sure that no one had past before the camera prior to exposure, and the shutter had been closed before he slipped the plate holder into place.

There had been spectators. Three girls, from a nearby farm no doubt, had looked on with interest during the posing. But they had stood well to one side. He remembered making sure that they were well out of the field of view before he had pressed the bulb. At no time, in fact, had they been within range of the camera's lens, and he remembered how grateful he had been for their silence and unobtrusiveness. There had been no glittering wall, nothing to play the mirror. It was impossible that he had photographed a reflection.

The theory of double exposure occurred to him, but he was forced to quickly dis-

(Continued on page 1087)
Ten Million Horse-Power in a Pebble

The century came to an end, and brought with it the discovery of radio-active substances. The subtle researches of Mme. Curie, of Rutherford, and of other scientists, showed that a gram of the new mysterious element, radium, in the course of its changing into common lead, gave out the enormous quantity of 3 million horse-power hours in the form of heat and electric radiation. Here one came suddenly against a definite quantity of energy of the same order of magnitude which Lodge had predicted.

If the sun contains proportionately as much radio-active substance as the earth, the riddle of its inexhaustible radiation of energy undiminished for thousands of years, is solved. For then the heat of the sun would be born new every hour after the emanation of heat was changed into nothingness; and all theories of an approaching cooling of the sun, and of an accompanying extinction of life on earth, with the death of mankind by cold, would fall away.

The investigation went further. It touched upon the physical basic relations of space and time, and produced in the first ten years of the new century the relativity theory, linked with the name of Einstein.

The basic laws of the relations of energy and material go into the wider and greater law, according to which energy and matter are only various forms of some unknown third entity. Matter can disappear from the world without leaving a trace and turn itself by a fixed law of proportion into anything. Energy can convert itself again into mass. A gram of any given mass, it may be water or air, it may be sand or garden earth, according to the new theory, must, on disappearing from this world, leave an amount of energy of 34 million horse-power hours; and another riddle of the world approaches its solution. What becomes of the inconceivably great amount of energy which the many thousand tons of our milky way ceaselessly radiate into endless space? We are face to face with the possibility of an answer. Somewhere in endless icy distance the energy will again turn itself into matter, perhaps forming itself into luminous spiral nebulae evolving new world systems. Increasing knowledge solves the hitherto unsolved riddles of the world. The atom, so long regarded as the smallest and indivisible particle of matter, reveals itself as a complicated structure, a complete sun and planet system of incredible smallness. An electron which is a quantum of negative electricity rotates about an elementary quantum of positive electricity, and we then have the hydrogen atom. The electron whirls around its central star six billion times in every second, bound to it by enormous stress. Ever more complicated and more involved as these endlessly small world systems become, the greater the atomic weight of the matter involved in them is. Hundreds of planets, in dozens of orbits, whirl around the positive central system of the atom of uranium. The structure is here so complicated that it does not remain stable, but in the course of millions of years grows simpler by the shooting out of single suns. This gives us the spontaneous breaking down of these radio-active substances, in virtue of which atomic energy is set free in what was formerly termed colossal quantity.

But what means do we possess to get control of this enormously powerful source of atomic energy for our own desires and uses? If the hypothesis is correct, then free electrons which one directs with appropriately aimed beams of light against atomic world systems, must bring about a catastrophe, such as a swarm of great comets would cause which suddenly burst into our sun's orbit. Single elementary quantum must be torn out of the system, just as an enormous comet would draw the earth or Jupiter on its orbit, and might carry it off with itself.

That is the conclusion of theory, and experiment has wonderfully confirmed it. In the evacuated cathode tube the atomic structure of nitrogen has been broken down into the simpler system of hydrogen and helium. The atomic structure of chlorine has been broken down into two new hitherto unknown atoms. So far we have gone to prove that what our age will find the way which leads from the first breaking down of an atom by accident to the definite control and utilization of the new source of energy, that is a supply of energy which a handful of dull, worthless stones broken into nothingness gives us may amount to hours of horse-power, for which to-day hundreds of miners must break down coal for months at a time in danger and darkness; a world in which energy in excess is at our command. (Excerpted from "Die Wocke.")
Household Science
By H. Winfield Secor
ASSOCIATE MEMBER AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS

I

The accompanying illustrations some
ordinary yet frequently disregarded
scientific facts, which concern our
daily life are vividly shown. How
monstrous it is to pour from an
and shallowly a kerosene oil on a stove fire? Dozens of times possibly, but if
ployed in the household is so
will always try it "just once more." If
you must put kerosene oil on a fire, care
should be taken to pour out a small quan-
ty in a thin stream; this is poured into a
cup or can, and this may be thrown on the
paper and kindling, but always before the
fire is lighted. Danger from pouring kerosene upon a fire is caused usually in
one of two ways: either by throwing too much kerosene into the fire, which will
cause the lids to be blown off, starting a
furnace, perhaps, by throwing the hot
brands or coal on the floor; or again, the
oil may ignite when poured from the
spout of the oil can, and follow up the
spout, and before one knows it the can
may explode, due to the heat and air
formed within the can, and the clothes
catch afire. Put the oil on first, if you
must, but do not add a small quantity,
poured from a cup. Keep the oil can at
a distance from the stove at all times.

HOW NEWSPAPERS REDUCE ICE BILL
As a matter of economy it is well to
know that a cake of ice may be made to
last from two to four times as long as it
does normally. The ice should be placed
or paper around it. Several thick-
esses of paper will serve to keep the air
currents away from the ice, and this helps
deleterious effects. In the case of the
poorly insulated ice-box, or one that has
no cork or felt filling or tight air pockets
surrounding the ice chamber. If the ice
is to be kept in an open container, such as
a tub or boiler, it should be wrapped around
tightly, but if it is to keep vitally
cold in a ice-box, then the paper may
be placed over the top and sides only. There
are paper ice blankets now on the market
sold for the purpose of reducing the
economy on the household ice bill.

HEAT NEAR GASOLINE TANK DANGEROUS
Gasoline as well as ether, kerosene,
et cetera, are more or less dangerous and
liable to form gas and ignite, or if the
cavities mix in the air, that might be
in the room's air. If the vapor mixes with
to a gasoline can be poured or near a stove. If
the stove throws a considerable amount of
heat, there must be a certain amount of
gas formed in the gasoline by vaporiza-
tion of the gasoline to ignite. Most peo-
ple do not understand why gasoline is
dangerous, but it is possible that gas and air
will combine and form a flame near the
 ether, as it vaporizes quickly, and
alcohol is also a prolic vaporizer, as
you have probably noticed when rubbing
this liquid on the muscles of the arm or
over the hand, for rhematism, etc., when
the rapid evaporation of alcohol into the
air caused that extremely cold feeling.

WHY SOME ICE-BOXES ARE WORTHLESS
In one of the accompanying illustrations the trick of improving ice-boxes by filling
the space between the inner and outer box with chalk or diatomaceous earth, the
coal, cork, sawdust or mineral wool, is
shown. Some of the better class of ice-
boxes to-day are made with hollow air
pockets surrounding the ice compartment,
but these must be absolutely air-tight to
be of any value. The writer remembers
distinctly several ice-boxes which he had
experience with, which were notorious
cold waters, and upon investigation the
cause thereof was found to be that they were closely
built with alleged air pockets, and these
were not air-tight at all, permitting the
air from the room to blow through them,
which, of course, helped to melt the ice at
a very unhealthy rate. This trouble
is caused by the wooden top and bottom
stripping these covering these pockets, and
filling
the same with one of the aforemen-
tioned heat insulators, such as granulated
rubber, powdered rubber, or cork. The
air boxes of to-morrow will be made undoubt-
edly with vacuum pockets, thermons
bottle filling, or by some other means. Then a cake of
ice will last about four times as long as it
does now.

There are some very interesting ice
chests and ice-cement containers now being
built by an American concern, in which
balsa-wood, which is a much better heat
insulator than cork, is employed. The
balsa wood surrounding the ice-cement or
ice compartment, is 4 to 5 inches thick, but
not heavy for it is considerably lighter than
back. The balsa wood and the cement
contains does not require any ice.

DANGER WITH GAS STOVES.
Gas ranges and stoves are used by the
thousand all over the country, and now
and then one hears of an accident with
out these heating appliances which could
have been avoided with little care and
thought. One of the acest, with which the writer forever
comes in contact, is that where the
oven of a gas range has exploded, blowing
the door or doors off the hinges, and in
some cases, knocking down the lady who
had lighted the stove. Now how did this
accident happen, you ask? Very sim-
ply, the ignition switch was applied to the
pilot or starting burner, from the outside
of the range. Unbeknown to the operator,
or anyone else, the ignition switch was
partly turned on and the oven had filled with
gas. When the pilot burner was lit, this
ignition switch was applied to the pilot, and
air and gas in the oven, with the resulting
explosion. The safety valve is here to "open the door and leave it open for a few
minutes, before lighting stoves"; or it may
be left open while lighting it for that matter, and closed after-
ward.

Some people always light gas stoves or
gas radiators in such a way that there is a
cloud of gas in the room, while to have any kind of open flame, such as
an explosion. The writer never has any trouble
once in a hundred times by following this
rule. Sometimes this popping back will be caused by the air mixer being out of adjustment.

CONCERNING STOVES IN AUTO GARAGES
Practically every owner of an automo-
ble has been cautioned by those who are
in a position to know, not to use or have
an open flame of any kind near the car,
for the reason that there may be, and
usually is, a slight amount of gasoline vapor present, which may ignite.
It is dangerous, therefore, in the first premises, to have any kind of open flame, such as a
coal, oil, or gas stove in a garage, es-
pecially in a small garage, and then trust
this stove over night. Some people do it
and get away with it, including a few
of the writer's friends, but it is a
ticklish business, especially when no
fire alarm can be had, on the car. Electric heaters are dangerous in a small
garage if left on over night, unless it is
of those earthenware and engine heat-
ers, which do not glow red, but whose
heating coils remain dark.
If it is desired to use a 400 or 600 watt
electric reflector, the danger of igniting any gasoline vapor from the in-
candescent heating coil in the focus of the

(Continued on page 1018)
How Gas Turbines Work

Prof. T. O'Conor Sloane, Ph.D., LL.D.

OVERS of the old time history of invention in tracing back the development of the steam turbine refer to the old smoke jack, which was the horizontal windmill installed in a chimney and turned by the uprising draft of air. This is assumed to be a sort of gas turbine. It was used in old days for turning the spit, when meat was roasted instead of being baked as is usually done nowadays. Then we come down to something more tangible in the shape of John Barber’s English patent of 1791. Like many English patents it is rather hard to understand, and the drawings are not very good, but it is taken as representing the first patented gas turbine. Then we come to Dumbell’s gas turbine of a somewhat later date, shown in Fig. 1, which in a way resembles the smoke jack. The picture shows a rotating horizontal mill wheel or drum with a multiplicity of wings on its periphery to be acted on by the draft from the fire. Above the fire he has a boiler in a sort of sand bath arrangement of no particular utility from the present-day point of view.

Coming down to more modern times, the diagram Fig. 2 shows the elements of a turbine actuated by hot air. The pump at the bottom pumps air thru the tubular boiler-like structure F. Within this is a furnace, so that a cubic foot of air pumped into it emerges as several cubic feet of air from the top. The blast whirs the turbine around and then goes into the furnace surrounding the tubes, and in the furnace heats and burns a combustible which may be oil or may be a solid fuel. This, however, is hardly the conception of a true gas turbine.

Fig. 2 shows the discharge nozzle of a simple explosion type gas turbine. This is a very curious machine. Gas and air are past into the chamber E, and are exploded by a spark between the electrodes. The hot gas from the explosion rushes out, blowing against the turbine, whose wings are indicated at W. The wheel whirls around and at the end of the explosion a slight vacuum is created by the inertia of the outrushing gases. This draws air and fuel by inspiration into the chamber E, from their respective pipes, and another explosion takes place, followed by a slight vacuum. The pressure is supposed to be about five pounds to the square inch above, and the vacuum about one pound below the atmospheric pressure. It is said that this turbine will give thirty-two rotations a second, and as much as 12,000 revolutions per minute are assigned to the wheel with a periphery speed of 285 feet a second. Its efficiency is put at very low, less than 3 per cent. Yet in the descriptions of it one can read between the lines that it appeals to the engineer. Its utter simplicity and absence of any pumping arrangement, and its automatic action, are quite impressive.

Another conception of combustion chamber and inlet is shown in Fig. 4, the Karavodine explosion chamber. Y and Z are the inlets for fuel and air, and at X is indicated the water jacket. This, with the turbine wheel, also works automatically, the valve D rising and falling as required.

The more practical type of turbine includes a pump to force air into the combustion chamber, and provision for introducing the fuel, usually also a pump. The combustion chamber gets red hot, and if cooled by a water jacket will produce steam, and one of our illustrations, Fig. 5, shows the combustion chamber with its jet T and water jacket receiving cold water thru the pipe as shown, and delivering steam thru the receptacle C, whence it is blown upon the wings of the turbine so as to economize that much energy.

A variation of the above is shown in the next cut, Fig. 6, where the combustion chamber is traversed by tubes a, which arrangement virtually constitutes a water tube boiler, and which delivers steam thru the jet t upon the wings of the turbine. A further variation on this theme is shown in the jet in the next picture, Fig. 7, where the hot gases from the turbine are made to traverse the outside of a serpentine boiler, generating steam therein which blows against the wings of the turbine in front of the gas blast.

It is fair to say that the problem is yet unsolved. Many turbines have been constructed, but none have come into very extensive use as yet, and the field for invention still lies far ahead. Many years inventors have been striving to produce the rotary steam engine, and lately have attained some slight degree of success. Years of work have brought the steam turbine really to perfection, and it is used on a very large scale for high powers.

If one may venture to summarize the difficulties of the gas turbine, the result may be put in three or four divisions. The high heat is very hard on the wings of the turbine, but by using high speed steel this trouble has been overcome to some extent. The escaping gas after the combustion do not bear as favorable a ratio to the incoming air and fuel, as exists in the ratio of water to steam in the steam engine. A cubic inch of water pumped into the boiler of a steam engine will heat hundreds of cubic inches of steam, the quantity depending on the pressure at which it is measured, but no such favorable ratio exists in the case of the gas turbine. Therefore, one of the great desiderata is an efficient rotary pump to force the air in. Finally, unless the abnormally high heat of the explosion is (Continued on page 1075)
Electric Desk and Auto Clock

Back in 1915 a man became dissatisfied with the service he was getting from his clocks. He had clocks of various kinds in his home, his automobile and his office—and they were as good clocks as he could buy. The largest cause for dissatisfaction was the ever-present necessity for winding—some needed it each day—but they all ran down sometimes. This man happened to be A. E. Keith, the inventor of the automatic telephone and a world famous electrical genius. He made a clock that not only needs no winding, but which keeps remarkably accurate time. As his experiments progressed he not only did away with main springs and their temperamental troubles, but he eradicated the bugaboo of isochronal adjustment. This is the adjustment for the varying power supplied the movement by the main spring—strong when fully wound and gradually diminished to nothing when the spring is completely unwound—the most difficult to make.

Mr. Keith simplified the entire movement—made it foolproof, tested it thoroly in his laboratory, and then put it in a medium priced car in everyday use. That car during the next five years covered 100,000 miles of city and country roads and was subjected to the strain of long tours. The clock kept running—kept automobile models secure their electric current from the car battery, while the other models contain a small dry cell sufficient to operate the movement for a year, when they are easily replaced at a very low cost. The amount of current required is so small that it is impossible to measure it with ordinary laboratory instruments.

Briefly, the electric mechanism operates as follows: The current in all models except the automobile clock is supplied by a dry cell. (Continued on page 1068)

Had Your Portrait Typewritten?

Mr. Hobart Reese, of Washington, D. C., has gained considerable fame for himself by the remarkable likeness of famous people which he hammers out on his typewriter. Mr. Reese would make an able detective, wouldn't he? He could type a likeness of a visitor on his machine.

The Latest in Portraits—Typed While You Wait, as it Were. President Harding, Mary Pickford and Douglas Fairbanks are Seen in True Likeness Here in Mr. Hobart Reese's Novel Creation—Typewritten Portraits. To Analyze These Pictures Use a Magnifying Glass to Ascertain the Letters Used.
Starting Autos in Cold Weather

Some automobile engines are more stubborn than others to start in cold weather and with some cars it is quite a problem to get the engine started on a cold winter morning, particularly where the car has leaky valve stems and a poor or worn out carburetor, or badly worn cylinders. Some of the hints and ideas illustrated herewith will be found useful, as experience proves, even in the case of many new cars.

Possibly one of the oldest tricks known to motorists in order to start a stubborn engine at any time, whether in cold or warm weather, is to prime it. Some engines have priming valves or pet-cocks on them which can be opened and a little gasoline or ether squirted into these valves by means of an oil can. Where priming cocks are not provided and this method is found the best for a stubborn engine, priming spark plugs may be installed in the major portion of the cylinders which will enable some gasoline or ether to be injected into the cylinders for starting. They cost but little more than the ordinary spark plug. Engines having overhead valves may be primed by applying some gasoline or ether down over the intake valve stems. It is best after the engine has been started to put a little oil on the valve stems as they may stick, the gasoline having the effect of cutting the grease and oil off again.

Next we have in the bag of tricks for starting in cold weather, the panacea of applying heat to the carburetor or intake manifold. As the accompanying drawings show, there are several ways in which heat can be very effectively used to aid in vaporizing the gasoline, which will not vaporize when the carburetor and engine are cold until this kind of thing has been tried for five or ten minutes and warmed up. Pouring hot water over the intake manifold is an old dodge, and it is best to bind a funnel around the intake pipe where it leaves the carburetor, so that this water can be retained and then emptied by means of a pet-cock, or else a piece of brass pipe should be soldered in the bottom of the funnel surrounding the pipe, so that the water drains off below the carburetor, and not one drop of it will get into the gasoline; it will raise some mischief if it does. An electric grid or quick-start vaporizer is supplied by one manufacturer, current for the heating coils being supplied from the car storage battery or else from dry cells. This intake manifold vaporizer is made in the form of a gasket about ⅜" thick and is placed between the flanges on the pipe connecting the carburetor with the intake manifold, and the bolts are then replaced and tightened up. No other kind of an electric intake heater is made in the form of a coil to surround the intake pipe, and this is likewise supplied with current from the car battery, or it may be designed to be operated from 110 volts A. C. or D. C., so as to be supplied with current from the lighting circuit in the garage.

A standard electric carburetor and engine heater is available on the market which appliance consumes but 100 watts. This heater is designed to be used to keep the engine and carburetor warm thru the night in a cold garage, it being necessary to place two or three blankets all around the engine in order to retain the heat and cause it to accumulate and thus keep the engine compartment warm. A better way would seem to be, from the writer's experience, to use this electric heater (which, by the way, stays dark and does not become incandescent, which would make it liable to ignite any free gasoline vapor), alongside of the intake manifold just above the carburetor, and then to place over the carburetor and heater with a piece of carpet, or, better still, asbestos cloth, in order to retain the heat more effectively.

(Continued on page 1025)
Snow Crystals

There are in Nature a number of substances which form crystals, and it is very wonderful how exactly these crystals obey strict mathematical laws. The section of a quartz crystal is a perfect hexagon, with the angles mathematically true. It is interesting to observe that the hexagon occurs elsewhere in Nature. It is present in great abundance and almost infinite multiplication in the combs of the bee-hive; the section of each cell is the hexagon. Again, if a man places the tip of the fingers together, holding the arms horizontally in front of him and keeping the hands straight, he will form the contour of a hexagon, an angle at each wrist, an angle at each elbow and an angle at each shoulder, and one theory is that it is by a similar use of his legs that the bee gets the shape of the cell.

Quartz crystals make one of the most beautiful exhibitions of hexagonal forms on a large scale, but almost everything in the way of crystallization on a large scale must yield in beauty to the almost microscopic snow crystals. These are formed by the freezing of water vapor. If the water vapor, which is really water in the condition of gas, is gradually cooled, it first forms a liquid which is simple water. On further cooling it forms ice, a solid. But if the vapor of water mixed with air as in our atmosphere is exposed to sudden freezing, it passes directly from the gaseous to the solid state and forms snow.

The first effect is to produce minute crystals, and these crystals consolidate very lightly and form the slow descending snow flakes. When examined with a microscope, the crystals of snow always show the hexagon aspect, and long ago, under the microscope or magnifying glass, were found to be most beautiful objects. They form little stars of quite elaborate design and surpass in symmetry and complexity almost any inorganic structure. They have long been a favorite object to be drawn by hand, but now photography is called in and the somewhat difficult operation of taking photographs of the fast vanishing crystals is often carried out quite successfully. The crystals are collected on a black card so that they can be seen, are sorted out, and good ones are transferred to a glass slide for examination under a microscope.

The observer must be willing to work in the cold, for it is obvious that the least rise of temperature will melt the snow. He must not breathe upon the little stars of ice, for that of course would melt them. One or more are carefully disposed upon the glass slide with a feather; the microscope which is arranged for photography is focused upon it, and an exposure of some seconds to perhaps several minutes, according to the conditions of light, is given.

The star-shaped crystals have six rays; if needles are formed, which sometimes happens in very cold weather, they end in six-sided pyramids; and if little ice flakes appear, which also form under some conditions, they too are subject to the law of the hexagon, and are six-sided. If the formation of the crystals has not been interfered with by any condition of the upper atmosphere, the little stars will be found to be perfectly symmetrical, each of the six radiating members corresponding exactly in shape with its companions.

The extreme regularity of the flake, every specimen being an accumulation of crystals, is very remarkable. In the mineral world aggregations of crystals are very

(Continued on page 1962)
Carving With a Pocket-Knife

By G. E. WILLIAMSON

THE boy of to-day is the expert mechanic of to-morrow, his pocket-knife is the forerunner of tools of greater scope and accuracy, and his first crude efforts may be the spark of genius that will later startle the world. The class of work shown in these photographs, is not carving in the usual sense of the word, but is more properly designated by the word freak. Carving tools or a dull knife would be equally useless, as the most of it requires a point like a needle and an edge like a razor.

Any ordinary two-bladed medium-priced knife will do the work, but the small blade should be ground perfectly straight on both edges for about two-thirds of the length, and very thin so it will not split the wood where it is thin. The big blade should have a straight cutting edge with the back rounded; any blade can be ground to this shape.

The most suitable wood for this kind of work is any soft straight-grained wood having no hard streaks in it. For all around work and especially bent work, basswood is the best: for straight work, white and sugar pines, such as are used to make doors and window sash, are very good.

While all of the work in these illustrations has been done with a knife, with-the exception of drilling small holes where necessary, a large part of it can be done quicker and better with other tools. Small saws, chisels and blades of convenient forms and sizes can be made from dress and corset stays by means of grindstone and files, while knitting needles and parasol ribs make fine drills; flatten the end and file to size. Needles and the many kinds of hooks and other desired forms can be made from suitable sizes of wire.

In drilling long holes, for the best results, fasten the drill and turn the wood.

To make a needle out of a wire or dress stay, flatten and bend slightly at the point where the eye is wanted and file a notch nearly thru with the edge of the file, then bend the other way and finish. Smooth the inside of the eye with the point of a nail.

For roughing out the work, grasp the knife firmly with the end of the thumb between the first and second fingers out of the way of splinters, lay the work on the knee, the hand also resting on the knee with the blade almost flat and crossing the stick at a slight angle; hold the hand firmly and pull the stick.

To use the knife for a turning lathe, turn the blade nearly straight up and down and with the hand still on the knee, turn the top of the stick towards the blade.

A few trials will demonstrate the idea. For heavy cutting use the big blade, but not to pry with. To cut a small tree or a board when there is no better tool at hand, take the knife in the hand with the blade towards the little finger and cut along the line where wanted. Cut lightly until started, then make another cut parallel a short distance away, with the point leaning towards the first cut. Go down with both cuts until the chip is all out. Make a third cut near enough so that the chip will come out easily and go to the bottom again. When about half way thru, turn the board over if possible and if you can bend it away from the blade a little it will help greatly.

To do scroll work on thin wood, use the needle point. To demonstrate, take a piece of cigar box and push the blade in from the back of the work so that the point is just thru and in the line to be cut; work the handle forward and back in the line you want to cut, maintain a slight pressure, keeping the point on the line and you will soon get the idea.

Solomon's Knot Puzzle

To make this interesting puzzle which can be easily whittled out of wood, take six pieces of wood about 3/4 inch square (Continued on page 1052)
Shall I Take Up Engineering?

By H. Winfield Secor

(ConcLusions)

Associate Member of American Institute of Electrical Engineers

A

engineering education always stands as a man good stead whether he may

be or an employee, a partner or owner, in his future years.

And it is a well-known fact that a

technically educated man, along better in any business, than will the

man who lacks this technical training. He knows the exacting requirements of the engineer's profession, and will invariably develop his mind in a business sense, so that he will be able to figure on profits and sales as well as on buying costs, so that there will be a small chance of a loss.

THE PRINCIPAL CLASSES OF

ENGINEERING

The six principal branches of the engineer-

ing profession are perhaps the Electrical, Mechanical, Civil, Mining, Chemical, and Radio Engineering. Each of these includes various specialized departments and a man invariably has to be or should be a good electrical engineer, before he takes up radio engineer-

ing, as the two are inseparably associated.

THE ELECTRICAL ENGINEER'S WORK

The electrical engineer, as might be ex-

pected of course, specializes during his college work on electrical subjects, but it is surprising to see those who have not studied the list of subjects covered in such a course, or the scope and breadth and other similar subjects, which the future "E. E." has to master. He should and usually does take up the German and French languages, as both of these are rich in engineer-

ing literature, and in many cases after his graduation he will find it useful to be able to consult the original technical papers published in foreign journals, particularly in German and French periodicals, and to read them, although the matter is published in the reviews columns of American or British journals not being of any great value, owing to their brevity and lack of detail.

It is surprising how many excellent elec-

trical engineers one meets in his travels, who have graduated with the degree of mechanical engineer. One reason for this is that some colleges and technical schools do not give an "E. E. course, but only an "M. E." course, the latter being very broad and comprehen-

sive in the electrical subjects embraced. In conversation with Dr. Nikola Tesla, he has frequently mentioned his interest in, that he graduated as a mechanical engineer and furthermore, that the fundamental ele-

ments involved in mechanics usually gov-

ern his train of thought, when he studies to develop some of his many electrical inventions, even including polyphase alternating current apparatus. Those who have studied mechanical engineering and physics will at once see that there is indeed a very strong bond of correlation between the two sciences, especially when we think of the wave-forms and vibrations occurring in the study of sound, etc. When studying or computing the harmonic phenomena of an electrical circuit, for instance, it does not matter whether we study this from the electrical or mechanical point of view, the result will be the same.

The electrical engineer should and usually does have the opportunity to study steam power plant operation, either on a large plant or at which he studies, or at the school power-plant itself, as is frequently the case.

Among the subjects studied are water-

power electric generating plants, the elements of telephone practise, the design and calcula-

tion of electrical transmission lines, the lay-

out and calculation of proper cable-power number, and the design of illuminating residencies, industrial plants and cities, as well. He must be thoroughly versed also in the design and operation of dynamos and alternating current controllers, transformers, alternators, and apparatus for the same, electric railways, etc.

The college educated engineer of no matter what branch of the sciences is given a thorough course in mathematics thru algebra, trigono-

metry, geometry, and the calculus. One of the greatest boons to any engineer is the slide-rule for use in calculating any math-

ematical values, computing costs, designing apparatus, etc., an instrument which saves many hours of time. He is also required to think in the mind of the tedium of multiplying and dividing quanti-

ties, which is really the work of a machine. The electrical engineering graduate, however, usually associates with some concern, where he can use his knowledge to good purpose. Some "E. E.'s" gain their first practical ex-

perience in designing transmission line and erecting power plants; others make their first start in the designing and many reasons, and as mentioned above, the mechanical engineer, who receives a great portion of his training in the University, is very likely to concentrate his energies, so as to materialize more as an electrical engineer than as a mechanical one. Usually the mechanical engineer takes up in much greater detail the subjects more in line with his work, such as machine design, steam-turbines, ships and their propelling ma-

chinery, including engines and boilers, the design of steel- frame buildings, including an exhaust study of the air and strains in steel columns, beams and trusses, etc. Hydro-electric plants are usually studied also, as well as the engineering mechanics of locomotives and railway trains, and many other interesting and important subjects.

The graduate mechanical engineer fre-

quently takes his first job with a concern in his line, who may manufacture anything from a road-scaper up to a battleship. It is thus easily conceived that the "M. E." has indeed, as we might say, a large part to do with the great progress that is everywhere. We cannot help but think of his calculations and designs everyday we see a steam engine or turbine operating. The high speed elevators that carry you skyward 30 or 40 stories in New York's great skyscrapers are the result of the intense mechanical and electrical brains imaginable, and are not the result of simple rule-of-thumb design, as followed in other branches of the mechanical arts. The opportunities for advancement in the mechanical engineering profession are legion, as may well be imagined, and to a very large extent this is due to the great need and pressure on the side of mechanical engineers, the same as in other engineering branches, depend upon the interest, initiative and industry of the individual.

THE CIVIL ENGINEER'S FIELD

Time was, and not so many years ago, when a Civil Engineer was usually looked upon in his community as the "boss sur-

veyor," and that was about all he counted for among many people. The magnitude of the engineering work to be studied and ab-

sorbed by the Civil Engineer today is in-

deed very surprising, for, unlike many of the other branches of engineering, the "C. E." frequently has to do with the laying out of entire cities. Not only, however, is he concerned with the accurate surveying of the land and laying out of the streets and avenues, but farther than this he has a great deal to do with such things as water works, the design of water sup-

ply systems of cities, the design and layout of sewerage systems. Aside from this, and the work he is to do in order to tell you whether or not you should build an electric central station at a certain locality, how much it will cost to develop your land, the exact value of a tract in dollars and cents, and many other surprising

things which a first glance at the man builds, is the theodolite, and which is but to your innermost conscience, if you did not know these things.

Surveying is, we might say, the first "step in" to the civil engineer's (Continued on page 1071)
Talking Over a Trolley Wire

A GROUP of prominent technical experts representing eastern railroad systems witness a demonstration of what is known as the carrier current system of communication, at Schenectady, recently.

The system makes use of a second current superimposed on the same trolley wire which supplies current to operate the car. This carrier current, which is generated at a higher frequency than the power supply, serves to transmit messages along the wire, from which it is picked up at any convenient point and made to energize a telephone instrument.

The demonstration took place on the lines of the Schenectady Railway Company, five miles from the city, and was arranged by the Railway Department of the General Electric Company, which is interested in the development of the new system.

From the moving trolley car the railway men were enabled to talk successfully with a station on the line several miles distant and also to listen to conversation from the operator in the station. The second feature of the demonstration was listening to the conversation of the subdivision attendant at a waiting room two miles from the station, the messages being transmitted over the trolley wire and amplified in the waiting room by a loud-speaking telephone instrument.

The demonstration was designed primarily to show the application of the system to communication on electric railways, especially as regards expediting train operations. It was developed particularly to afford an effective means of communication between the head and rear ends of long freight trains and to prevent pulling out of order on the system on the C. M. & St. P. R. R. where it has been given exhaustive tests, shows it to be well adapted to communicating ahead of trains stalled by a faulty block. In one case cited the use of the system on a single track portion of the C. M. & St. P. cleared up a misunderstanding on signals, and saved one or two hours' time, the loss of which would have been caused by having to send the flagman ahead to the next block.

The apparatus used for carrier current communication is small and simple in operation. It consists essentially of vacuum tubes used as oscillators, rectifiers and detectors, making up a telephone equipment equaling in size and simplicity the most modern apparatus.

(Continued on page 1091)

Stories That Tend to Show That Fishes Are Able to "Think"

Sportsmen, and even the hardened fisherman, bear witness that fish do possess some intelligence, citing their marked increase of wariness in waters that have been fished over often. Young trout under the circumstances are less wary than the old ones. The carp, according to Kirby's book on fishes, thrusts itself into the mud in order that the net may pass over it, and if the bottom is stony makes great leaps to clear the net.

It has been said that fish which have been kept for many years in a basin of the Tuileries come when called by name, but it is of course the sound of the voice and not the articulate words to which they respond. In Germany trout and carp are summoned to their food by the sound of a bell.

A small perch's nest of young was disturbed one day, and upon the next day the fish and young were searched for in vain. Upon further investigation it was discovered up stream, the parent guarding her young with jealous care in a cavity scooped out of sand. Another story is related of a skate which was observed in an aquarium at Manchester. A morsel of food was thrown into the tank, which fell directly in an angle formed by the glass front and the bottom.

The skate, a large specimen, made several attempts to seize the food, unsuccessful owing to the position of its mouth. He lay quite still as though thinking, then suddenly raised himself into a slanting posture, the head inclined upward, and the under surface of the body toward the food, when he waved his broad fins, thus creating an upward current in the water, which lifted the food from its position and carried it straight to his mouth.

The blue shark and his pilot fish also come in for a story. Captain Richards, R. N., tells one about a blue shark following a bait which was thrown out to it from the ship. The shark, which was attended by four pilot fish, repeatedly approached the bait, but every time he did so one of the latter rushed in and prevented him from following it.

After a time the shark swam away, but when he had gone a considerable distance turned back again and came quickly after the vessel, and before the pilot fish could overtake him, seized the bait and was caught. While hoisting him on deck one of the pilots was seen to cling to his side until above water, when it dropped off. All the pilots then swam about for a time, as if searching for their friend "with every mark of apparent anxiety and distress."
Making Ice on a Stove

By GEORGE G. FELT

It is a long step from a hot flame to a bar of ice but this step is shortened by the latest achievement of science and chemistry. Can you imagine placing your ice machine over a gas or oil flame for about thirty of forty minutes, and then cooling it for a few more minutes in a pail of water, putting the whole outfit in your ice chest to have refrigeration for twenty-four hours? What would your grandmother say to this one? What will the housewife say when she finds she can draw away with the messy iceman and all her worries, when he fails to show up? What will hubby say when he finds the ice bill is out of his way?

The article can hardly be classed as a machine because there are no movable parts, motors, screw adjustments or switches to fuss with. It is a container constructed of malleable iron, made to withstand many pounds pressure to the square inch. In this container are certain chemicals the formula of which is kept secret. The container is composed of two cylinders, which are connected by a small tube of the same material as the cylinders. A more clear conception of the device can be obtained from the accompanying photographs. There are three sizes of ice maker manufactured; the smallest size will take the place of a twenty-five pound cake of ice in an ice box. The medium size is equivalent to a seventy-five pound cake and the largest to a hundred pound cake. This does not mean that the machine will make a twenty-five, seventy-five or a hundred pound cake of ice; but it does mean that it will give the equivalent in work of that sized cake of ice when placed in an ice box.

The operation of the machine is very simple. All that is required is a pail of water, some heat, and the machine itself. The heat is applied to the generating cylinder, while the other end is placed in a pail of water until the gauge indicates that the chemicals have been heated sufficiently and forced over into the refrigerant cylinder. To complete this operation takes about thirty or forty minutes. The generating cylinder is then placed in the pail of water for ten minutes, after which the ice is placed in your ice box and refrigeration begins at once. The refrigerating cylinder will become coated with frost and will take from twenty-four to twenty hours. A thermometer on the refrigerating cylinder will read 40 below zero Fahrenheit, a few minutes after the machine is placed in the ice box.

There are many other uses to which the new refrigerating machine can be put, chief among them being its use in the home. A brass cylinder comes with the machine, that can be inserted in the refrigerating cylinder and a bar of ice can be made suitable for table use. Or else ice cream can be made in this cylinder with the addition of a stirring paddle. Ices are frozen thoroughly and rapidly in this vessel. A special size that is compact will be made for campers, hunters and autoists. The uses to which this machine can be put are endless.

The device is covered by foreign and domestic patents. The inventors are Maxwell Karge and Mr. E. J. Connell. The latter resides in Marseilles, France. Mr. Karge is a noted New York inventor.

The history of the invention is as follows: In 1853, a French physicist by the name of Carré, demonstrated for the first time that it was possible to produce cold by using the action of the return of certain gases to the gaseous state after having been previously liquefied. But in order to carry out his calculations and theories required continuous experimenting and research work. A machine has been developed which is a marvel of precision and simplicity. All cumbersome mechanical appliances, and many drawbacks have been eliminated, especially the one of complicated heating apparatus. As the machine is now manufactured, it is possible to make ice and cool liquids in the most isolated and hard places. This expense is the first cost, as there is no repair, and no parts to wear out or corrode. There are no valves or gauges to manipulate and no danger of explosion.

How Lost Children May Be Recovered

Every day dozens of children are lost, and the first thing the mother does, as a rule, is to rush around, waving her arms and crying that her child has been kidnapped, and in this excited state, she is seldom able to give an accurate description of the clothes the child was wearing at the time.

The police, generally take the lost little ones to the police station, and search for any means of identification, so that they may notify the anxious parent as soon as possible, who often forgets about the police station in her excitement, but seldom do they find any.

In some of the maternity hospitals, they have a large assortment of beads, which are lettered, and as soon as a baby is born, the letters composing its family name are strung upon a cord, plain beads are used for the rest of the string, and the complete string of beads is placed around the infant’s neck.

All children are fond of beads, and if the mothers of little children would follow the scheme used in hospitals, adding the home number and street, there would be little delay in returning the lost tots, and saving of much mental anxiety on the part of the mothers.—William Reinhart.
ID you ever stop to think for a moment that much of the knowledge we have about a certain medical case is more or less guesswork, especially when it comes to ascertaining the effect of certain bacteria or medicines on a particular part of the gastro-intestinal tract? Such is the case, however, and in order to accurately determine just what effect the bacteria in buttermilk, for example, have on certain sections of the intestinal canal, Professor von den Reis of the University of Greifswald, Germany, according to cable dispatches, has been using with considerable success tiny, electro-magnetically controlled metal “ships” fitted with iron doors. One of the accompanying illustrations shows the shape and size of one of these metal cylinders, and anyone who has swallowed quinine capsules or especially the larger gelatin capsules containing various oils, et cetera, will realize that quite a large cylinder can thus be easily swallowed. The cylinders, which, by the way, are used to unload bacteria at desired point in the intestinal tract, as well as to take on samples of the secretions at certain points in their travels, may be made of silver or some other metal plated with silver or platinum. A series of small iron doors or valves are fitted on the capsule and these can be opened and closed by means of a powerful electro-magnet placed against the back or abdomen of the subject, the position of the “ship” being accurately determined by means of the X-ray.

When the metal capsule with its load of bacteria, or else traveling in ballast reaches the desired point, Professor von den Reis excites the powerful electro-magnet, which causes the iron valves to open, these valves being closed by the pressure of a spring when the magnetic attraction is cut off.

The method of procedure in making a scientific test for the effect of certain bacteria on the digestive processes is as follows: The patient first swallows one or more of the capsules containing the bacteria and the travels of the capsules are traced with the X-ray, and their cargoes are discharged at the proper moment. Shortly afterward when sufficient time has elapsed for the bacteria or medicine to act upon the food in the intestinal tract, empty capsules are swallowed and when these reach the scene of action, as determined by the use of the X-ray once more, the trap doors are opened and a sample of the food being acted upon by the bacteria and the bodily secretions is trapped, and later these samples of the contents of the intestines are studied minutely in the experimental laboratory.

The layman might be somewhat alarmed at this remarkable method of accurately ascertaining just what is going on in his digestive processes, especially as he might suspect that ill effects would ensue from the powerful magnetic rays passing clear thru his abdomen, but his mind may be perfectly at rest on this score, for extensive tests made in Paris some years ago failed to show any effect whatever on the human body when it was subjected to the field of the most powerful electro-magnet obtainable.

Bacteria Laden Metal Capsules Swallowed in Experiments by Medical Students

Heart Tissue Alive After Ten Years

Ten years ago Dr. Alexis Carrel of the Rockefeller Institute isolated a fragment of tissue from the heart of an embryonic chicken. The tissue kept on growing; it has kept on growing ever since. At first it was real heart tissue, and for 104 days, as the cells multiplied themselves, pulsations could be detected under the microscope—the beating of a heart. Then the connective tissue cells overran the others, and since then it has been connective tissue. So fast does it grow that it would now be an enormous mass except for the fact that every forty-eight hours it is subdivided and part of it discarded. Many generations of chickens have been hatched and have gone where good fowls go, but the substance of the chick that happened to be selected for Dr. Carrel’s experiment on January 17, 1912, is perpetuating itself just as lively a rate as ever. It is, so far as those who are watching and nourishing it can see, immortal.

The original culture has been subdivided nearly 2,000 times. The cells increase so fast that on the average the area of the culture is trebled in forty-eight hours. At the end of that period it is divided into two or three pieces, which are transferred to a bath of Ringer’s solution. After forty-five seconds in this bath they are transferred to a fresh mixture of the medium used for perpetuating the strain, composed of equal volumes of chicken plasma and chick embryo extract.

They are then placed in an incubator and kept in an average temperature of 103 degrees Fahrenheit. The best plasma is obtained from healthy chickens not

more than two years old which have not been fed for twenty-four hours. The tissue extract employed is obtained from chick embryos seven to eight days old. In his last report, pubhshed three years ago, Dr. Ebeling said the rate of growth seemed to have increased progressively during the first seven years of life outside the chicken heart from which the original tissue came.

During the first year the growth was slow and irregular, because it was not yet known that certain substances contained in embryonic juices were essential to permanent life.

The method of cultivating the chicken tissue is similar to that of cultivating disease germs. The use of culture material within sealed receptacles is necessary. The receptacles being of glass, the living tissues may be studied constantly.
New Soft Focus Screen

SOFT or diffused photographs are now in vogue, and very few professional photographers can boast of producing real good pictures, unless their studies include some diffus focus effects. In pictures of this nature the sharp outlines, the intense shadows and the brilliant high lights all blend into each other, giving the picture a very mellow, smooth effect.

Heretofore, expensive lenses, costing several hundred dollars, have been used for this purpose, and the amateur has found it impossible to duplicate the results obtained by professionals, and at the same time many professionals have found that they could not compete with their rivals in business because of the rather prohibitive cost of these lenses. A New York inventor has solved the problem, however, by supplying a lens attachment which can be placed upon any camera, and with which results comparable with those obtained in our well-known photographic studios are possible.

This lens attachment fits over the outside of a lens of a camera in the same manner as the copying or telephoto lenses do. It consists of a photographic reproduction of a fine ruled glass screen.

A Binocular Eye-Piece for Telescopes

By DR. ALFRED GRADENWITZ

INASMUCH as our eyes are used to binocular vision, the continued use of only one eye, as in the case of telescopic observation, of course, imposes upon the eye actually disengaged a marked and in the long run intolerable strain. While this disadvantage, in connection with microscopes, has long been helped by doubling the instrument or eye-piece, the case of the telescope has been much less amenable to a successful solution. Duplex telescopes for terrestrial observation have, truth to say, been advised (Fig. 1), but this solution, on account of the considerable dimensions and difficulties of construction and adjustment, could not be applied to instruments intended for astronomical observation.

The problem has, however, now been solved by Carl Zeiss, of Jena, Germany, (continued on page 1070)
Invisible Airplanes

ID you ever stop to think what would happen if we could build flying machines of some invisible transparent material, such as glass for example? For one thing this design of airplane would make flying machines pretty difficult targets to hit with any kind of gunfire. And speaking of bombarding-planes the metal parts of such transparent planes, if once adopted, would provide such a small object to the sight that, at an elevation of 7,000 to 10,000 feet, such planes, if made of transparent material, except the engine and a few minor parts, would be practically invisible even with high powered field glasses.

Well, just to prove that we are not exhibiting one of our dreams, we are glad to state that an English inventor, Mr. Ernest Welsh, has discovered a material having all the transparent properties of glass, while he confidently believes that this new structural material can be used in the manufacture of aircraft. If the airplane which now roars thru the sky over our heads could be rendered not only transparent and invisible, but provided with a first-class muffer, which is not improbable at all, its war-time possibilities would surely border on the supernatural. It may take some time, even several years, before such a machine is successfully designed and built, but the country which holds the secrets of the building of such a flying machine will, it would seem, possess a tremendous advantage over its enemies.

Looking at from the humorous point of view, this transparent airplane stunt suggests some very desirable features indeed, especially on the morrow, when we have air traffic lanes policed by eagle-eyed air cops, for then we can speed right along and disappear into the fourth dimension, as it were, owing to our invisibility. Also when we are courting a pretty girl and papa objects, we can dive down in front of her home right before his nose, and whisk her away.

The inventor of this new transparent glass-like material does not state whether he believes the engine could be built of it or not, but if all of the rest of the material except the engine could be built of this material, it would still be a great boon, especially in military and naval maneuvering.

"Gold Maker" A Fake, Prof. Fisher Finds

Prof. Irving Fisher of Yale University, who recently caused a sensation by stating that a certain German scientist had apparently discovered a method of producing synthetic gold, has abandoned his treasure hunt.

"I met a man who, I was told, had succeeded in making artificial gold," said Prof. Fisher, "and he offered to demonstrate his claim. He said he submitted samples of gold which he alleged he had made to the Reichshank in 1917, and that the authorities of that institution found it to be 99.9 pure. Herr Havreinstein, President of the Reichshank, told me this was correct, though there was no proof that the gold was synthetic. The alleged inventor gave me to understand he used mercury as a basis and said he employed an electric vacuum furnace with a more perfect vacuum than had been heretofore obtained."

"Did you go to see the inventor's experiments?" I asked the professor.

"No," he replied. "I saw a distinguished German scientist this morning and he told me the man is a fraud and has a prison record. My friend who originally gave me the information about this man had known him for years and assured me the man is not a fraud, however mistaken he might be about his invention. I am disposed to believe my friend has been misled."

Prof. Fisher went on to say the alleged inventor declared he could produce synthetic gold for "10 per cent. less than the present price of silver," a curious statement, though it might be accounted for by the man having used silver as one of his bases for experiments.

"But why has he done nothing since 1917?" I asked, "if he has made such a tremendous discovery?"

He explained that quite plausibly by saying he had been busy with other inventions which would benefit Germany, while he was doubtful if synthetic gold would help the country.

Prof. Fisher, who has come to Germany not only to investigate this matter, but to study the currency question, told me he found that during the war the German Government did make serious attempts to produce gold in new ways. They did, in fact, succeed in extracting gold from sea water, but not at a profit.

"These attempts," he added, "have been abandoned, and I have no evidence that the German Government is making further efforts."
When Lightning Struck My House

By JAMES M. KENT

ELECTRICAL AND MECHANICAL ENGINEER

It is Not Often that Such a Vivid Description as the Accompanying One By Mr. Kent Can be Given of an Accident, Such as When Lightning Struck His Home. The Sudden Power of Lightning is Brought Home to Us Very Strongly, When We Note All of the Different Effects That This One Bolt Was Responsible for. Even the Cellar Was Flooded with Water Because a Gasket Was Blown Out at the Water Meter, Due to One of its Fuses. Sixteen Fuse Plugs Were Literally "Blown to Pieces," One of Which is Shown in the Insert Photograph at the Right. It is Truly Remarkable that No One Was Injured or Killed.

In Science and Invention I noticed an article on Lightning. I had an interesting experience when my residence was struck by lightning. Myself and family were sleeping in our third floor room—a finished attic—and the stroke occurred during the night.

The bolt first struck a nail head—one of the nails which holds on the sheathing boards right underneath the shingles. Directly opposite to the ten penny nail struck was another similar nail holding a porcelain knob supporting one of the No. 14 copper wires on the attic ceiling. This was one of the wires supplying service to my attic lights. Jumping across the space of about one foot between these nail points, the bolt whizzed around the head of the knob to the No. 14 wire, which was melted off at the point where struck.

From this No. 14 wire the lightning current spread all over my house wiring, jumping across from the top of each fixture (under the canopy) to the gas piping above the insulating joint and blackening the ceiling at each fixture, thus seeking paths to the ground thru the gas piping. The inductance impedance of the gas piping proved to be so high that large portions of the charge got across, at various points in my house, to the water piping and thus escaped to the ground partly in this manner. The current flow thru the water piping was so great that a leather gasket where the service pipe entered the water meter (in a brass union connecting the pipe to the meter) was burned up and my basement was flooded with water before I got down there. I had to turn off the water and break the sealed metal coupling to put in a new gasket of rubber before I could proceed further with my investigations.

In escaping from my house wiring the path thru gas pipes and water pipes did not prove sufficient. So a very large portion of the charge rushed back thru my service wires, out to the secondary of our supply transformer on the pole, and thus spread to neighboring houses, to some extent.

My main service fuses were sixty ampere cartridge fuses. These were not merely melted, but absolutely exploded by the current leaving my house thru the service wires. I had eight branch circuits in my house. The fuse plugs in all of these circuits were not only melted out, but exploded as shown in the photo herewith. You will note that the pressure developed inside the plug by the gas of the volatilized fuse was sufficient to bulge out the edge of the brass cap holding the mica disc of the plug. All sixteen of my plugs were in this condition, tho I cannot account for the flow in those not located in the circuit struck—other than the feeding back of current to points where it jumped to gas pipes.

The inside of my electric light meter was burned to a crisp. At the point where the bolt jumped across between the points of the two nails the wood rafter was split to powder for a length of four feet (two feet each way—from the nails) but was split on one side only, the other half remaining intact. A hole six feet square was knocked in my roof and a similar hole of equal size in the ceiling right underneath. The shingles over the entire roof were slightly loosened, either by the air pressure or possibly by the intense sound wave. The points of the nails were not melted—only slightly blackened, at the place where the main flow took place between them.

To volatilize the fuses in these sixteen plugs and produce a gas pressure inside them sufficient to blow out the mica and bend the brass cap in the manner seen must have required a current of not less than 100 amperes thru each plug (possibly much greater). Sixteen plugs were treated in this manner. The plugs carried out only a part of the charge. These facts will serve to illustrate the probable great value of the momentary current that flows from such a lightning discharge.
The Amateur Magician

By JOSEPH H. KRAUS

A Few Good Parlor Tricks Without Apparatus

ran thru the cards. Evidently he could not locate it. He asked me whether it was sure it was in the deck, and I told him I was positive of that fact, tho I do now recall that I used the word positive heretofore, in that I had been positive of so many things in the past much to my discomfort. Raising the deck and flipping into it above the table, he dropped it, and seemingly from the center of the deck, a card flew out, turning itself face upward on top of the fallen pack. Before I could recover my astonishment, he had picked up all the cards and started to shuffle them.

He requested that I choose a card when I interrupted him, "Hold on a minute, haven't you forgotten something?" Harbrace in the habit of jumping from one trick into another, not even giving his audience a chance to recover fully from one shock before the second one presented itself, and his tricks too. He assured me I would get the explanation later, but I informed him that I would rather have it now while the memory of the trick was still fresh in my mind.

"Very well," he answered, "First we will count off from the face, one, two, three, four, five cards." His action suited his words, as he transferred five cards from the deck turned face upward to his right hand. Then he placed these on the bottom. "Lifting the entire deck we make five neat piles thus," Here his hand moved from left to right with the deck of cards. He stopt at intervals to drop a few from the bottom. The cards were now of course turned face downward.

"From the top of the fifth pile (back), I removed one and placed it on the first thus. I removed another and placed it on the second pile, always of course taking the cards from the fifth pile, or the very last one placed on the table. I repeated for the third and fourth piles and then asked you to look at the top card in the fifth pile, or what is now the top card.

"But how did you know the name of that card?" I had again interrupted him which I must admit was a rather rude thing to do, I also knew that Harbrace did not like it very much because he snapped right back at me saying, "Now, what in the world do you suppose I took five cards off the top (face) for at the beginning of the trick." I hadn't the slightest idea.

"When I reached the fifth card, I remembered what that card was and in laying out the piles, I removed four and then the fifth card became the top card of the deck, which was the n'est-ce pas?"

"Of course, of course, but you shuffled those cards.

"It is quite sure I did, but you have noticed that in doing so I used the riffle method of shuffling cards. In other words, I placed the two halves down on the table, lifted the corners and let them run together, but I took particular care that at least five cards which were originally on the top of the deck retained their original positions, by keeping the top half in my right hand, and making sure that those five cards from the right hand were seemingly accidentally but purposely riffled to the top again. This thus preserved the original order of the top five. Is that clear?"

"Yes, but--"

"Now what?"

"I didn't say that card turn over?"

"Oh, yes, how stupid of me. You see that is the extremely simple part of the trick. I, knowing your card, brought that card to the bottom of the deck. Then under cover of the hand, I pushed the card out so that it extended from the side of the deck. Still under cover of the hand, I dropped the entire deck, but due to the weight of the cards themselves the cards fall solidly or en masse. They are preferably dropped from a height of twelve to fourteen inches, and in order to give a better effect, the downward travel of the deck may be speeded up by a slight throw. The air affecting the thin card as it iningles upon that extended portion, causes that card to turn around and of course face upward.

THE DISAPPEARING CARD

Picking up the pack again, Harbrace shuffled it. "You fooled me like that once before. You had better let me shuffle them this time," I exclaimed. To this he assented. Turning the entire deck face down upon the table, he said, "Think of any number, then counting from the back (Continued on page 1063)"
Fortunes from Little Things

By CHARLES FREDERICK CARTER

Next time you see a safety pin take off your hat and kowtow respectfully three times to it. For this humble utility is deserving of deference on three counts: First, on account of its age; second, on account of the highly important part it played in the war; third, on account of its ever-increasing usefulness in civil life, now that the world is more or less demobilized.

There seems to be a pretty general impression that Foch “sewed up” Ludendorf’s forces, to use a slang phrase. Well, he didn’t do anything of the kind. Literally, the Allies generalissimo pinned up the Germans; and to prevent any embarrassing slips he used safety pins.

Why, one of the first things the American Government did after declaring war was to place a rush order for 300,000 gross of safety pins, followed soon after by a second order for 200,000 gross. These pins were all of a single type for a single purpose—japanned black pins to fasten canvas bandoliers containing each a cartridge, or a grand total of 4,320,000,000 of these slight tokens of our esteem for the ex-Kaiser and his gang.

These pin quantities of safety pins were used in hospitals and dressing stations to pin bandages. There were many other uses.

Altogether the American army alone used 2,000,000 gross, or 288,000,000 safety pins, or an average of 75 pins for every man in the army, and we won the war. No safety pins were used in the Spanish-American War, and we had embalmed States increased 189 per cent in quantity and 164 per cent in value; or from 1,640,284 gross to 2,550,650 gross. The average annual increase was 182,000 gross. Today the annual output is 10,000,000 gross, or an annual average increase of 465,584 gross for the last 16 years.

Ten million gross is 1,440,000,000 pins. To make this enormous quantity requires 68,181 miles of wire, or enough to reach twice around the globe at the equator and leave enough over to make six straws in an air line between New York and San Francisco. Exclusive of the head and guard, this calls for 4,167 tons of material. To ship the pins from the factories would require 278 cars.

Americans, more particularly of the younger generation, are notoriously lacking in appreciation for age, but even an American office boy ought to be impressed by the knowledge that the safety pin, in use by the Romans centuries before the Christian era, was one that Dulliey Ward found some safety pins of this type in making some excavations at Colchester, England, in 1911. A skeptic may step into the British Museum and take a peek at the fine collection of safety pins there, dating as far back as 10,000 years before our era.

But the history of the safety pin has not been continuous. It died, was buried, and forgotten. Its second incarnation came in the

The Chart Above Shows the Successive Stages Thru Which Safety Pins Pass in Their Manufacture. A Very Remarkable Machine Turns Out These Safety Pins from Wire and Sheet Metal Stock at an Unbelievable Speed. The American Army Alone Used 2,000,000 Gross of Safety Pins in Winning the War. No Wonder the Ex-Kaiser and His Gang Got Stuck.

(Continued on page 1076)
A PRESS FOR TROUSERS

HEREWITH we show a press for putting creases in trouser legs while the wearer of this article of wearing apparel sleeps the sleep of the just. It is the handiest automatic valet yet devised for the press. The cardboard is placed, when in use, one sheet under the lower leg and another over the top. The press is pulled over the legs, then lifted and turned, and the cardboard is slightly pressed. To remove creases, the press is placed in the press, this will help in producing a sharp crease.

COMBINATION PIPE CASE AND TOBACCO BOX

A pipe case and tobacco box in combination, which will be an ornament to the library table, cannot be considered an objectionable item for the attention of the home mechanic. The pipe rack and tobacco jar are old friends in a separated form; let us combine them and have something new, particularly as the combination brings us attractiveness and efficiency. Our design can be carried thru endless editions or variations, quite as the older rack and jar was developed. It consists of a box having two compartments, one for the pipes and one for the tobacco. A soapstone slab 3/8-inch thick is used in the tobacco compartment to keep the tobacco moist. In order that this slab may be removed for the purpose of wetting with water, four adjustable clips are attached to the cover in the manner shown. The stone thoroly soaked once a day, will keep the tobacco in prime condition. This compartment is lined top and bottom with zinc, tin or copper. The pipe compartment is designed to hold six pipes, and these are held on racks about as shown.

CIGAR HUMIDOR

The average humidor for cigars or cigarettes has the disadvantage of drying out too easily; the design which is shown here is prepared with the hope of overcoming the above fault, being provided with a cover, that contains a 3/4-inch soapstone slab, that acts in a two-fold capacity, In one capacity it keeps the humidity of the contents of the humidor, and in the other to form a weight to force the cover firmly down into the beveled sides of the container. To make this joint air-tight we suggest that a large rubber band be stretched over the outer sides on the lip of the cover and shellacked permanently in this position—so that it may be soaked in water—the water penetrating the porous stone; every two or three days should be sufficient.

NECKTIE CABINET

A necktie cabinet, with a mirror on the front door, designed to hold a dozen ties is here illustrated. The ties are suspended from hangers and are held firmly in place by spring clips attached four to each hanger. The clips are made of spring brass of the sheet variety 3/4 inch wide and 1/32 inch thick.

IMPORTANT TO NEWSSTAND READERS

In order to eliminate all waste and unsold copies it has become necessary to supply newstand 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 he will not be able to supply your copy. For your convenience, we are appending herewith a blank which we ask you to be good enough to fill in and hand to your newsdealer. He will then be in a position to supply copies to you regularly every month. If you are interested in receiving your copy every month, do not fail to sign this blank. It costs you nothing to do so.

To. Newsdealer
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Please reserve for me. copies of SCIENCE & INVENTION every month until I notify you otherwise, and greatly obliged.

Name
Address

Did You Ever Cuss Those Wire and Other So-called Tie Holders Which Support Them on the Side of a Door or Window Frame, Where They Catch All the Dust and Dirt Imaginable? Here is a Better Way to Keep Them in Perfect Condition—in a Tie Cabinet.

1032
MOTOR HINTS

NOTICE TO CONTRIBUTORS

Kindly note a change in this contest. For the coming month we would like to receive from our contributors articles on the following subject:

ELECTRICITY ON THE CAR

We believe that there are hundreds of new electrical ideas that can be incorporated in the car that our readers would like to know about. We are particularly interested in any novel stunts, new devices, new kinks, and new hints made possible by the electric current.

In order to win a prize the first requisite is that the device or stunt be practical. The term PRACTICAL will be the keynote of this contest.

You will be more apt to win a prize if you will design the device yourself, and make a photograph of it, sending the same to us. Ideas are all right, but the reader wants to see that the device actually has been made, and WORKS.

The following prizes will be paid:

FIRST PRIZE $25.00
SECOND PRIZE $15.00
THIRD PRIZE $10.00

All other accepted articles which win no prizes will be paid for at the rate of $1.00. Each article submitted should not be longer than about six or seven hundred words.

Address all manuscripts to EDITOR "MOTOR HINTS," care of this publication.

First Prize $25.00
REMovable CONDENSER FOOLS THIEVES

In the illustration herewith is shown a scheme for preventing car thefts. Any competent mechanic can remove or destroy the condenser in ignition circuits, as assembled. Then place on dash panel two copper or brass blocks, having a small hole in each, in a handy place near the wheel, but not too conspicuous. The blocks must be insulated from each other. Ground one block, then lead a wire from ungrounded block to ignition terminal on switch; procure a suitable condenser and attach to it two plug terminals to be inserted in the holes in the copper blocks. The condenser is thus restored to use. With this condenser in your pocket the devil himself cannot start your engine without replacing it. The different systems will need different hitches, but a great deal depends on the mechanic. I have tried this stunt and it works very well.

Contributed by LEVI ALM.

Second Prize $15.00
THIEF-PROOF COMBINATION SWITCH

In the illustration is shown a novel protective switch of the combination type. The whole apparatus is attached under the dashboard. The dials are on the face of the dash. When the marking on the dials is made there should be a point at O. In the illustration there are two brass or copper bolts with nuts to fit same. Two copper brushes are fastened to the nuts and continue to be a part of it during its operation. The wiring may be changed so as to vary the combination. An extra lead wire is used to conduct the electric current from the battery to the ground. The wiring should be changed frequently.

Contributed by JOHN E. BOSTON.

PHONEY LAMP PROTECTS CAR

I provide an "open" in the ignition circuit in the form of an electric light socket which can be placed over the speedometer or other desired place. The socket may be obtained at any garage and two burnt lamp fragments open (car won't start).

The wiring is shown in the illustration.

The car can be started only when the short-circuited lamp is in the socket containing the "open" lamp.

The contacts on one bulb are connected or shorted by a wire. To operate the switch, the person, when leaving the car, takes the bulb with the contacts connected, out of the socket, and replaces it with the other bulb. Hence the ignition circuit is broken, but the stranger doesn't know where.

Contributed by LEONARD REXIN.

THIEF TRAP EMPTIES "GAS" TANK

In the illustration is shown sketch of how to prevent theft of certain types of cars which have gas tank under front seat. A hole is bored and tapt in the rear end of the shaft, which protrudes from the gear box when lever is in reverse, to take a screw or screw. The latter is connected by a small wire to the arm of a valve in the bottom of the gasoline tank. Mr. Thief starts car easily enough and shoves her into low. The valve opens, but he can't hear the gas trickling out. He gets into high—but he doesn't go far. The bigger the valve the less distance you will have to run after your car.

I would suggest that the concern which makes the auto spike lock for use on the car wheel, fix it so that it fits rigidly around one spoke. It could be done surely, tho it would cost a little more to make, but it would not be possible for the thief to deflate the tire and twist the spike around, as he now does.

Contributed by ALEX. MacKENZIE.
Synura Gives Oily Taste To Drinking Water

By DR. ERNEST BADE

In the nethermost depth of the animal kingdom where plant and animals intermingle with each other to such an extent as to be indistinguishable, and where, at certain times, the plant becomes an animal and the animal a plant, tiny ciliated animals are found. These free swimming forms propel themselves forward with thread-like appendages which whip the waters. They are masters of motion when observed under the microscope. And these whip-like structures of the more complex structures can be found. The method of reproduction is primarily a division of the cell substance, and it occurs most profusely under favorable conditions. Colonies are produced when individual animals do not become separated from their parent. But then the colony would soon grow to enormous size, and the inner animals would soon be killed by the pressure exerted by the outer ones, if no limiting factors were present. Therefore such reproduction is only

individual is 30 microns and the diameter of the colony is 60 microns; each micron is 1,000th part of a millimeter and the millimeter is 1/25,000th part of an inch.

Each cell-animal has two chromato-phores. These are well defined plasma particles of slightly denser consistency, of a definite shape, and yellowish brown in color. Altho chlorophyll (green coloring matter in plants and algae) is present in Synura, it is masked by the yellow color. These chromatophores, which only

New York City's Drinking Water Recently Acquired a Disagreeable Oily Taste, Traced Directly to the Synura—Little Oil Bugs, as We Might Call Them in Everyday Language. The Synura Are Seen Under the Microscope in Colonies, as in the Central Cut Herewith Shows. The Two Smaller Photog. Show Similar Organisms Which Sometimes Cause Trouble in Drinking Water. The Reservoir In Which the Synura Happens to Thrive Is Cut Off from the Main Pipe Line, and the Water Treated With Copper Sulfate. Bags Containing this Chemical Being Hung Over the Sides of a Boat, Which Is Rowed Around on the Surface of the Water. The Amount of Oil Produced by Each Synura Is Exceedingly Minuscule, but Can Be Detected in a Dilution of One Part in 2,000,000 Parts of Water. One Drop of Oil in 200 Gallons of Water Is Quite Noticeable. This Is Equivalent to a Drop of Water in a Cube 8 Feet on a Side, as Shown in the Illustration Above.

which appear to be nothing more than tiny strands of a contractile material, are still a mystery to the naturalist, for he does not know how or whence they take their motion. It is a simple thread of plasma, which some observers say consists of lighter and darker parts, and therefore has some resemblance to cross-striped muscles of higher animals, whose "strength" one must assume. That this must originate in the nucleus, which is the center of energy in these tiny organisms, is undoubtedly true. But there is more than this. Where such a one-celled animal, or where a number of them have combined to form a colony and then possess a number of cilia as in Synura, it never happens that they become entangled nor do they beat the water indiscriminately, but always keep time so that they swim uniformly onward. Just as a ball does the colonies of Volvox, Synura, et cetera, roll along rise and sink in this life-giving element, and are, in part, independent of the water currents.

Where these one-celled animals unite to form a colony the first phases of the not at all suitable for any length of time, and for this reason only those ciliated animals unite which are male, female, or those which are not capable of copulating. So it can be said that this union is a stage in the division of labor. Reproduction thru division is only possible for a certain length of time. If for any reason this method is continued without cessation, then a gradual loss of vitality of the stock takes place. This decay and final death is prevented by conjugation. Reproduction and rejuvenation not only apply to the combining animals, but also to their progeny, while in the higher animals it only applies to the young.

The Synura is a pear-shaped individual, as the illustration shows, uniting with others to form a sphere which is surrounded by a skin-like covering. This covering can be likened to a vegetable membrane. Each individual cell of Synura is provided with two cilia, which are somewhat longer than the animal itself. The entire colony is yellowish in color and is capable of a rapid rolling movement in the water. The length of each multiply by division, give the animal its particular color. One or more eye spots are also present in each animal; their place can be taken by numerous scattered tiny bodies of a reddish color. But whether these eye spots can distinguish light or darkness has not as yet been definitely determined. In Euglenia, at any rate, the light distinguishing particles are found in the colorless protoplasm just before the red "eye" spot.

The life history of ciliated animals varies quite considerably with the different species. The majority of them eat solid food like other animals, some decompose carbon dioxide like green plants, while others absorb soluble organic substances like the chlorophyll-lacking plants. And since two of these mentioned methods of taking up their food is possible in one and the same form, these organisms are the boundary between the two great plant and animal kingdoms, and they cannot be definitely assigned to either.

The product formed within the body is a fatty oil whose composition is not at pres-

(Continued on page 1083)
"Skipping Boat" Contest Winners

First Prize $25.00

The photographs submitted show my choice of several attempts to skip the boat. A few tryouts and the difficulty of spinning a pontoon large enough to support one-half of the model became so apparent that I hit upon the idea of one pontoon with sufficient displacement to float the motor. The spring motor is of my own construction, consisting of the necessary clock work and a flat spring five and a half inches long. The impulse of the spring is transmitted through a wooden pulley 4 inches in diameter, to a series of pulleys on the propeller shafts. These small pulleys are about five-eighths inch in diameter at the bottom of the "V" belt groove and the belt is a waxed cord. The "V"-shaped tin-work in front and rear of the motor adds the displacement to carry the weight of the extra materials.

The propellers are semi-pontoon 2½ inches in diameter. The propellers become pontoons when up to speed, and the body of the boat rises to the surface. With the propeller shafts perpendicular to the water the boat would rise to the surface and the pontoons would lash the water to a foam. There was no motion in any direction in the plane of the propellers. When the body of the boat was warped slightly, so that the left edge of the rear propeller was one-eighth inch low, and the right edge of the forward propeller was slightly low, the boat would move forward or rather drift slightly forward after the motor had run down. The rudder I fastened by a clip to the cross-brace on the stern. It was not used in any of my experiments and was overlooked when the photograph was made. I add that I feel reasonably safe in saying that this method of propulsion will not be adopted universally by the builders of speed boats.

Second Prize $15.00

The model which I have submitted will skip for the very obvious reason that the excessive power which it is possible to deliver to the vaned disk is more than ample to lift its weight and move it in a forward direction, which forward direction of orientation is accomplished by the very simple method of placing the vaned disk, or lifting surfaces, at an angle suited to the forward motion. Please note that I do not employ any additional agent for the purpose of forward movement.

WM. J. BEACH.

Third Prize $10.00

By my experiments and model I have proved to myself that the skipping boat idea is practical.

My model consists of four propellers each 4x1¾ inches, and 3½ inches pitch, rigid in pairs fore and aft; the two starboard propellers turn in the same direction and opposite in direction to the port propellers. Thus any horizontal thrust that would tend to turn the craft about on a central axis is nullified. The shafts are not vertical, but inclined so that each pair have a common terminal thirteen inches above the propeller hull, twelve inches of each shaft is occupied by a rubber band motor, the motive power. All four motors are supported by a central mast rigged with a horizontal cross arm running fore and aft.

The helicopter principle of direct vertical lift is applied with difficulty in the air, but the density of water allows a vertical lift of healthy proportions, so much so that a craft of almost any design, partially or wholly devoid of buoyancy, can be lifted bodily to the surface under favorable conditions. To simplify the motors, submerge the ship, and release all the propellers together. The vertical thrust of my model raises the craft high out of the water, while only the trailing edge of each blade touches the water. The tilted shaft permits but one blade to revolve in the water at one time. The other blade of each propeller meanwhile reciprocates or recovers in the air (a medium of lesser resistance), like the arm of a swimmer using the crawl stroke.

While the submerged blade is creating a nearly vertical lift, its drag or drift causes an active horizontal thrust in but one direction. This secondary thrust is created in the same direction by all four propellers. These two thrusts ye editor was fishing for and constitute the skipping boat theory. Perhaps a propeller could be designed, or the shaft made to jog or dance up and down, that would cause a craft of this kind to skip, but my model will not skip because it is dependent on propeller thrust for action. This thrust is produced by surface contact and to raise the propeller from the water deprives it of surface contact and diminishes its thrust. The density of water prevents the propeller from again entering it at its initial speed.

R. E. MULLIN.

First Honorable Mention

I am a reader of Science and Invention, and in the December number I noticed that nobody seemed to want to take the chance of building one of the skipping boats. I have found that constructing one is quite a job. The first question is,

(Continued on page 1085)
Practical Chemical Experiments

By Prof. FLOYD L. DARROW

CHEMICAL BASES

In the two articles immediately preceding this one we dealt with acids. As already stated the three fundamental types of inorganic chemical compounds are acids, bases and salts. Nearly all of the compounds with which we experiment in inorganic chemistry may be placed in one of these three classes. We have seen that an acid is a compound that has a sour taste, changes the color of indicators, produces hydrogen ions in solution and, as we shall now see, neutralizes bases to form salts.

But what is a base? What are its properties? Why is it as different from an acid as black is from white? These and other similar questions will best be answered by a series of practical experiments.

**Bases and Indicators:** Prepare 10 per cent. solutions of sodium hydroxid and potassium hydroxid by dissolving 50 grams of each in 500 cc. of water. Also have at hand ordinary household ammonia and a bottle of lime water. At the same time prepare fairly strong solutions of sulfuric, hydrochloric and nitric acids. These may be about 1 to 4 or 5. (Always remember to pour sulfuric acid into water—not the reverse.) In another bottle have strong acetic acid.

For indicators we will use litmus, phenolphthalein, and methyl orange. To prepare the litmus solution boil a small number of litmus cubes in a beaker of water, allow the solution to cool and pour off the clear liquid. The phenolphthalein solution may be made by dissolving a little in alcohol. About 1 gram of the indicator to 100 cc. of denatured alcohol will be sufficient. For methyl orange dissolve 1 gram of the substance in a few cc. of alcohol and dilute with water to a volume of about a liter. A quarter of this quantity will be ample for your use.

Now arrange a row of eight small beakers on your laboratory desk. In the first place a few cc. of sulfuric acid, in the second sodium hydroxid, in the third hydrochloric acid and so on, making every other beaker first an acid and then a base. Dilute the contents of each beaker with a little water and then add to each in succession litmus solution. The acids, as you will observe, give a red color and the bases a blue.

Dividing the beakers into four pairs mix the contents of each pair. Note and explain the color changes that occur.

Empty and rinse your beakers. Then repeat the above demonstration using phenolphthalein indicator. Note that the bases give a pink color while the acids give no color at all.

Again repeat using this time methyl orange indicator. By mixing the various acids and bases that you have, you will

(Continued on page 1083)

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This Illustration Shows Chemical Apparatus Set Up for the Preparation of Ammonia from Ammonium Chloride and Slaked Lime.

Here We See the Necessary Chemical Glassware to Produce the Interesting Effect of a Fountain in a Vacuum. The Tube Extending from the Ammonia Water Flask is First Used for Filling the Inverted Flask with Ammonia Gas and the Cork Subsequently Inserted.
FROM time to time we find descriptions and drawings of "To-be-made-by-the-amateur" reproducers, but to my knowledge there have been none which really bring about the desired results. They all give forth a certain metallic sound which is harsh and unyielding. The use of wood seems to offer the only remedy.

All that is needed to make the reproducer described in the following description into the tone arm. Sandpapering the outside will add to the appearance of this and all other wooden parts.

The sound box is turned from a piece of wood as closely resembling the other in quality as possible. Both the longitudinal and lateral holes are drilled in the rough piece. A surplus of stock is allowed to remain on the square end for centering one end in the lathe, while a plug is driven into the open end for the The cutting off is accomplished with a cutting-off chisel or hand sawed and filed.

The diaphragm is cut from a piece of sheet mica and filed or turned to dimensions. The hole in the center may be changed to fit any small rivet to be found. Handle the mica gently, so as not to shatter it.

A block of wood, two or three inches longer than the finished piece must be, is swung from the face plate or jaws of the lathe. The outside dimensions of this

The Drawings Above Show a Very Practical and Interesting Phonograph Improvement Which Anyone Can Build Themselves, Even Without a Lathe, Simply By Boring the Necessary Holes With Wood Bits, Including an Expansion Bit Perhaps, and the Judicious Use of Saw, Rasp and Plane Knife. Some of the Best Phonographs Today Are Fitted With Wooden Tone Arms; One Well-known Type Being Prized in a Ring of Ball Bearings at the Base. Mahogany, Such as Used in Making Pianos, is a Very Fine Stock to Build it From, as it is Close-Grained and Takes a Good Finish. Any Hard Wood is Preferable to Soft Wood.

The sound box is first turned from a piece of any close-grained solid wood, well seasoned. The outside dimensions may be changed slightly, but the cup or sound chamber must be kept close to size; also the small projection on the rear, as this must fit snugly into the recess turned second center. This plug should have a slight shoulder on the outer end to expedite removal after the outside is finished, and the ball has been turned on the end. The square is now finished with hand tools.

The retaining ring is very simple, being turned from a piece fastened to the face plate, the outer end, inside and outside being turned first and the cutting off left until last. The outside diameter should be held to a close fit in the sound box. The cutting off should agree with those of the swing stand on the drawing. The recess in the top is the most particular measurement as this latter accommodates the swing arm. The groove or slot is cut ¾ inch from the top and about one-third of the way around the piece.

For the swing arm a piece of wood 5¼ by 2½ by 2½ inches is laid off as follows. One and three-quarter inches from the end and on the 2½ in. face, a small mark is

(Continued on page 1052)
Making a Bookcase for the Home
By O. Stevens King

Here is an ideal plan for a bookcase; and it is just the thing for the man about the house who wants to make a useful and attractive piece of furniture for the home. The one special feature of it is a wood stain which is free from varnish for the best results. If the shelves are to be in white as shown in the photographic illustration herewith, they should be given two coats of flat white paint and then one coat of white enamel. They can be stained the same as the rest of the case if it is so desired. In either case the choice should be determined by the furniture with which it is to harmonize. With the drawers only the front faces are stained.

When the stain is dry the main parts of the case, the top piece, the bottom piece and the two sides, should be assembled, so that it will be easier to handle while finishing. Where needed 3/4-inch boards can be bored and 1/2-inch flat-headed screws can be used and the heads putted over.

After the case is assembled in this way, a coat of filler is applied and allowed to dry in a warm place. When thoroughly dried it should be rubbed lightly with a fine sandpaper, so as to remove any rough spots on the wood. One coat of varnish is then applied and the bookcase is left to dry. No varnish is to be used on the white enamel.

When putting the shelves in the case, either 1/4-inch flat-headed screws are used and then the heads putted, or else the round headed blued screws of the same length can be used. Either are satisfactory; the latter mentioned being best with the darker finishes. The vertical drawer supports are put in by nailing them to the shelves.

Pancake Coil Mounting

I have been comparing the honeycomb inductances and spider-web inductances; both are trimmed in the same manner, but they differ in two points: 1—winding; 2—selectivity of a set. The honeycomb coils are interchangeable, why not the spider-web? In illustrations hereafter the apparatus is shown. This apparatus permits the now first inductances to be varied only by coupling. By loading a small inductance, the signals will be found to be very weak.

The new apparatus, as I have designed it, permits large coils and smaller ones to be used on same stand. There is another point in construction that I have noticed. The wires on the primary have a face toward the secondary. The tickler and secondary have also a double face. If the winding of the latter two coils might have the winding on one of the face toward the primary there is increased efficiency. Of course the cardboard or frame of the coils, does not affect the induction appreciably, still attention to small details increases the signal.

Contributed by FRANCIS McEVANEN.
FIRST PRIZE, $15.00
MEASURING THE VELOCITY OF BULLETS.

Does it seem impossible to "time" a high-velocity bullet in flight, and not only that, but to tell, to the ten-thousandth part of second, how long it will take that bullet to travel ten feet? And this by ac-

SECOND PRIZE, $10.00
BLOW TORCH AND PIPE COIL HEAT ROOM

The accompanying illustration shows how an ordinary gasoline blow torch and a coil or iron piping serve as an efficient heater for a cold room of the dwelling or office in winter.

THIRD PRIZE, $5.00
"HOME MADE LIGHTING PLANT"

Having much extra work in an all-around repair shop and having given trial many kinds of lighting for night work, the electric, oil and city gas, all had certain evils without counting the excessive expense attached for many lights. The brilliant lighting effect secured on auto trucks by the use of acetylene gas lights being noted and learning of their low operating cost, a second-hand pressure gas tank was secured together with tubing of metal and many burners such as is used in the truck head lights.

Next, the tank, some 8x36 inches, was mounted in a corner of the shop and metal tubing was taken from it to all vantage points for lights. Next we procured several cheap kerosene lamp burners and large chimneys to fit same, by mounting these burners and holding them on hangers, the latter made of scrap iron straps, and installing the gas burners in the tops of the oil burners and connecting the same beneath to the metal tubing by means of rubber connections, the gas burners were complete.

Fig. 1 of the drawing shows plainly the nature of the gas tanks and connections for head light as used on auto trucks. Fig. 2 shows face view of head lights and in the center will be seen the outline of the acetylene burner which is double fork with pin holes in each for directing its gas spray at angles and white lighted the lamping spray produce a brilliant light. When the tank becomes exhausted, it is taken to a garage and exchanged for a full one. Fig. 3 drawing shows the shop building outline and lighting system pertaining to same. Note tank at A, and lamps at B, C, D and E.

Contributed by R. C. LIEBE.

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A PHOTOGRAPHIC BAROMETER

Every cloud is a weather sign, even fog. For in the corner of your eye it shows that it will be a nice day. To continue with the clouds—low clouds that move swiftly tell us that rain is approaching, while high, hard edge clouds or delicate wispy clouds, that look rolled or jagged, foretell a strong wind. Look out for rain when the sunset in the sky is yellow or greenish, also when the sunrise is red. When the evening sunset is red and the next morning is gray, the day will be fair.

Rain is told by a circle around the moon. If there is rain before seven o'clock, it will be fair before eleven o'clock. When it rains and an east wind is blowing, the rain will last for quite a while. A sudden shower is soon over, but one that is slow will last long. In the morning if you see dew on the grass, it will not rain during the day; but if a dog eats grass it shows that rain is bound to come.

Winds from the east bring rain. Winds from the west bring clear, bright and cool weather. North winds bring cold weather, while south winds bring warmer weather. There are many other ways to foretell the weather but they are difficult, so I have not attempted to describe them.

And now I shall tell you how to make a photographic barometer. Look among your negatives, select one which has 2 or 3 figures in the landscape. Make a good-size print of it. Before we can proceed further, however, the print must be thoroughly hardened in an 10% formalin bath. Then prepare the following:

<table>
<thead>
<tr>
<th>Material</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water</td>
<td>3½ oz.</td>
</tr>
<tr>
<td>Gelatin</td>
<td>30 oz.</td>
</tr>
<tr>
<td>Dissolved in the aid of heat and air</td>
<td></td>
</tr>
<tr>
<td>Cobalt Chlorid</td>
<td>30 gr.</td>
</tr>
<tr>
<td>Glycerin (water free)</td>
<td>20 drops</td>
</tr>
</tbody>
</table>

Coat the sky carefully with this solution. If you have the water colors with which prints are colored, you may add further beauty to this barometer by coloring the foreground with the proper shade of green, or whatever colors are necessary. You may now mount it in any way that appeals to you. Of course, no glass should be put over it. Place it in a sheltered position on the porch, and in fine weather the sky will be blue, while in a clear weather it will be white.

No doubt the change in the color of the sky will seem like a miracle, but a student of chemistry will tell you that it is due to the action of moisture on the cobalt salt.

Contributed by JOHN YURGINAS.

CEMENT FOR CELLULOID

Celluloid may be cemented with acetone collodion. Among other adhesives suggested for this purpose are the following:

<table>
<thead>
<tr>
<th>Material</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shellac</td>
<td>1 part</td>
</tr>
<tr>
<td>Camphor</td>
<td>1 part</td>
</tr>
<tr>
<td>Alcohol</td>
<td>4 parts</td>
</tr>
</tbody>
</table>

Dissolve the camphor in alcohol, and in this solution dissolve the shellac.

Contributed by WM. R. REINICH.

PHOTOGRAPHING HIGHLY POLISHED SURFACES

The failure to photograph objects with highly polished surfaces cannot always be attributed to a lack of skill, but more often to a lack of knowledge of the manner in which to properly overcome these obstacles.

The first thing to do is to make a careful study of the object to be photographed. The use of putty, to overcome the violent reflections from polished surfaces, frequently changes the textural quality of the object; for instance, silver objects may appear to be made of wood in the photograph. The success or failure in effectively photographing polished objects is partly a question of the proper illumination.

Because the angle of reflection equals the angle of incidence, the illumination should be arranged so that the reflection is away from the lens. Direct front light is impossible, and to safeguard against this a dark curtain should be hung not too far in front of the object, leaving a small aperture for the camera eye.

The light from one side and the top should be cut off, concentrating the light so that it comes from one direction, and is not to fall on the object at an angle of 45 degrees. Inspection in the ground glass will show the object with all the objects in fullest detail, but the shadows will appear very dark because the light surfaces show up black when in shadow. Follow the old rule and expose amply for shadows and show the highlights to take care of themselves.

Contributed by WM. R. REINICH.
How to Build a Radiotrola

By H. GERNSBACK and R. E. LACAUT

The Instrument that provides your home with the best grand opera, lectures, sermons and jazz

In a recent article in Radio News we made mention of the Radiotrola.
Mr. Gernsback coined the word, the meaning being that the instrument was supposed to take the place of the present Victrola phonograph, or at least make a good substitute for it. There is, of course, nothing fundamentally new about the Radiotrola with the exception of the novel design used in this machine. The chief novelty is that no aerial and ground are used at all with the instrument; but the use of the loop is resorted to with good results.

The Radiotrola was designed and constructed by the authors for the private use of the editor, who desired to satisfy himself that it was practical. It is a well known fact, understood by all to-day, that radio is becoming more and more popular not only with the radio "bug" but with the man in the street, with the housewife, with the business man—as a matter of fact with everybody. It is realized that the average layman does not wish to be bothered with technical details. All he wants is a machine, which, placed in his house, will bring him music, concerts, opera, jazz, etc., without being asked to become a radio expert.

The Radiotrola as a matter of fact, can be used by anyone once a little instruction has been given him.
We do not think that the machine which we show here is the ultimate. It is simply the first of its kind, and for this reason naturally not the sort of machine which we shall see five or ten years hence. But it is a start, and works satisfactorily, bringing in at a distance of fifteen miles from W.J.Z. (Newark, N.J., Broadcasting Station), the music and concerts loud enough to be heard throughout a large loft.
The efficient range of this instrument with a loud talker is probably not more than fifteen to twenty miles, although it could be considerably increased with more stages of amplification, but the Radiotrola is provided with a set of phones that can be plugged in while the magnavox loud talker is cut out. In that case, the range is increased to fifty or seventy-five miles. The instrument was built with a view to do away with all unsightly wiring, aerial and ground, and to resemble the standard make phonograph as much as possible.
The cabinet used is by no means a regular phonograph casing, but is nothing but a record cabinet, and the style used by the authors is shown in Fig. 2. This cabinet of mahogany was bought in a retail store for $12. While a much larger cabinet could have been used, it was thought best not to do so for the reason that the loop would have extended up to an inconvenient height, and the instrument would have looked too cumbersome. While the instruments are somewhat cramped in the small space of the cabinet.
it is also true that the apparatus is very compact and rather business-like, and above all it does work nicely.

It was found best to put the main switch right into the battery circuit, which switch when closed lights up all the filaments and connects the magnovox as well, all simultaneously. Thus if the adjustments have been made once, it is not necessary to make them again (except for very slight variations), as, for instance, when listening to a lecture. It was found that with the magnovox, music would come in very well, and with the same adjustment spoken words come through rather loud, but not so clear. By merely detuning the last circuit the sounds come in, not quite so loud, but more distinctly.

Construction of the Radiotrola

The Radiotrola, as described in this article, and built according to the data given hereafter, will function at maximum efficiency within a radius of about fifteen miles, although this range can be greatly increased; it depends chiefly upon the local conditions of installation. For longer ranges, another stage of radio frequency amplification should be added, but this was not used in the original instrument, which was to be employed within the radius mentioned above. Any type of loud-taker may be used instead of the magnovox, which is installed at present in the original Radiotrola.

The Amplifier

In conjunction with the loop aerial, which acts as the tuner, a combination radio and audio-frequency amplifier is used. The circuit, Fig. 1, shows in detail the connections between the various elements which are numbered for reference. In this circuit, No. 1 is the loop aerial consisting of a wooden frame 20 x 18 inches and 4½ inches wide, wound with ten turns of Litz wire, or small cable composed of several strands of fine copper wire, spaced ½ inch apart. No. 2 is the .001 mf. tuning condenser with a small fixed capacity of .0005 mf. in parallel, which may be connected by means of a small switch. With this capacity, the range of wave lengths which can be tuned is about 200 to 600 meters. No. 3 is a potentialmeter used to determine the grid potential of the two first tubes acting as radio frequency amplifiers. No. 4 is the radio frequency transformer, which is shown in detail in Fig. 3. The primary consists of 65 turns of No. 40 S. C. C. enamelled copper wire, the secondary is wound with 72 turns of the same wire.

In order to tune the radio frequency amplifier, which is of the resonance type, two small variable grid condensers are shunted across the primary of the radio frequency transformer and the honeycomb coil L25, which gives a regenerative effect, since the plate circuit of the second tube may be tuned. It is important that the radio frequency transformer and the honeycomb coil be mounted at right-angles to prevent induction between these circuits and production of continuous oscillations causing whistling in the receivers. It should be noted that either a Per or Mercury RC3 tubes must be used for the radio frequency amplifier, as these tubes have less internal capacity than the others, give better results.

The detector tube may be of any make, although a model 804, or a tube with better performance, may be used, not needing so much adjustment; the amplified oscillations are applied on the grid of the detector through a small fixed condenser, No. 8, of about .00025 mf. capacity, a grid leak No. 9 of suitable resistance, keeping the grid at the proper potential for best rectification. Each audio frequency amplifier is of the ordinary type, the two stages being coupled by iron core variable A jack, No. 12, is provided for plugging in a pair of phones when it is desired to use the Radiotrola for long distance reception; when no phones are plugged in, the jack automatically connects the loud taker in the plate circuit of the last tube.

In the original instrument, a magnovox was used, the field of which was supplied by the amplifier "A" battery, a switch, No. 6, being provided to cut it off when not in use. For best results with this type of loud taker, a high plate voltage is necessary, and on the Radiotrola, 160 volts furnished by four 45-volt "B" batteries were applied on the two last stages of audio frequency amplification, only 90 volts being used on the radio frequency amplifier.

To simplify the adjustments, a single rheostat is used to control the radio and audio amplifiers, as shown in Fig. 1; the rheostat used for this purpose is of the "power" type, in order to carry safely, without overheating, the filament current of two tubes.

Assembling

Fig. 2 and the photograph showing the complete Radiotrola give a good idea of the arrangement of the various parts inside of the cabinet. The loop aerial, which can be turned in the direction of the station to be received, pivots on a support made of brass, as shown in Fig. 4, the two ends of the wire wound on the loop being brought through the support inside of the cabinet. This is mounted in the center of the top panel, which is of insulation material, such as bakelite and supports also the three condensers. Inside of the cabinet, shelves that slide in from the pull-out, are the amplifiers, the "B" batteries, and the 6-volt storage battery, furnishing the current to the vacuum tubes and the field coils of the magnovox.

The magnovox is mounted on a small shelf in the back of the cabinet so that the length of the aerial, as shown in Fig. 1, is even with the bakelite panel on the top. The connections from the condensers and loud taker are attached to binding posts mounted on the control panel, enabling the complete amplifier mounted on the shelf to be pulled out for inspection, by simply removing the wire from these binding posts.

(Continued on page 1084)
Radiophoning To and From "L" Trains

The present plans of the Chicago Elevated Railroad do not mislay the patient straphangers who gladly pay the present fare of 8 cents without any murmur, and be willing to donate an extra dime or two for the privilege of riding on the elevated. The elevated system is figuring on installing a radio system on its cars and furnishing its passengers with songs, music, and even grand opera, on their way to and from work. Pretty soon it will be a privilege to work; not only will the passenger be entertained, but it will be possible for you to call your home while in transit and suggest what kind of meat you want for dinner.

The first trial of the radio was made on a Chicago, North Shore & Milwaukee electric line recently. A dozen pretty girls from the offices of the line danced with the road officials to the strains of music transmitted from the radio station on top of the City Hall. They were also able to carry on conversation, i. e., talk for producing the necessary high frequency oscillatory current suitable for charging the antenna, together with a high voltage d. c. dynamo, the current from which is acted upon by the vacuum tubes in the production, as well as the voice modulation of the high frequency oscillations.

Radio Gives Telephone Secrecy

The superphone, an apparently simple attachment for telephones, which is said to assure secrecy of communication and security from interruptions and to make possible multiplex telephony, was demonstrated recently in the office of the Chief Signal Officer of the army at Washington, D. C.

It was shown that one telephone line to which superphones were attached could be used for a number of conversations simultaneously and that no two speakers could hear or interrupt another two.

The superphone, it was explained, has been developed under the direction of R. D. Duncan, Jr., Chief Engineer of the Signal Corps research laboratory of the Bureau of Standards, assisted by S. Isler, assistant radio engineer. It is based on wired wireless or line radio, invented about ten years ago by Major Gen. George O. Squier, Chief Signal Officer of the army. The invention consists of a small, portable set of instruments, which may be installed in any office or residence in a few minutes and connected directly with existing telephone lines. High frequency alternating currents are employed.

Signal Corps officers said that the invention was of great value for military purposes, because of its assurance of secret communication. It would be of hardly less value, they said, to business men, bankers and others to whom it was desirable to have complete privacy in confidential channels of communication.

SUN DUST BARS INTER-PLANET RADIO

Electrified dust thrown off by the sun forms an atmospheric envelope about the earth about 100 miles away which prevents wireless waves from escaping into infinite space, according to Prof. J. A. Fleming, University College, London, whose work in wireless research is known all over the world. The screen made by the dust, he says, acts as a sort of wireless speaking tube and enables waves used for long distance work—which are about ten miles in length—to travel 6,000 and 12,000 miles. If it were not for that screen, according to the professor’s theory, the wireless energy thrown out by the big sending towers would not cling to the earth, but would pass away and be lost.

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When coming in contact with the screen the waves are deflected and guided between it and the earth’s surface until they reach the receiving station for which they were intended.

The electrified dust is thrown off by the sun in immense quantities and the pressure of light—which exerts a total pressure of many tons on the whole surface of the earth—is strong enough to overcome the backward gravitational pull of the sun and so drive the dust particles on the long journey toward this globe.

The dust attains great velocity in the freedom of the empty spaces and generates enough energy so that a single handful would drive the biggest ocean liner for twenty-four hours. Each particle bears an electric charge from the sun and on reaching the outposts of our atmosphere friction slows it down, and thus floating, a layer or conducting screen is formed which is an unseen blessing to radio engineers. Prof. Fleming, altho he holds no positive views on interplanetary communication by wireless, says that the moon is unfit for long distance radio communication because it has no dust screen about its surface such as the earth has.
Radio for the Beginner

By ARMSTRONG PERRY

1. How to Buy and Install a Receiver

WE are pleased to announce a series of twelve popular articles on radio entitled "RADIO FOR THE BEGINNER," by Mr. Armstrong Perry. Mr. Perry is well known as a radio man and has the ability to see radio through the eyes of the layman. In these articles we are trying to show to the average layman, that is, the man in the street, who knows nothing about radio, just how to go about to receive the music that now abounds all around us.

There are, at present, five stations broadcasting radio music, lectures, stories, grand opera, social and instrumental music, the stations being as follows:

Westinghouse, Newark . . . . . . . . . WJZ
Roselle Park, N. J.............. WGY
Pittsburg, Penna............. KDKA
Springfield, Mass............. WBZ
Chicago, Ill............. KDY

Anyone within a radius of 100 miles of these stations by means of a simple apparatus can listen in.

We are quite certain that the articles are as clear as it is humanly possible to make them without straying into deep technicalities. If you should not understand anything, be good enough to address Mr. Armstrong Perry, enclosing stamped envelope for reply—Editor.

purchase a receiver. If you are within fifty miles of San Francisco, Los Angeles, Denver, Omaha, Kansas City, Wichita, Chicago, Cleveland, Buffalo, Boston, New York, Washington, or any of the larger cities, a receiver costing from $15 to $30 will be good enough to begin with. The dealer calls these "mineral detector sets." If you are farther away from a city where radio telephone transmitters are at work you will need a "vacuum tube" receiver. This costs from $25 up, including the necessary batteries, tubes and phones. In either case you will need to put up a wire—the aerial—so that the radio waves can trickle down from it to your listening ear.

A mineral detector set is less sensitive than a vacuum tube set. As compared with the "v. t." apparatus it is like a man who is somewhat deaf. It takes more energy to reach his ear drums. So for the cheaper receivers the wire needs to be comparatively long—say 100 feet—in order to pick up sufficient energy to penetrate the receiver and make sounds loud enough for your ear to hear.

Copper or aluminum wire is best. Between these and wires made of iron or lead there is somewhat the same difference as between a very steep chute made of polished wood and one covered with sand paper. You might slide down the sand paper just as fast, but you would not be quite all there when you arrived at the bottom. Just so the electric current loses part of itself in coming down a poor conductor. In the language of the electrician, copper and aluminum have higher conductivity than most other metals. A wire
made of strands gives better results than a solid wire of the same size.

Your wire had better be straight, tho' it is not necessary to stretch it tightly. Usually it operates better if it is thirty feet or more above the ground. One that I use starts at a post twenty feet above the ground and runs up to an angle of 45 degrees to another post on a roof 75 feet high, whence it descends to my radio cabin on the roof floor. Another starts at a barn, goes to an apple tree and then to a receiver in a ground floor room. Still another follows the picture molding around a second story room. They all pick up all kinds of messages.

One thing I am careful about is to keep these aerial wires from touching wood or metal. I fasten an old bottle or a composition insulator to the post, building or tree, then run the wire through. Otherwise the radio waves, after being picked up by the wire, leak off into the tree, post or building as water spurs from a leaky pipe. As a certain oil man said to a superintendent, who proudly reported that he had been able to get 99½ per cent. of the gasoline out of crude oil:

"That is not enough! We must have it all!"

When my radio wire passes from out-of-doors into a building I put in a lightning switch or a lightning arrester. Once I saw the lightning strike a wire just outside. It was very wonderful—magnificent, but ever since that day I have tried to make sure that the lightning remains on the outside. I hate to think of trying to confine within four walls any wild thing that needs so much room and air! Besides, I do not like the attitude of insurance companies toward lightning losses. They are as stubborn as the Lord was in the case of Lot’s wife. If you invite destruction by disobeying orders, it is your own funeral and the undertaker’s bill comes out of your estate.

Another little detail about putting up an aerial wire is that it should not run parallel with other wires in the neighborhood. Parallel wires are worse than one of those strings of neighbor’s dogs where one begins to howl and sets them all howling. Electricians call it “induction.” There is a better word that begins with “H” and expresses my feelings about it better. If your wire is at right angles with all others, or nearly so, you will not need to use either word.

There is a knack to handling a coil of wire that I learned after spending several weeks of my life straightening out kinks. If the wire dealer is a desirable citizen he puts a single strand of rather stiff wire around your coil like a collar. By sliding this around and around your coil you can release one turn of wire at a time. If you take the collar off, sooner or later you lay your coil down or drop it accidentally and when you try to straighten it out you find it hopelessly tangled.

There are many kinds of aerials: Inverted “L’s,” “T’s,” “fans,” “umbrellas,” “wire mesh,” “loops,” and “cages.” I prefer a single wire partly because I am naturally lazy, and partly because I am satisfied when I can hear what I want to hear. The more elaborate aerials require more time and money.

The inside end of your aerial wire goes into the binding post marked 110 or “Ant” on your receiver, and you turn the screw down tightly. Not to do this binding post is one marked “G” or “Grid,” which is short for “Ground.” To this you attach another piece of wire and run it to any convenient water pipe or steam radiator. If you have neither, solder the end to any old piece of metal and burn it red hot. Soldering better any connection. It is easy to do since the invention of the soldering paste that requires only the heat of a match.

Whatever kind of receiver you are using, when the wires are all connected and the knobs and things adjusted according to directions, you begin to hear noises that you never thought of. It is a surprise party with unknown friends dropping in from all parts of the world. (Watch for the next installment.)

NEW RADIO APPARATUS FOR AIRCRAFT

At Croydon, the London terminal aerodrome, on November 4th, very successful tests were carried out with a new wireless apparatus for guiding airplanes in foggy weather near the aerodrome. The aerodrome and surrounding district have been divided into sections and by means of the new apparatus the wireless operator on the ground is able to tell the pilot of the airplane which section he is over and the exact minute to turn. The apparatus has been installed in a building known as the control tower on the aerodrome.

The tests were made with a Handley-Page airplane and the operator in the control tower guided the machine to various parts of the aerodrome.—Lieut. G. H. Duby, D. S. M.
American Amateurs Heard In Europe

The Every-Day "Radio Bug" is Greatly Interested No Doubt, in the Recent Announcement By Mr. Paul F. Godley, Well-Known American Radio Expert That He Had Heard 28 American Amateur Transmitting Stations When He "Listened In" in Scotland. The Distance Between the Transmitting Stations and Scotland Varied Between 2,500 and 3,000 Miles in Most Cases. The Greatest Amount of Energy an Amateur Station Can Legally Use is 1,000 Watts, and Only About 1-1/10th of This Wattage Was Used to Bridge the Atlantic. Compared, For a Moment With the 900 Kilowatt Radio-Transmitting Set Used at Commercial Stations, as Shown in the Picture Above, When the Wonder of It All Will at Once Dawn Upon You. The Comparative Magnitude of the Amateur and Commercial Waves Lengths, as Well as the Relative Size of Antennas, Are Graphically Shown Above Also.

A bout a month ago it was reported in the daily press that twenty-six American radio amateurs were heard in Scotland by Mr. Paul F. Godley, an American radio expert, who installed a very sensitive receiving station at Glasgow, for the express purpose of listening in, to ascertain whether or not such small transmitting stations as those used by amateurs could be heard regularly in fair weather and under average static conditions over such a great distance as that existing between America and Europe.

Some of the amateur radio-telegraph transmitting stations in America are located far inland, and the maximum energy employed in transmitting the test signals over the 2,500 to 3,000-mile gap did not exceed a kilowatt, or 1,000 watts, whereas the commercial radio-telegraph stations employ from 100 to 200 kilowatts, or more, to bridge the same distance.

The accompanying chart shows graphically what a remarkable scientific achievement the trans-Atlantic amateur transmission really is. The upper scale line shows by comparison the small magnitude of the one-kilowatt amateur station as compared to the 200-kilowatt commercial, or government station, intended for regular trans-Atlantic communication.

In other words, the commercial station uses 200 times as much power as the usual amateur station, the only real difference being, of course, that the larger station is pretty sure to get the messages thru almost any sort of interference, or static.

Next, we may glance at the tremendous aerial wire system, or antenna, as it is usually called, employed by the professional station. An antenna of the type used at Radio Central on Long Island, for example, measures about 3 miles in length, or 15,840 feet, and the two dozen odd wires, each larger in diameter than a lead pencil, are supported 410 feet above the ground on latticed steel towers. The average amateur antenna will measure about 60 feet in length and will be about 35 feet above the ground, and comprises possibly 2 to 4 wires, each being as thick as an ordinary store string.

In other words, as the graphic chart shows, the amateur antenna, magnified 100 times in the picture in order to make it visible at all, as compared to the commercial antenna, is only 1/12 as high in the air as the big fellow, while the length is about 1/263 the length of the large aerial.

When it comes to the size of the apparatus or instruments employed, the amateur outfit looks like a "bunch of junk" compared to the formidable array which greets our eyes when we open the door of a typical trans-Atlantic radio station.

The amateur can place his apparatus (even for transmitting across the Atlantic and rated at far less than 1 kilowatt, when he is using, for example, the highly efficient continuous wave vacuum tube generator or oscillator) in a space measuring about 2 feet by 1 foot by 1 foot. Disregarding entirely the steam turbines, boilers and other machinery, the commercial radio station, rated at, say, 200 kilowatts, will require about 2,000 times the cubic feet of space, that the amateur occupies, to take care of the high frequency alternator of the type used at Radio Central, together with the control switchboard panels and the auxiliary condensers, transmitters, etc.

As a matter of fact, the professional station will occupy much more space than 4,000 cubic feet, even when the steam turbines, boilers, etc., are left entirely out of the calculation.

When it comes to the wave length used, and we must remember as extensive tests by Marconi and other radio experts have shown, that long waves are much more efficient in covering great distances than short waves, the amateur again scores a distinct mark in the advance of efficient radio transmission.

If we take as a typical wave length for a trans-Atlantic station that used by Arlington (N. A. ), which is 3,000 meters, then the little amateur station, transmitting on a maximum legal wave length of 200 meters is operating on a wave length only 1/15th as long as that radiated by the big stations. And as a matter of fact very few commercial trans-Atlantic stations today take chances in using a wave length as low as 2,000 or 3,000 meters, and they actually work on much higher wave length, anywhere from eight to ten thousand up to twenty thousand meters (one meter being equal to 3.28 feet).
What to Invent

By JAY G. HOBSON

INGENUOUS BICYCLE GENERATOR

Attention! Bicycle enthusiasts. Pin your optics to the following suggestion of our friend Maffet, from Opal, Colorado. No more burnt-out batteries, no mussy oil or carbide lamps and no accidents at night riding your rubber-shod steed with this needed improvement.

A Novel Idea in Electric Light Dynamo to Be Built on Bicycle Wheel.

DEAR MR. HOBSON:

In response to your request for ideas in the August SCIENCE AND INVENTION, I am enclosing one of a generator for bicycle lights and horns. This one is very simple and sturdy, and should supersede the present unsatisfactory battery outfits. As the sketch shows it consists of a number of magnets mounted around the hub of one of the wheels. These could be either of the horseshoe or bar type. In the latter case two field coils could be used and thus make a stronger generator. The field coils are mounted on the frame of the bicycle as shown and are arranged between the spokes and frame, in close proximity to the pole-pieces of the magnets.

THOMAS C. MAFFET.

PULLMAN EXERCISER

You who do considerable riding in the modern Pullman cars, and especially you who take those long, tiresome, muscle-stiffening trips over the steel threads, certainly will appreciate an addition to the coach that will enable a fellow to exercise, and work up an appetite during the expensive period of inactivity.

For instance, the Pullman company could easily afford to install a tread-mill for running, a bicycle arrangement for leg exercising, a punching bag for arm and shoulder practice and wall-weights for general limbering up. These devices undoubtedly would become very popular with the men folk, whose natural tendency is one of force and motion. With a small compartment of this description a fellow could slip off his coat and pitch into a frenzy of exercise that would make his old meal taste just like mother used to provide. And, finally, when one's destination was reached he wouldn't feel like a stowed-up elephant after an all-night ride in a small box car. I certainly hope some of you traveling readers suggest the above to the railroads so that they may provide this useful addition to their equipment.

MEN'S CRUMB CATCHER

Another mystery unsolved! Did you ever go to luncheon with some friends all sit down on perfectly clean chairs, eat your hot, crispy rolls and butter, finish with pie, get up and with surprise find the seat of your pants full of crumbs—the very seat that you have been sitting on! Well, the next time that you eat just notice this phenomenon and I am sure that you will agree that there is great need for an invention of a men's crumb catcher to surround the seat of the table which now seem impossible of achievement.

Possibly one in the form of a cloth extension attached to the table cloth and to one's coat would serve the purpose. Anyhow, to further the cause of neatness with our meals some thought along this line wouldn't be amiss.

LINTLESS NEWSPAPER

To those who read in dark-colored clothes a lintless newspaper would most assuredly be highly welcome. This suggestion was profoundly impressed upon me the other day after I had finished reading the Sunday paper. I approached some feminine and masculine friends in the corridor of a hotel, mentally at ease about my appearance. But to my surprise one of the ladies announced: "Oh, look, it's been snowing all over your clothes." The darning newspaper had shed its surplus dandruff all over me, and right there and then I decided newspapers were being cut with dull knives and somebody should invent one that keeps sharp and eliminates the bothersome lint.

ACETYLENE AS MOTOR FUEL

Dr. Paul Weyland, President of the Association of German Natural Scientists, who is now in this country, says that owing to the poverty of the German people and their inability to get oil at the present prices, a substitute has been invented for their use in the form of acetylene gas, which is proving very successful for automobiles. He says that Germany is far behind this country in the use of electricity and that this means of motivation is looked upon with disfavor.

"Germany has no oil, and with her currency in its present condition she cannot afford to purchase what she needs," said Dr. Weyland. "This has led to a discovery which will revolutionize the automobile industry for Germany at least. Acetylene gas, generated by the action of water on calcium carbide, I believe, will be the coming motive power for automobiles in my country. The engine has been perfected. The gas is compress and stored in cylinders. The user stops at a station and instead of having his gasoline tank filled exchanges his cylinder and gets it recharged. Stations for this purpose are already building.

"Germany is far behind the United States in the application of electricity as a motive power. It is not favored in my country. Even the electrically propelled locomotive for trains is in disfavor. Our use of electricity is negligible as compared with yours. But there is a real economic reason for this; labor in Germany is very highly organized and restless. To use electricity as freely as you do requires high control power stations. With labor in revolt, they place an enormous power in the hands of the working men, which we fear to give them.

"But we are still making an excellent vegetable oil by gathering the fat from the seeds and using it for lubricating purposes. One use we have made of an electric motor which is of great value in increasing the growth of plants, an intensified cultivation."

1047
Folding Automobile Top

(No. 1,390,534 Issued to Abraham D. Hedges.)

The framework which supports the front parts of the automobile-top in this invention is composed of straight and of tubular sections of steel. There are two of the latter rigidly connected at the rear seats with curved balancing arms which extend forward when the top is raised, as illustrated. These are attached to the sides of the automobile by bolts. The bottom ends of the curved arms are connected with levers, which levers have springs attached to them to assist in balancing the arms. The automobile is provided with curved openings or pockets to receive these arms. The cloth top folds down in back of the rear seat and is provided with a hooping device, for the purpose of holding it in its open position after the top has been extended.

Phonograph Reproducer

(No. 1,390,651 Issued to Alex. Hoover.)

In this novel reproducer and speaker a thin sheet of tin or other material is placed in the center of an ordinary diaphragm and several auxiliary diaphragms, an armature post is past, threaded on its upper end for the reception of a nut, and provided on its lower end with a socket adapted to receive the stylus needle. Immediately above the main diaphragm is a four-legged spider in which the needle rests, in depending fingers, superimposed upon the diaphragm. When it is claimed, serves the important purpose of increasing the air resistance of these diaphragms in use in conjunction with the later cut records. The reproducer will also give excellent results on bill and date records without the necessity of changing the position of its needle, or any of its parts with respect to the record, the inventor claims.

Electric Razor

(No. 1,390,702 Issued to Joseph A. Hammontree.)

In this razor the chopping stroke is changed to a swinging stroke. The operating means found in the handle of the razor, the proportions of which have been reduced so that the instrument is graceful in appearance, is, in fact, and absolutely silent, the inventor would consider it a straight edged razor blade attached to the armature of a buzzer. One might suppose that the razor blade would require a guard in order to prevent the shaving of the face. Yet, by actual experimentation, it has been found that the instrument when operated by an inexperienced shaver will not cut his skin.

Balloon Searchlight

(No. 1,390,902 Issued to Columbus Groome.)

Suspended from a lighter-than-air balloon is a powerful incandescent light suitably shielded by a square, box-like structure made of metal. This casing has in each of its vertical sides a bull's-eye, and also one on its lower horizontal side. Each bull's-eye is connected individually to a conical reflector, open near the source of light. On the outside of the box and situated over each bull's-eye is a curtain, connected at its free end with a cord.

Amusement Device

(No. 1,390,789 Issued to St. Charles Jacob.)

A hen, duck, or other animal, is hinged on its legs, and provided with a suitable spring to maintain its upright position. The representation of a hen is hollow, with an inlet at the side and also an outlet placed near a suitable hole on the game board. The head now becomes the target and, when a baseball hits it which is thrown by one of the players, the hen falls, laying an egg which slides thru a chute down to the front.

Electrothermo Relay

(No. 1,390,326 Issued to William A. Rhodes.)

This is a very novel relay, in which a member capable of expansion in response to electric current, operates a snap contact. The expansion member consists of a tube,

Oscillating Fan

(No. 1,390,762 Issued to Philippe de Clamency.)

An improvement over the ordinary oscillating fan is embodied in this construction. After mounting the motor on suitable ball bearings, the cord passes down over a pulley in a frame suspended below the casing and thence thru a hollow pipe to the ground. From this place the light may be controlled, so that it will shine in any desired direction. For signaling or providing an aerial buoy, this system would undoubtedly be successful, but we fail to see its efficiency as a searchlight for training a beam on an aerial target.

Electrical System for Firing a Flare Gun

(No. 1,390,865 Issued to Loren M. Hartz.)

In order to preserve the beauty, timidity and tone qualities of photographic reproductions, the inventor of this amplifying system has provided for a deflection of the air vibrations from the sound conduit or horn of a phonograph, claiming that ordinary phonographs reproduce sounds, due to the hard air column, are harsh and blasting, and that many of the harmonics are made impossible. This is accomplished by deliberately deflecting the sound into a flask-like chamber, which is connected to a network of resonant sounding boards designed particularly to be responsive to harmonics, and to cover all of the general audible frequencies. The resonant chamber is then focused to the amplified overtones which are sent out from the horn together with the sound produced mainly by the air columns of the horn.
Scientific Humor

First Prize $3.00

Did the Shock Kill Then? Flossie—"Yes, father lived longer than we thought he would — the power plant broke down." —Edward L. Friedman.

Did the Spark Coil?—Car Owner, Entering Garage: "I left my cylinders has been missing all day." Mechanic—"I expect the carburetor." —J. Edwin Wilson.

A Genius.—Crashaw—"How did you gain the reputation of being the big man out here, who knows everything?"

Suburban—"I managed to put up one of those portable houses without having to ask the manufacturer to send over one of their experts." —J. J. O’Connell.

W E receive daily from one to two hundred contributions to this department. Of these only one or two are available. We devote to publish only scientific humor and all contributions should be original if possible. Do not copy jokes from old books or other publications as they have little or no chance here. By scientific humor we mean only such jokes as contain something of scientific interest. Note our prize winners. Write each joke on a separate sheet and sign your name and address to it. Write only on one side of sheet. No letters acknowledged unless postage is included.

All jokes published here are paid for at the rate of one dollar each, besides the first prize of three dollars for the best joke submitted each month. In the event of a tie send in the same joke so as to "tie" for the prize, then the sum of three dollars in cash will be paid to each one.

We Hope This Is Your Last One!—Contributor—"What did you think of my last joke?"

Editor—"I’m glad to hear you call it your last." —Edward L. Friedman.

Did the Bill Turn Her Hair Gray?—Several doctors were jollying on the bunch about a long gray hair that had been found on his coat sleeve.

"If you must fall in love, why don’t you pick out a young one?" they asked.

"That hair came from one of my patients," explained the accused.

"You can’t put that over on us," returned the wit of the party.

"You know very well that your patients never live to have gray hairs." —J. J. O’Connell.

Are We Slipping?—Negro Preacher—"Brethren, today the people are monkeying into God’s business. The more the worse. When God made the world he put it on an axis so that it could turn. If everybody drills for oil, and lets all the axle grow run, some day this old world will stop dead still, and there will be no day or night." —No name.

An Operatic Family.—Creco—"Have you seen Carmen?"

Statter—"Sure, my two brothers are conductors." —Edward L. Friedman.

In the Fall They Wire-less.—Willie—"Ma, teacher said the wires on the tele- graph poles are educated.

Ma—"She couldn’t have said that. What did she mean?"

Willie—"Well, she said the wires expanded in summer and get saggy, while in winter they contract and become taut!" —Raymond I. Long.

Soon She’ll Use the Wireless.—Oldtimer—"I wish we could bring back the good old days!"

Singleton—"Why, man, there were no good old days!"

Oldtimer—"Yes, there were for me. When I came home late nights then my wife beamed me with the broom; but when I come home late now she lands on me with the vacuum cleaner!" —Raymond I. Long.

He Should Have Refused to Fuse.—Tom—"Say, you didn’t know that I was an electrician?"

Jerry—"Since when?"

Tom—"Why last night over at Jane’s the electric light fuse burnt out. Guess who fixed it? Me—myself!"

Jerry—"Huh! You’re no electrician—you’re an idiot!" —Edward L. Friedman.

Not By a Darn Sight.—Professor in P h y s i o l o g y — "A ball and socket joint is a movement to progress in any direction. Now, Jimmie, name a ball and socket joint of the human body."

Jimmie—"With courage—The eye sight." —Emit S. Christilles.

In Dry U. S. A.?—First Student—"Teacher, if two parts of hydrozine and one part of oxygen form water, why isn’t water inflammable?"

Second Student—"Because it’s wet." —Frank Ralinger, Jr.

A Short Circuit.—He—"Why did you offer so much resistance to that last kiss?"

She—"Well, doesn’t Ohm’s law state that the greater the resistance the more current and force will be required to overcome it?" —J. K. Smith.

Without an Anaesthetic.—Tom—"Why are telephone girls called operators?"

Boy—"Because they usually cut you off in the midst of conversation." —Harold Byner.

Probably Killed Time.—A clock and a watch could not agree as to the time, so after arguing a while the clock laid off two of its hands and struck. The watch setting a big head from winning the argument, lost its balance, and fell on its face. The main spring being so suddenly unloaded of its propriety went broke, and a bolt in the excitement lost its head.

—Otto Thoesser,
Building 1/16 H. P. Induction Motor

(W18) G. C. M., Cleveland, Ohio, writes the Oracle:

Q: Asking for additional data concerning 1/16 H. P. induction motor.

A: Would care of 8-inch spark coil built?

1. (1) With reference to building 8-inch spark coil, as described in the January issue of the Practical Electricity, would advise you as follows regarding its construction.

A: The iron wire should be as small as possible in order to make the coil work, and should be either annealed or, if not, should be turned over and annealed to make it more flexible. The iron wire is wound around the bobbin, and then the ends of the wire are securely fastened to the bobbin. The iron wire is wound around the bobbin, and then the ends of the wire are securely fastened to the bobbin.

2. (2) How do you join annealed wire?

A: Framed copper wire is joined in the same way as any other copper wire. The enamel may be removed by scraping with sandpaper or by various other means. The enamel should be removed from the wire, and the wire should be allowed to cool before it is used. If the wire is heated, it will become hard and brittle, and the enamel will not adhere well to the wire. The wire should be allowed to cool before it is used.

Mechanical Engineering Course

(W18) Guy W. Mays, Diamond, W. Va., asks this Department:

Q: A point of greatest following up an mechanical drafting course with one in mechanical engineering.

A: From the Oracle's Editor's experience he would advise any student interested in the field of mechanical engineering to look into as many opportunities as possible. The field of mechanical engineering is a vast one, and there are many different jobs available for those with the proper training.

Electric Heat for Garage

(W18) John H. Hemmings, Hartians, Pa., writes:

I have a 1/4-horsepower motor to a garage measuring 45 feet wide by 30 feet long. The average height of the walls is 16 feet. The garage is insulated with corrugated iron. There are three windows measuring 24 inches by 7 feet each, and two doors, each measuring 15 feet by 15 feet. What horse power would be required to heat this garage in the coldest weather, and also what horse power would be required to prevent frost from forming on the garage roof? What is the cost of maintaining the garage in this manner?

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

1. Only three questions can be submitted to be answered.
2. Questions on the same topic or type of written or otherwise submitted will not be answered.
3. Schematics, diagrams, etc., must be on separate sheets.
4. Questions addressed to this department cannot be answered by mail free of charge.
5. Questions will be answered to the extent of the material available.
6. If the questions entail considerable research work or correspondents will be informed as to the fee before such questions are answered.

Platinum Plating

(W18) John K. Brown, Philadelphia, asks the Oracle:

Q: Platinum plating. What is the status of platinum plating?

A: Platinum plating is not frequently done, but below is a very good formula for the solution of platinum plating.

Dissolve 17 parts chloroplatinic acid in 500 parts of water, and make up to 1000 parts with distilled water. Mix the solutions. Use a constant temperature of 100 degrees F. Little by little a solution of 500 parts sodium hydroxide is added, and the whole is brought to boiling; water lost by evaporation being replaced. After the solution is cooled and filtered, the solution becomes green and has a yellow color it possesses and becomes colorless.

This bath is used with a strong current, and its strength is increased by adding 1 part of the amnonium-platinum phosphat precipitate, obtained from the solution of chloroplatinic acid.

Another formula is used by adding to a solution of chloroplatinic acid 1 part of potassium carbonate to form a clear solution. This is used in making strong plating solutions. A more powerful solution is this, or required, or else a black powder will be deposited. The plating is done on a plate of platinum, and platinum is always plated on first.

Sulfide plating is also used.

A: So-called steel electrotypes are used quite frequently in this country. They are made by depositing a layer of a steel electrotypes from a steel electrolyte on a copper plate. A coating of iron is deposited on a copper electrotypes by the enameled copper in order to harden the surface. The iron is then deposited on a copper plate, and the powder is then baked and rubbed with benzine. To preserve them from rusting, they are covered with a coat of shellac or with an oil or beeswax.

Electrical Heat for Garage

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Nikola Tesla's Present Activities

(W19) Victor H. Teige, Hackensack, New Jersey, asks the following questions:

Q: What is Nikola Tesla doing at the present time? Is he employed and how does he maintain his various offices and research laboratories in New York City, where he is now living?

A: It has been computed that about 600,000,000 R.T.U. heat units will be required, including heating and cooling of the buildings, windows and walls, and the roof; as a boiler horsepower will give about 3,500 R.T.U. per hour, about 18 boiler horsepower will be necessary to steam heat this garage to suit your requirements. If electric heaters are employed, the cost for kilowatts of electrical energy will be required.

One of the recently marketed inventions of Dr. Tesla is the alternating current motor, perhaps, is his new speed and revolution indicator. His work on the principles of space is an application of the领先 watchdog manufacturing concerns in America. The company has only two half-disk motors, driven by a shaft connected with the machine under test, and a second disk mounted on opposite side. The shaft is driven at a speed that corresponds to the speed of the disk, driven by a shaft connected with the machine under test.
Did YOU Ever Dream of Being a Great Canal Builder—like Goethals?

The greatest men are the greatest dreamers. In youth they look years ahead and picture themselves doing the big things that later thrill the admiring world. As boys—they imagine themselves directing the boring of gigantic tunnels underneath towering mountains. They see mammoth transoceanic ships—like floating castles—Leviathans—all creatures of their own creative brain. They see great ship canals—channeling through trackless jungles in spite of a thousand obstacles that had threatened failure.

All this they see in their youthful dreams. But at last it comes—the great day in which the dream comes true.

What Happened Between Dream and Success?

Did these men sit back and dream idly? No. No. They had the good judgment to know they must prepare themselves for their great chance. They began by determinedly making the first step early in life.

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But in their day no DRAFTING course existed that was not packed with theory and mathematical difficulties. It's different now. Today the Columbia School of Drafting can teach you DRAFTING in from six to ten months in your spare time at home. Think of it—only six to ten months on a study that can start you to success equal to that of Goethals. You may be the next Goethals. Destiny is always calling for such men, but remember this—destiny calls only men who are prepared.

Columbia Course Is Easy

Hundreds of Columbia graduates are already started, equipped with the first essential of DRAFTING success—expert draftsmanship. These men, without special education, became DRAFTING experts in less than a year and are today employed at salaries ranging from $35 to $100 a Week.

At one time during the construction of the Panama Canal it was thought that the project would have to be abandoned because of landslides in the Cut. But Goethals, our greatest engineering genius, stuck to his task and WON.

From $35 to $100 A Week

One of them recently planned and laid out the famous Arlington Memorial Amphitheatre at Washington. Others have done equally well. You can do just as well. When you start the course, we'll send you a complete MECHANICAL DRAWING outfit and a professional set of highest grade DRAFTING instruments to use throughout the course and after you become a professional draftsman.

Help in Finding a Job

We put behind you our Students Employment Bureau in helping you secure a position that will pay well. We have helped hundreds of our graduates and are regularly receiving requests for more of our trained draftsmen from some of the country's biggest industrial plants.

Even though Destiny may never call upon you to do the work of a Goethals—yet substantial advancement is always open to you. As you forge ahead from Draftsman to Chief Draftsman and from that to Engineer, to Production Engineer and so on—you keep going on up the salary ladder until your income nets you $15,000 a year and over. There's really no limit to what you can accomplish in this profession. The start is the thing that counts.

Don't say you haven't the education or the talent or the time. You have everything you need—as much and probably more than many of our most successful graduates had. Show that you have the determination to start on your career today by mailing the attached coupon right now.

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Name______________________
Address____________________
City______________________State____________________

John Hays Hammond—Steinmetz—McAdoo—all learned DRAFTING early in their careers.
Wood Carving With a Pocket-Knife

By G. E. WILLIAMSON

(Continued from page 1022)

and each one measuring about 3 inches in length. Locate and mark the center on each stick by a line all around; now cut out a center notch 13/16 inch long until you have exactly 1/4 inch of wood left. Cut three sticks like this and label them No. 1.

Take two of the sticks and cut another piece out on one side and directly in the center, 3/4 inch wide, leaving the 1/4 inch as in the other cut. The sixth piece is left uncut. In putting the puzzle together you will find some of the pieces will require a little extra fitting, but they should not be too loose.

The Three Wooden Strips Used in Making the Solomon's Knot Puzzle. The Assembly of This Clever Joint is Seen By Studying the Drawings and Successive Stages Here Given.

As the illustration shows, to build up this puzzle first take two No. 1's, put them together so that the notches meet, hold between the thumb and first finger of the left hand, and with the right work the third number one stick into place with the notch up. Roll the thumb and finger slightly, which will bring the first pair parallel; now put the two No. 2's in place with small notch up, and, if properly fitted and adjusted, stick No. 3 will go into place easily.

No. 1—Model Windmill

This is a model windmill made of 72 pieces of basswood 1/4-inch square. Base 5 inches square, top of tower 3/4 inches height 12 inches, diameter of wheel 5 inches, length of fan and shaft 7 1/2 inches. All joints in the tower are exactly like the joints in the Solomon's knot puzzle. The outside corner posts lock the bottom, the posts being locked by the platform, which are in turn locked by the upright standard that carries the mill, the wheel of 16 pieces being locked together and also on the shaft by the short center piece running from the standard out thru the wheel, and cannot be removed until the fan has been taken off, the long upright piece at the back end being the only piece that can be taken out to start with. The mill contains no nails, screws, strings or glue, yet the

No. 2—Wooden Chain

Next comes a chain made from a single piece of basswood, 2-inch square, length 32 inches. After getting the wood round and smooth, draw 16 lines the whole length of the stick, spaced equally all the way around, then draw another line parallel with each of them, the distance between them being the amount of wood to be left in the link. Next draw lines straight around the wood, one inch apart, the full length; this can be done by taking a piece of stiff paper with a straight edge and wrapping around so that the edges

(Continued on page 1054)
Listen to the Voice of Experience!

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ADMIRATION

always follows the robust, graceful and alert man. Pity trails behind the weakling, because his failing energy is not sufficient to carry him over the obstacles that obstruct every man's path to progress. Do you belong to the REAL MAN set—the dominant class of successful people; or are you among the sickly, flat-chested, weak-legged, nervous and always ailing—the insignificant class, that, instead of living just merely manage to breathe and exist?

NO MATTER what your position, environment, physical and mental development now is, you are being given a wonderful chance to get more satisfaction out of yourself and the world by this

Amazing Opportunity for Greater Strength

offered by Prof. Matysek, the man who, years ago, having resolved to become healthy and highly developed, has experimented and trained himself until he is ranked among the strongest men in the world. He, in order to accomplish this, has been secretly practicing on this

“Body Beautiful” Maker

Thousands of men who have tested this “Muscle Control Course” say it is the SUREST and QUickest “MUSCLE BUILDING OVERNIGHT.” MAKES EXERCISES THAT PRODUCE REALLY ATHLETIC MEN WITH GRACEFUL OUTLINES FULL OF PHYSICAL PLEASURES.

These Muscle Control exercises are the CHIEF SECRET of why I am growing, despite my age, day after day, stronger and better developed, as well. Do you blame me for offering to acquaint you with such progress making exercises that will bring forth the maximum results you are after and NOW are within your easy reach?

Matysek’s Muscle Control Course Consists of

Two hand-written charts containing twenty-one beautifully produced pictures showing every detail as to how to perform the exercises themselves. The instructions are “straight from the shoulder,” such as only an expert who went through this pain big enough to make the physically produce. The following is but a part of what is embraced in the course.

How To—quickly make response to the inactive bowels.
How To—easily correct the rounded shoulders.
How To—expel bumbling gas out of the stomach.
How To—promptly curve away the sinew of the body.
How To—strengthen the nervous and internal organs.
How To—control every muscle of your body.
How To—store up energy for feats of strength.
How To—completely relax and contract.
How To—breathe effectively.
How To—arouse your inactive nerves.
How To—create better blood circulation.
How To—increase your chest circumference.
How To—learn the famous shoulder blade control.
How To—thicken the shoulders.
How To—make your shoulders supple.
How To—broaden your back.
How To—depress the abdominal muscles and waist.
How To—control the chest muscles, biceps, triceps, thighs, calves and all other muscles.
How To—assist in training the abdominal regions to be immune from rupture.
How To—master correct posture.
How To—overcome impotency

and many other vital matters you need every day, too numerous to mention.

Let My Muscle Control Exercises Mold Muscle on You Quickly and Solidly

Only ten minutes a day, in the privacy of your own room, solves any case. From my own experience, as well as the very large number of pupils I have successfully aided, I know that in less than five days your efforts will be realized to a most surprising extent. If you are already training on some good "system" these Muscle Control exercises will force your progress to 100% faster. If, however, you do not exercise, then for your own sake and own happiness, start building yourself up into a real man. Do not merely drag on.

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Wood Carving With a Pocket-Knife
(Continued from page 1052)

come in line. Make these lines heavy and
draw others between them just plain
enough to locate the center. Next cut out
the wood in a "V" shaped groove between
what is wanted for the links, cut about ¼
inch deep, leaving about 1 inch on each
end solid.

Cut a "V" shaped notch straight to-
towards the center on the first heavy line
away from the edge. Then inch by ¼ inch
decent, turn the stick and do the same exactly
opposite, having 7 ribs between each one.
Now round the sides of your notches, beginning at the light lines drawn
last. Now take the next rib on the right
and notch the same on the second heavy
line, turn over and repeat. Take the third
rib and cut on the third line and continue
to the end.

Here is where you begin cutting out
the wood not wanted in the links and
about the only directions of any value
that can be given is to keep your knife
sharp and your patience well curbed.

No. 3—Wooden Chain From March

In making the chain out of the match,
the knife was so thin and sharp that it
would cut entirely thru the links before
the slightest hint of a blade could be felt
and after many failures it was necessary
to use a magnifying glass to succeed.

No. 4

These are three cages cut from a piece
of basswood 3½ inches in diameter and
6½ long, diameter of ball ¼ inches. The
first job is to work a square block into
a perfect sphere with enough wood on the
ends for the handles, then lay off the
center rib ½ inch wide, as it is all cross-
grain, then lay out the four ribs running
lengthwise. Work out the three cor-
ered pieces to the depth required, leaving
the ribs the same thickness all the way
in. Finish the ball before going any farther
with the cages. Draw the guide lines
in all of the openings at the exact place
where you wish to separate the cages. Here is where the needle-pointed blade
and an unlimited supply of patience is needed.

Make the cut close around the small stem,
just deep enough to connect with a cut
between the inside cage and the second
one just deep enough to meet it. The
other end is cut in the form of a cone
and if your blade is less than 2½ inches
long you should make a longer blade out of a
dress stay. The next cut is far easier:
on the small end cut the outer circle to
meet the cut between the outside cage
and the other end cut is close around the stem.

No. 5—Wooden Goblet

This one piece of basswood 3
inch and 6 inches high, hol-
left, with four loose rings
other passing thru the
ving out the stem of the
inch square cross-section
for the rings.

7—Bottle Puzzles

7 show respectively a glass beads, strung
through a wooden
first exhibition shows
opened, suspended
wooden arm-elongated stopper.
the details with
the little booklet, publishing here
in page 1056)
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Wood Carving With a Pocket-Knife
(Continued from page 1054)

No. 8—A Model Barrel
This barrel is composed of 16 staves, 4 hoops, each fastened on with 4 nails, made of brass which were completed and assembled out of the bottle to make sure that it would fit properly, and all nails driven in their proper places, first insert the staves and hoops, and get it all straightened out, the two larger ones having three threads tied to each of them, so that they can be removed from the bottle level and at the right height. Tools for placing the staves are two wires, one with a fine sharp point, with another pointed at the end of a steel just enough to hold while it is being lowered, the other wire to push it off, allowing the nail to hook over the under side of the hoop, thus; and last the hoop should be one without any nails; after the staves are all in place, with hooked wires place the second hoop on top end and care- fully push it tight against the nails that will be above it when finished (the nails for the two bottom hoops and the top one can be in place before putting the staves in the bottle, each long enough to project inside of the bottle ¾ inch). The hoops are pushed back from the inside, to get the second and fourth hoops in place. Drive the nails in by means of brass hammer and against the staves.

The bottom head is forced in from the inside. Each head is made of four pieces, the fourth piece in each head being forced in so that it will be forced in tightly. It will require several different kinds of crooked wires and hooks to do the job.

No. 9—A Hard Puzzle Within a Bottle
This is a Japanese puzzle of 21 pieces bought at a toy store. After learning to put the puzzle together with the hands, take two pointed wires long enough to reach the bottom of the bottle and learn to put it together with the wires. When you can do that you can put it into the bottle. The sharp end of the star is marked like flooring and have holes drilled thru them sideways near the middle, the inside hole is ½ inch in diameter in the center, make a stopper with a ½ inch hole in the lower end, then having a head about 1 inch in diameter. Put the star points on a thread like beads and juggle them into position a few times, then drop them into the bottle. Tie a thread to the small end of the plug and drop it in and get your points worked into position and tie the two together as tightly as possible, by means of wire tools. Thread the loose end of the thread attached to the plug, thru the stopper, place the stopper and gently pull the plug into place, where it will hold the star if the work has been properly fitted. Whistle a match stick thru a long slim plug that will fit the hole where the thread comes out, put a little glue on it and force it in and cut off the thread.

No. 10—Clever Fan in a Flask
The illustration herewith shows how a water fan is whittled from one solid piece of wood, and then placed inside a small glass bottle. The fan is whittled and the leaves cut, and is as separate as the first step. The fan is then closed and put inside the bottle, where it is opened by means of two wires hammered flat and split for about ½ inch like fork tines.
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[Carson, Pirie, Scott advertisement]
The Ninth Spool

By CHARLES S. WOLFE

(Continued from page 1012)

quite awhile ago he got onto the fact that Mrs. Alvarez was unduly intimate with this Smithson chap. He took measures—
strenuous ones—to end the bust-up. But then when he's putting himself on the back over the thorough job he's made of it, comes the explosion.

Fenner turned to Alvarez, who was showing signs of another outburst. "Keep your head, please," he warned, soothingly. "How long has it been since you suspected your wife of improper conduct?"

Alvarez made a manful effort for control. "Two months, maybe," he said, brokenly, "Ten weeks. About that much time. I find, by accident, a letter. It is signed with the name of Smithson. I say nothing. I watch. I see them meet. They kiss," his fists clenched and unclenched spasmodically, "I follow this man to his lodgings. I take the pistols. I go to him and ask that he fight."

"Yes?" Fenner queried interestingly, as the swarthy little man paused, "And what happened?"

Alvarez choked. His face convulsed with rage, and I feared we were about to witness another outpouring. "He is no gentleman!" he cried, and tears of rage and humiliation sprang into his eyes, "He is how you say it—a big brute. He's take both pistols by force from my hands. He's spank me!"

I turned my head. Davidson leaned back in his chair, stared hard at the ceiling, and blew a big cloud of smoke aloft. Fenner gave no sign of amusement.

His sympathetic murmur carried the little man on. "For my name—for my honor—I make no complaint to the police. I tell this pig if I find him again in my house, I will shoot him. I go home. I tell my wife she is discover. She is very—very obstinate. My servant I can trust. Together we stop all her mail till I can read it. He follows wherever she go when I am away. There is no more between us. But this afternoon, I go to the man the knock-out drops. He sleep. She is gone!"

"So is the money," Davidson murmured, "For the money," Alvarez screamed. "I care not one damn! It is her! I want her back. You will get her for me."

He looked appealingly around the group. "If it's possible under high Heaven," said Davidson, grimly, "We will get her back!"

Alvarez caught the significance of the Chief's remark. "Not for prison!" he screamed, "Not!"

Fenner stemmed the rising tide swiftly. "You are talking to the most merciless Chief of Police in these United States, Mr. Alvarez," he said, laughing. "He spends half his time catching criminals and the other half getting them out of their troubles. I suggest that you take us over to your residence and give us a chance to pick up any loose ends that the sehorita may have left dangling."

The Chief's car whisked us to no time to Alvarez's desolated abode. On the little South American produced a bundle of letters which he said was mail received by his wife, since the discovery of her intrigue. Swiftly Fenner subjected each to heat, an effort that proved fruitless. From his pockets he produced several bottles, bathing the suspected paper in one solution after another. As the last letter came dripping from the last bath, Davidson grunted his disappointment. "No sympathetic inks, eh?" he growled.
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While he was running us around to our diggings, leaving Alvarez on his violated hearth, the Chief propounded a theory to account for the presence of the spools of wire. "Know what I think she wanted with 'em?" he asked, "A ladder! It's my opinion that before she got the idea of drilling the secrets, she had intended to twist up strong lines out of wire and make a wire ladder. See? She could have slid from her window while Alvarez's man was watching the regular paths. Then she got the dope some place, and didn't need the wire."

"You never can tell," Fenner commented, non-committally.

"No," the Chief replied. "And it don't matter what she wanted with it anyway. It don't help to locate her. Just the same, I think that was the big idea."

Later, while slumbering in our room, I heard a chuckle from the bed across the room in the darkness. "What's the joke?"

I demanded, listlessly.

"It was a mirth-wrecked, out of the blackness. "I was thinking of Davidson's wire ladder," he chucked, "Great Heaven!"

"Sounds reasonable to me," I retorted. "She never intended to use all that wire on pictures."

"But there was no guitar!" Fenner protested.

"No guitar?" I echoed, blankly. "Why should there be?"

"That sort of thing is never done without a guitar strumming as the lady descends from her window. She explained it all to me, mockingly patient. "Davidson has been patronizing the movies."

The following forenoon found me exceedingly busy. Remembering the appointment at three, I hung doggedly to my task straight thru the lunch hour, dashing on thru to the coroner's office ahead of time as that time as a consequence. To my amazement I found Fenner seated in a deep arm chair, clad in a dressing gown. It's pattern, for lack of stronger adjectives, I must call atrocious. He had evidently purchased it for the occasion, for I had never beheld it before. Around his head was neatly wound a turban, contrived from a piece of cloth that was making a noble effort to protrude his robe. Before him on the table was a large crystal gaz ing ball. Cross legged, he regarded me with the utmost gravity as I entered.

"Fenner," I began, taking in the details of the bizarre scene dazedly, "What—"

"Do not ask profound, Bill," he said, with cold disapproval, "You beheld Fenner, the seer."

"What—"

I began again, to be interrupted.

"I am seeing Davidson's wire ladder and raising him one," he grinned. That gem deserved repetition.

Before I could question more, Fenner's quickening face and the battle of the knox announced our illness. I had the satisfaction of seeing the open-mouthed amazement of Davidson and the bewilderment of Alvarez.

The Seer—makes the trance?" the little South American stammered.

"I do not make the trance," denied Joe, with the greater gravity. Of fathom the mysteries of the sphere. Let no one disturb the conditions. He gazed with great directness at the fidgeting Chief. I had made up my mind to the police head mur mered, "Go on with the show. I'll be good."

Fenner gazed fixedly at the ball. So did all the rest of us. I saw no change of any kind in its surface, but presently Fen ner began to speak, dreamily.

"You will find the Seer's wife," he in tended, monotonously, "in the town of Murray, twenty miles south of this city. You will go to number 509 Water Street, where..."

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you will find those that you seek. But you will find her not as Señorita Alvarez, nor yet as Mrs. Smithsonian. She will be called Mrs. Patton."

Alvarez was ready to burst with excited questions, but Davidson was already pushing him before him toward the door. "Go," he rumbled to the little man. "It's up to us now. We'll see her there if she says so. That sphere nonsense has nothing to do with it. I'll find out later how he picked up the scent."

The roar of his racing engine told of Davidson's hasty departure. I turned to Fenner, who had thrown off his tunic and was only lighting a cigarette. "Cards on the table, please," I demanded, bluntly.

"It was the ninth spool that gave me city, street, and number," he said, slowly. He had wandered over to the wireless table, and had rearranged the nine spools of wire, taken from the pocket of his dressing gown.

"Be it known to all and sundry," he continued, with his fantastic grin in which he often affected, "Be it shouted from the house tops and announced from the church spires that this and Smithsonian was not born on a raft. Whatever may be his shortcomings morally, he is no untutored savage. Not be a damned sight!"

"You keep your mouth shut," I urged impatiently. "You will observe," he went on, unhurriedly, "that I have numbered them from one to nine, wisely. It is as easy to indicate his markings on the edges of the spools. That is the order, I believe, in which they should be considered. Now, Smithsonian was flawless. He resolved from all blame in bringing about their downfall. Señorita Alvarez showed the kid and pulled the boner. She should have taken with her either the spools or the dry cells. Without either the chances are, there would have gone by chance."

"It struck me as odd that she should buy a vibrator, as Alvarez called the contraption, that required dry cells when she had the house curfew at hand. It sounded still more strange that a massage outfit should have two little lights, to again quote his Excl. It is true, they might have been Tungsten rectifiers, but—if so, why the batteries?"

"Then I picked up a spool, you may recall, and started to spin it up. And there I felt that I had the Señorita by the heels, but I kept up the search to hoodwink Davidson, a weakness that I have. Look here!"

He picked up a spool, found the free end, and passed it to me. Feeling a thickness at its end, I examined it closely and found—a tiny loop, very neatly made. I stared at it blankly.

"Looks suspicious," I ventured. "But what's it for?"

"Let me show you," he cooed. Swiftly he cut out of our set the two bulbs and transformer that comprised the one step amplifier. Quickly he connected the amplifier to the spinning boner. Then diving under the table, he rummaged amid discarded apparatus, to emerge suddenly with a large object in his hands. He laid it before me triumphantly. "Remember building that?" he demanded.

"Good God!" I cried, in stunned enlightenment. "You mean to say you are actually building that particular piece of apparatus."

Without comment he picked up the spool, numbered one, and placed it on the spindle. Delicately he threaded the wire into the guides, dropping the little loop over the hook on the empty spool of the machine. With a flick of his finger he started the little motor and the wire fed evenly off of it and its containing spool. From the horn came the strong, vibrant voice of a man. And what an outpouring of endearing terms, what a wealth of romance and feeling
came to us on that pleading voice. Dum-bounded, I listened.

"The missing clue," said Fenner, calmly, as the ghostly voice pleaded on. "The unsuspected love letters of the mail-barren Señorita Alvarez. Right under her cock-sure lord and master's nose, Bill, and your two little lights become the obilging vacuum valves! Full instructions, counsels, warnings, the countless details of the flight together with the rendezvous on the ninth spool. The stone gone, Bill! In Hoc Signo, slip one over!"

I stared. The voice ran monotonously on as the wire passed evenly between the metal poles. Fenner, almost, ran a hand thru his mop of hair, thrust both hands deep into the pockets of his robe and stared out of the window.

"A ladder of wire!" he said, softly, "Ye Gods!"

### Snow Crystals

(Continued from page 1021)

common, but it is seldom that they are regular in their aggregation, as are the snowflakes.

The Weather Bureau of the United States Government has taken many photos of snowflakes, and it is said that every great snowstorm has supplied five to thirty-four new crystals. Attempts have even been made by the Weather Bureau to determine the conditions of a storm in which the formation of any particular variety of crystals is brought about.

Mr. Wilson Alwyn Bentley, well known meteorologist of Jericho, Vt., has accumulated a world famous collection of snow, frost and ice crystal photographs, and it would certainly seem as if the makers of lace and ornamental fabrics could obtain many valuable hints from the 4,000 or more photographs to guide them in making their designs. A garnet, a rock-crystal, calcite and fluorite and many other minerals may supply absolutely symmetrical and beautiful crystals, sometimes colored, sometimes colorless, and perfectly transparent — even curiously enough, to the aggregation of many crystals in numberless forms, and each group perfectly symmetrical, we have to go to the short-lived, almost microscopic snowflake.

### SUN DIAL SHADOW MOVES BACKWARD

In the twelfth chapter of II Kings, at the eleventh verse, we read that "Isaiah the prophet cried unto the Lord, and He brought him up from where they had cast him, and he came up to the degrees backward, by which it had gone down in the dial of Ahaz."

It is a curious fact, first pointed out by Nomez, the famous cosmographer and mathematician of the sixteenth century, that generally known that by tilting a sun dial through the proper angle the shadows, at certain periods of the year, can be made, for a short time, to move backwards. This was used by the French philosophers as a rationalistic explanation of the miracle which is related at the opening of this article.

Contributed by Wm. R. Reincke.
The Amateur Magician
By JOSEPH H. KRAUS
(Continued from page 1039)
down, turn over the card at the number thought of, thus." He picked up the cards preserving their same order, saying, "I have thought of number fourteen, fifteen. I turned them over and note that the deuce of diamonds is the fifteen of cards.
"Do you follow me?" I nodded in assent. "You do likewise," he continued. "Choose any card and remember its name and position in the deck. Turn it face upward, and start to examine the cards, transferring those with backs face downward to the right hand.
He sat quite still for a moment, then turned one over at random and said to me, "This is the ace of hearts." He laid it face upward on the table. "You may draw a card from the deck and I will put it in my hat."
I turned a card, the ace of clubs. He placed it in his hat and said, "You have a card in your hand which is the same as mine."
I took the card and laid it on the table. "It is the ace of hearts," he said, "and the card in your hat."
He turned over the card in his hat and it was the ace of hearts.
"You are a wonderful magician," I said, "but how do you do it?"
"It is easy," he replied, "but it requires practice."

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Arthritis
Sleeplessness
Habitual Sleepers
Menstrual Discomfort
Nose Foulness
Malaria
Great Bust

Name: __________________________
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Occupation: ____________________
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Measuring the Velocity of Bullets
(Continued from page 1039)

to the axis of the shaft, and it is aimed at a point on the front disc two or three inches from the circumference, and fired. If the two discs were at rest, the bullet would penetrate both at the same degree-interval. With the discs in rapid rotation, the second one will turn an appreciable distance while the bullet is traveling over the intervening space.

Assume, for example, that the discs are ten feet apart. The course more is traveling at the rate of ten revolutions per second, and that the bullet has a velocity of 3,000 feet per second. The bullet will, therefore, consume 1/300 second in traveling the ten feet between the discs. They are rotating at the rate of 3600° (360°/10) per second, therefore in 1/300 second they will rotate 3600°/300, or 12°. That is, the perforation made by the bullet in the first disc will be 12° in advance of that in the second disc. If the hole in the nearer disc is, say 27° from the 0° line, angular measurement, the hole in the further disc will be 39° from the 0° line.

Conversely, assume that after firing a bullet with unknown velocity, the two holes are found to be 16° apart; find the velocity of the bullet. Since the discs are rotating at the rate of 3600° per second, and are 10 feet apart, the bullet is traveling at the rate of 10 feet in 16/3600 second, which, by a very simple arithmetical computation, gives 2625 feet per second as the velocity of the bullet. In fact, for any given speed of rotation, numerical tables could be constructed, showing the actual velocity of a bullet for all angular distances between the perforations. Using the rotational velocity of 10 per second which we have assumed, 18°=2000 feet per second, 20°=1800 feet, 22°=1638 feet, etc.

No radii are really essential on the discs except the 0° line, which is used both as a guide for setting the discs and as the starting-point for measuring the angular divergence of the perforations made by the bullets. One pair of discs can be used for a number of shots, just as one target is used for repeated shots, until it becomes so full of holes that it is no longer serviceable.

Also, it will readily be seen that the distance between the discs and their speed of rotation, within certain limits, need not be of any fixed numerical value, so long as these two factors are known.

The device can be used at almost any distance within which it can be hit, but beyond 150 or 200 yards larger discs would be necessary unless an unusually expert marksman be employed to do the firing, and since the velocity of bullets at different distances from the firing point can be determined, the device is a valuable aid in determining experimentally the retarding effect of atmospheric resistance upon different types and weights of bullets.

It will be seen that it is not necessary for the bullet to penetrate the discs at any fixed distance from the circumference, there being, in a three-foot disc, about one foot vertical range in which the bullet can safely be placed.

For extreme accuracy, the discs are set with a plumb line and the position of the rifle fixed by means of a surveyor’s theodolite.—By Cleve Hallenbeck.

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Popular Astronomy
By ISABEL M. LEWIS, M. A.
(Continued from page 1011)

Lion light years since it first became a star.

It is one of the most remarkable facts capturing the past history of the solar system that neither the sun nor any of the planets has met with any serious catastrophe since the earliest geological period of a billion years ago, and possibly for many billion years prior to that time, though of this we cannot be so certain. In the past billion years we know that there has been no serious change in the amount of light and heat given forth by the sun and the collisions of sun or planets with any other body in the universe of sufficient size to interfere with our journey or with the development of primitive life. Some astronomers are inclined to attribute the glacial epochs and intervening tropical periods of the earth to encounters of our solar system with stray whirls of nebulae that are known to exist in the Milky Way. Such an encounter with a rare resisting medium might result in a radical change in the solar system and the planets. It is possible that the sun’s radiations from time to time, and this might account for alternately warm and cold periods that have existed in the past and which may occur again in the future.

It is difficult for us to realize how extremely small a unit our solar system is in the universe to which it belongs and how slight are the chances that it will collide with another similar system. It may be helpful in this connection to illustrate the size and importance of our solar system by adopting a reduced scale of measurement that will permit a comparison to be made with familiar objects. Let us take the distance from the earth to the sun as equal to one inch. With this scale of measurement the extent of the solar system across the diameter of Neptune’s orbit is five feet. The sun on this scale would be about one-hundredth of an inch in diameter. A super-giant such as Betelgeuse would be about three feet high. The light year, which is sixty-three thousand times the distance from the earth to the sun, would be almost exactly one mile. In our reduced sidereal system, then, light would travel one mile in a year while the solar system would travel four-fifths of one mile in a year. Now it is known that within a radius of the earth of about sixteen light years there are nineteen stars. So within sixteen miles’ radius of our five-foot solar system we would place nineteen stars. Of course we cannot say that there are no more stars than within this distance of the sun, for we do not know the proportion of dark stars in the heavens, so there may be a few additional faint stars within this radius that have escaped observation, but they cannot be many in number. The nearest star, Alpha Centauri, four and a half light years from the earth, would be four and a third miles from our five-foot solar system. When we stop to consider this, we see that this reduced scale the stars would be represented as crowding along, we might say, at the rate in no less than 100 times a year in various direc-

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More than forty years ago, when the telephone was still in its experimental stage, with but a few wires strung around Boston, the men back of the undertaking foresaw a universal system of communication that would have its influence upon all phases of our social and commercial life.

They had a plan of organization capable of expansion to meet the growth they foresaw; and their wisdom is borne out by the fact that plan which they established were numbered by dozens is efficient now when telephones are numbered by millions.

This foresight has advanced the scientific development of the art of telephony to meet the multiplied public requirements. It has provided for funds essential to the construction of plant; for the purchase of the best materials on the most advantageous terms; for the training of employees to insure skilled operators; for the extension of service in anticipation of growth, with the purpose that no need which can be foreseen and met will find the Bell System unprepared.

The foresight of the early pioneers has been developed into a science during the years which have elapsed, so that the planning of future operations has become a function of the Bell System. This is why the people of the United States have the most efficient and most economical telephone service in the world.

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Electric Desk and Auto Clock
(Continued from page 1019)
cell battery. The use of current is so slight as to be practically imperceptible. The battery is guaranteed to run the clock for twelve months.
There is no main spring. A spiral spring pulls B (the arborature) so that D (the driving pawl) drives E (a non-conductor ratchet wheel) in clockwise direction. D (the driving pawl) and F (the holding pawl) press downward on the ratchet wheel E.
When the ratchet wheel turns thru the length of one tooth the holding pawl F drops from the top of the tooth and makes contact (as shown in the drawing) with the driving pawl D, thus connecting the circuit from the battery thru the magnet G.
The magnet G being energized by the connection attracts the armature B, pulling the driving pawl D over the top of the next tooth in the ratchet wheel. D then drops from the top of the tooth, F being held at the top of the tooth and the circuit is broken. The spiral spring A again pulls the armature B, and the process is reversed.
Making and breaking the circuit, with tension spring A, takes less than 1/50th of a second every 45 seconds, this interval giving the proper gear ratio to the watch movement.

The turning of the ratchet wheel E explains also the source of the power shaft which is geared to the center wheel of the watch movement—and thus the running of the clock is made automatic.

ALL-METAL REVERSIBLE AIRPLANE PROPELLER

An all-metal propeller for aircraft, lending itself to a reversal of the blades, has been designed by the Engineering Division of the Air Service of the United States Army at McCook Flying Field, Dayton, Ohio. The mechanical details of this work were executed by a commercial enterprise in Pittsburgh, Pa., where preliminary tests were successful in reducing the weight, which an airplane would carry by landing, from 700 to 280 feet. Subsequent modifications of the new blades, according to claims, will probably enable the distance to be reduced to 100 feet or less once the machine returns to earth.
The blades of this all-metal propeller are built of steel tubing of tapering section and thickness. There is an absence of welding, save to close the extreme tip fitting over the two arms of the hub. The blades are secured in position by use of ball-bearing rollers. The latter, if we are to accept the claims of the designer, considerably reduce the friction of the rotation of the blades about their center axis. An angular development of 45 degrees is made possible by a control lever which extends to the cockpit.

Contributed by S. R. WINTERS.

MODEL SHIP MADE OF STRAW

MODEL ships have been built from tin and wood for many years, but it has remained untried by Mr. N. J. Sar- phine, an artist, of Venice, to build this beautiful model of the former Kaiser in 1870, as the yacht (the wah, on the west coast of Africa), entirely from straw. The photograph shows the model ship, and the dimensions of the vessel measures six feet in length, is eight inches wide, and weighs only 3/4 pounds. The straw ship is valued at $5,000. Great credit is due its builder as we have sel- dom, if ever, seen a model which has more wealth of detail than this one.

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made in the center. With the calipers describe a 2-inch circle and a 1½-inch circle. This piece is now placed with the back to the lathe, the center of the circles being in line with the lathe centers. After securing the block the two-inch circle is turned back five-eighths of an inch and the 1½-inch circle ½ inch. The hole is now drilled 2 inches deep. The piece is now taken from the lathe and the ¾-inch hole drilled in from the end. A plug in the open end, centered and a center placed in the end having a surplus of stock, is now swung again in the lathe, this time between centers. The outside is turned as much as possible, the rest being hand finished. The slot, cut in the end, should just be a slide fit over the flattened sides of the tone arm ball. A hole drilled thru both members takes a pin, which in turn allows the two members a vertical swing. The needle bar is made from any handy parts that are to be found. The small hole in the end of the thin metal shoulder be an exact counterpart of the hole drilled in the diaphragm. These two are now riveted together.

For assembly: The glue is warmed over a water bath and applied when hot to the projection on the sound box. This is placed in the recess in the tone arm and held under pressure until very hard. Where the two rubber rings (or more) are cut to fit in the tone chamber. Enough rubber must be cut to fill the space under slight pressure when the diaphragm and retaining ring are in place, the retaining ring being flush with the outside face of the sound box. Glue is applied to the outer edge of the ring, placed inside with a rubber ring between it and the diaphragm and another rubber back of the diaphragm. Pressure is applied and the whole laid aside to dry.

The needle bar is secured to the sound box by filing the head from a wood screw under the same diameter as the body of the screw. This is now screwed into the sound box on a 45 degree angle from the tone arm, care being taken not to split the edge. The slot is left with the same diameter as the needle bar. The metal strip of the needle bar is dropped into the slot and soldered slightly. By pinning the tone arm into the swing arm, placing the swing arm into the swing stand and putting a pin thru the slot into the body of the swing arm, the assembly is complete.

Motors of so many different types have appeared at different times, that it is unnecessary to describe them. A cabinet may be made to house all the parts if desired, and if care is taken in making all the parts, the reproducer and accessories will add to the appearance. The wood when varnished and stained a natural color, lends a different aspect to the talking machine than is usually connected with this greatest of all entertainments, and adds the decorative touch that seems to be lacking. The tone of the machine is benefited too by this wooden tone member, removing the metallic vibrations and imparting a softness that is unbelievable. Like the violin it improves with age.

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A Binocular Eye-piece for Telescopes

By Dr. Alfred Gradewitz

(Continued from page 1027)

whose new binocular eye-piece is readily screwed on any ordinary telescope in the place of the normal single eye-piece, and enables both eyes to be used for astronomical observation.

The attachment, as represented in Fig. 2, mainly comprises two sets of inverting prisms, arranged beside one another. The amount of light generating the telescopic picture is, in the interior of the front set, on a half-transparent layer subdivided into two equal halves, so controlled that the telescope is used by each eye only with half the available luminous intensity. The luminous sensation forming in the observer's mind, truth to say, is by no means the sum of the individual sensations produced on looking through each half of the double eye-piece, but the luminous intensity, as compared with a single eye-piece instrument, is thus reduced by about 50 per cent. This loss is not at all very noticeable, the loss of luminous intensity, in the astronomical scale, only corresponding to 5 class of magnitude. While, for example, the 300 mm. refractor at the Mt. Wilson Observatory with a single eye-piece enables stars of the 13th magnitude to be really seen, the use of the binocular eye-piece reduces visibility to the 12th class.

The two sets of prisms are so arranged as to be readily rotated with regard to one another, the observer is able, as in the case of an ordinary prism field-glass, to adjust the instrument to his individual eye-differences.

In order to vary the magnification, astronomical eye-pieces of various focal distances (25-5 mms.) can be used in connection with a given instrument. In the case of the 300 mm. refractor just referred to, the objective of which has a focal distance of 5 meters, there can thus be made binocular observations with a magnification of 200 to 1,000 diameters. These medium and high magnifications, however, are just those for which the binocular eye-piece is best suited.

In fact, the usefulness of double-eye observation is bound to be felt, especially in connection with the observation of objects possessing considerable luminous intensity, such as the sun, moon and planets. In the case of observation of such objects, it is of the greatest importance that the observer should be able to contemplate a given object for as long a period and with as little eye fatigue as possible, and these conditions, thanks to the binocular eye-piece, are developed in every respect. Observations which in the case of single eye-piece instruments would become a torture, are an actual pleasure with the binocular eye-piece, and the case with which even the minutest details on the interiors of the planets or the moon are detected by binocular contemplation is bound to impress every thoughtful observer.

An additional advantage of the double eye-piece is that the prism sets will re-erect the inverted images of astronomical telescopes, so that they can now be used for terrestrial observations, in which connection they will even afford special advantages.

By combining the binocular eye-piece with the objective fitting represented in Fig. 3, a hand telescope is obtained which is required only reasonably small individual eye-pieces, corresponding to various magnifications in order to be advantageously used at distances as short as say, 1-2 meter, in observing insects or the like actually acting as a microscope.
Shall I Take Up Engineering?

By H. WINFIELD SECOR

(Continued from page 1023)

career, and after a year or a few years in this class of work "out in the field," as it is called, the civil engineer is frequently called into consultation with regard to design and development work in connection with water and waste systems, power plant location and a thousand and one other things of allied interest and importance.

The scope of the civil engineer's activities is, therefore, seen to be a large one, and one of the finest things about this profession is that it wonderfully broadens the mind, and if the student has the proper aptitude for this course there is a very brilliant future waiting for him. Civil engineers receive anywhere from $2,500 to $5,000 a year while they are assimilating the practical elements of their profession after leaving college, and beyond the first five years there is no limit to what the "C.E." may accomplish, depending of course in great part upon his interest in his work and the business or professional associations, which he may be able to establish.

Mining Engineer

The mining engineer is one of those professions not so very well known, and, like many other unknown things in life, we often find it the most precious when fully understood. Wonderful opportunities await the hard-thinking mining engineer, particularly in the western part of our country, where there are many gold, silver and copper deposits still to be discovered and dug from Mother Earth. Mining engineers have a fine opportunity to become interested financially in mine development, and several well-known mining engineers have grown wealthy from a very small beginning, simply by combining their engineering wisdom and foresight with a little of that gambling spirit with which every successful businessman must have. It would appear from the present aspects of the situation that this is one of the most desirable of the engineering professions to follow. The Mining Engineer, especially that man who so perfectly exercises his education as to make himself invaluable, is in demand everywhere—not only in his own country, but in other countries. He may be sent to other countries also by his home concern, and in any event he has exceptional opportunities to invest in mining properties which may, in his later days, make him independently wealthy.

The mining engineer covers in his course of study many branches of engineering, including subjects in civil, chemical, electrical and mechanical techniques. He will need all of these at one time or another in practising his profession. He may have to sink shafts far into the earth; elevators, electrically or steam operated, have to be designed and installed; electrical power lines and generating plants may have to be designed and installed in mountainous and unpopulated sections, where his own resources and initiative will have to be depended upon. Then again he may have to make tests of mine gases and deposits, and here chemistry and metallurgy come into play, as well as geology or the study of the earth's strata.

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The Chemical Engineer.

The chemical engineer is what we might call a glorified chemist. A good chemical engineer today is capable of obtaining a very good salary, especially if he has the faculty of unearthing new chemical processes or products. As may be surmised, the chemical engineer finds his course of study all branches of chemistry in a very throry manner, and also many allied and inter-related subjects, such as metalurgy, dyeing, the manufacture of perfumes, medicines, and hundreds of other preparations. The chemical engineer is the one who "gives" in all such plants as the great dye works, glass and pottery works, rubber factories, paint manufactories, gas plants, oil companies (with respect to the different grades of oils and greases manufactured), soap factories, etc. Some of the best paid chemical men today are chemical engineers, and it is one of the coming and most promising fields of engineering.

Radio Engineering.

The science of radio engineering is not so very old, and there are, roughly speaking, but few educational institutions which give a specialized course in this new branch of engineering. First and foremost, the man who wants to become a good radio engineer should be an electrical engineer, and then follow this with a post graduate course covering radio technique.

Radio communication is growing at a rapid rate with the establishing of an ever-increasing number of high powered radio stations in different parts of the world, and one of the latest developments, which seems to bid fair to open up a new departure in the radio field in general, is the wireless telephone.

Up to a few years ago the experts could not accomplish a great deal with the telephone, but with the advent of the vacuum tubes, which are now designed to transform quantities as great as 0.5 kilowatt or more of alternating current power at 60 cycles, into radio-frequency power, suitable for transmitting the human voice across many miles of space, a brand new era has been ushered in.

The radio profession is without a doubt gradually swinging into step with the older branches of engineering and beginning to find its stride. At the present time there is a want of trained personnel, in fact, for first-class radio-engineers, as there is a tremendous amount of new apparatus as well as systems to be worked out and perfected. It has been said that with the present perfection of tuning apparatus, as employed at the world's greatest wireless station—"Radio Central"—on Long Island, stations can operate within 0.5 of 1 per cent difference of wave length. This sounds wonderful and is true, compared to the difference in wave lengths necessary between two nearby stations operating simultaneously even 10 years ago, but think of tomorrow—when not only a dozen or a few hundred stations will want to operate simultaneously, but thousands and tens of thousands of them! Here indeed is locked up one of the great secrets yet to be solved by the coming geniuses in the radio engineering profession. Another highlight on the opportunities for "R.E.'s" lies in the fact that the radio companies are slowly but surely expanding and erecting more stations, so that there is plenty of work to be done. There now only at the very threshold of the vast realm of Radio Engineering, as we shall know it tomorrow.
Bottle Opener

(555) Wm. F. Mitchell, Evanston, Ill., desires patents as to whether or not he can employ a bottle opener and bracket used by a certain wine dealer. Many changes would be made on a bottle fire extinguisher of his own design, particularly in the mechanism. The patents or the extinguisher made by the older concern is stamped "patent." 

A. There is only one way to determine whether or not you can make the particular convenience you have requested information on, and that is to have a patent search made. There are many styles of brackets which could be used, however, and which would not come under patents allowed to the other concern, regardless of how broad these claims may be. Almost any form of bottle opener which could be made in solid form could be used, or a spring that would hold a wire fastened to it so that a pull upon the bottle disengages the cork would answer the same purpose. A valve system would be to employ a sort of knife cutter or cutting corkscrew so that the raising of the bottle fire extinguisher would force the corkscrew thru a paraffin seal on top of the extinguisher. We would advise that you use some other style. 

Washing Machine

(556) Carl Pitz, New Holstein, Wia., has patented a novel wash tub washing machine, and asks whether he should drop the idea entirely. 

A. We certainly think that your invention is novel enough to be placed upon the market, and that it would be practical now that you have secured your patent to drop the matter. We would advise you to work upon it and try to get it placed.

Household Device

(557) A. D. A., of Philadelphia, Pa., desires to know the value of a household device that instead of employing an electric motor to operate it, that you also supply your customers with another machine operated by the user himself, by hand or by hand. This would make your device practical on a large scale, who have no available supply of electricity.

Demountable Tires

(557) R. J. H., Lyles, Mount Sterling, Ky., submits an idea for demountable tires in which the tire rim is locked in place by eccentrially operating devices. 

A. I. Athos the system designed by you for the removable tire on automobiles deserves some merit, we do not believe that a patent upon the same would be profitable.

Power Multiplier

(558) Charles F. Blakie, no address, who has been working on the "World's Most Wonderful Invention," submits a drawing of a system of levers with a "World's Most Wonderful Power Multiplier." 

A. If you have applied for a patent on this machine, the information which works and how much power is gained is well known to the U. S. Patent Office. 

A. Of course, applying power at one end of the system, the power is increased on the other end of the system, but also it will raise the temperature in the center. You are not getting power: on the contrary, you are "losing" considerable horsepower.
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Martin Brothers and Company
127 Market Building, Washington, D. C.
Startins Autos in Cold Weather
(Continued from page 1020)

The first thing to do in any event is to push the float button on top of the carburetor and flood it, until the gasoline runs out of the air pipe. For cold weather running a heater or stove pipe should be connected with the engine exhaust pipe and the air inlet on the carburetor, to warm the air constantly when the engine is running. A car having magneto ignition only is particularly hard to start because when the magneto is old or even by a self-starter, the magneto or dynamo is not re- 

olved at sufficient speed to "generate a high charge, voltage to give the normal hot spark. This difficulty can easily be overcome by placing a battery on the car, particularly on Ford cars, so that when the switch is turned to "On" the engine can be started by simply turning over once or twice.

If the self-starter on your car locks, which may not happen very often, it is well to know how to release it. Place the gear shift lever in high and with the ignition switch turned on, get someone to help if necessary, and rock the car back and forth. You will hear a sharp click, which indicates that the Bendix on the self-starter has released from the engine fly wheel gear, when you can again ignite the magneto and try the self-starter or else crank the engine by hand. In cold weather, when engines are sometimes hard to start, the storage battery should be run down after a starting trial, so that the self-starter will not turn the engine any more. It is then necessary to crank the engine by hand.

Also a second person to help you by throwing in the self-starter; this will save much elbow grease.

The car was rigged up at one time a 110 volt, 1/2 H. P. electric motor on the floor of the garage, together with a round belt which was arranged to fit on the crank and the motor mounted on a piece of hollow shaft, made to fit in the place of the crank handle. In this way the motor could be turned over without an air gap at the start. By jacking up one rear wheel and throwing the gear transmission in high, a stiff engine can be turned over easily by simply turning the rear wheel. This is often useful, especially if the crank handle pin on the engine tends to wear off. Of course it is possible that there may be a warm garage to aid in starting the car on cold mornings, but it is not advisable to have the garage too hot if you value your car varnish, as the quick change in temperature experienced in coming out into the cold air will cause checks or cracks in the varnish.

Don't Be a Wall Flower!

(Continued from page 1020)

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“‘How Can I Learn to Dance by Mail?”

Mr. Peter Hoytuck, of Derby, Conn., asked this question after reading that Arthur Murray, America’s greatest teacher of social dancing, had invented a remarkable new method, which made it so easy to learn the newest dances in a few hours at home. Because no music or partner is needed, the lessons are inexpensive, and because more than 60,000 had learned dancing by mail, Mr. Hoytuck sent for Mr. Murray’s course on five days’ free trial.

A few weeks later we received this letter from Mr. Hoytuck:

I had never taken a lesson in my life until I sent for your course. My vocabulary is made up of words praise. I would like to shower upon your easy method. How could anyone help but learn from such a wonderfully clear and concise way of learning the up-to-date dance steps? I have had some wonderful times at dances. I add to it a dance party every week. I am much better now, and it is not embarrassing. I always recommend you to everyone.

This is a sample of hundreds of letters from satisfied pupils who have learned to be good dancers.

How Gas Turbines Work

Partly employed in generating steam, a great waste will be indicated there.

There are modifications which have been tried and have met with various degrees of success—a rotary pump has been used to remove the burnt gases from the steam or water have been used to dilute the explosive mixture to prevent the production of too high a temperature, while the tubes and tubes have been used to control the reaction. But the invention of the real thing apparently yet remains to be done.

How Gas Turbines Work

By Prof. T. O’CONOR SLOANE, Ph. D.

(Continued from page 1018)
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The Radio data and diagrams, embracing upwards of fifty pages, gives the experimentalist more valuable and up-to-date information than will be found in many textbooks selling for $2.00, and $1.00 could be spent for a dozen different radio catalogs before you could gather together the comprehensive listing of worth while radio goods found in this great catalog.

United States, as nearly as can be ascertained, in 1861. There is a legend that Stewart made his first experiment with safety pins in New York as early as 1841; but this legend lacks probability. So far as authoritative records go, Stewart was certainly making safety pins in 1861. Under various changes of ownership and name the concern founded by Stewart has continued uninterrupted to the present day. The Consolidated Safety Pin Company is still making safety pins on a large scale at Bloomfield, New Jersey, and selling through a large network of dealers. Mr. Sargeant’s name, altho that gentleman was long since gathered to his fathers.

The first patent for a wonderful affair, including a tubular back, a spring bolt, a slotted tube, a slotted knob and pins with chains. If you forgot the combination you were up against it, for the thing was strong enough to hold a horse, apparently. Another ball and chain affair was patented in 1876. Yet another had a slotted sleeve nut and screw socket. The first patent issued for a safety pin approximating the present is not even so well known as the above. It have been granted to A. V. Sargent, of Newark, in 1875. But the original Stewart had been making safety pins at his little shop in New York for forty years before that date.

A sample of his pins of the vintage of 1861 is still preserved at Bloomfield.

Joel Jenkins, of Brooklyn, deserves much credit for developing the safety pin, both as an inventor and as a manufacturer of them. Early in 1873 he was granted a patent for the improvements, and a partnership was formed by himself and W. Stewarct, Walker Brothers, and consolidated with Jenkins’ own business. By this time Jenkins had so popularized the safety pin that the new firm began business with fifty employees. At that time everything was done by hand. Pins were ground out by the dozen, but by the single pin at 3 to 4 cents each.

No fewer than seven patents were issued to Jenkins for safety pins and improvements thereon between 1875 and 1884, and the improvements were credited wholly to Jenkins and his employees. George Hunt, an English mechanic, who was employed by the original concern and its successors for fifty years, credited with the original technical detail in perfecting the safety pin.

By 1882 machines had been developed for winding the coil on the pins and assembling the heads on the wires on the original machines, of course, were not the marvelous automats of to-day. Improvements for making safety pins have been continuous. To-day everything is done by automatic machinery. A battery of presses bite a slotted head out of a strip running thru and forms it into a head or shield at a single stroke, the small heads being turned out at the rate of one for each two ticks of a watch. Another machine is given a coil of wire which, without human assistance, bites it into its length, sharpens the point at one end and twists the coil in the middle to form the spring. A third machine assembles the pin, head and guard, and drops the finished product into a pan.

It certainly does sound strange to hear the head of an up-to-the-minute manufacture waste so much time to talk about this sort of thing. In this year of grace, but no man has yet been clever enough to invent a machine that will fabricate safety pins on a card. Hence this part of the job must still be laboriously performed by hand.
Aerials cannot always be conveniently set up—particularly on city apartment houses. With the new General Electric Company's Radio Frequency Amplifying Transformer, introduced by the Radio Corporation, receiving aerials can be dispensed with and indoor loops effectively used instead. At once the scope of radio is broadened.

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Forecasting Earthquakes
(Continued from page 1008)

year. For all characters of earth's crust, however, it can be measured and measured accurately. When this movement of the earth's crust—strain creep, the scientists call it—has pulled this crust to a certain degree of tension, the elastic rebound sets in. That is to say, the crust of the earth stands no more an elastic than a rubber band and at some point it gives way. Then and there an earthquake occurs. Sometimes this earthquake covers a large area, as that of 1906 in California when it is estimated that an area of 15,000 square miles, 68 miles deep, moved varying distances from one foot to 20 or more feet. Sometimes it is local, as in the quake of 1903, which affected only the Mt. Hamilton region, and is believed to have moved appreciably that entire mountain and is thought to be a "fracture object", if there is such a fracture on the surface of the globe.

Now, Dr. Lawson has discovered, in addition to these things, that the strain creep is antecedent to an earthquake, as well as consequence of it. As will be shown later, comparatively small movements, known as creep, and other similar established factors, which had moved several feet by strain creep during the number of years this earthquake, moved backward, or to one side, nearly as many feet, during the few seconds of the earthquake. This discovery proves that the crust of the globe, to a varying depth is on the move constantly, independently of the rotation of the earth and its revolution around the sun. This alone was a discovery of stupendous interest to all scientific men, but wait!

Given the known rate of creep of the crust of the earth, the character of the component parts of that crust, and the limit of tension to which that crust can be subjected, it is not difficult for the man who deals with scientific figures to esti- late, very closely, the time and place at which that crust will reach the breaking point. When the crust reaches that breaking point, when it can endure no more, it is no excepting the northern and southern parts of the earth's crust. When the crust reaches the breaking point, it will be able to remove himself and his family from the danger zone, and he will be able to prepare to combat successfully the fires which usually follow earthquakes in large centers of population.

It is evident that the main factor in the forecasting of earthquakes will be the close attention paid to observation of the strain creep, the tension of the crust of the earth, and the condition of that crust; the latter, once ascertained for a given section, remains permanently reliable information; it is the creep which must be watched. Waves of earth generated at the fault, or breaking point of the earth's crust, travel thru the crust at the rate of 1.25 to 1.37 miles per second, far too fast for the human eye to detect. Yet those who have observed seeing the earth's crust at the sea, the fact of waves on the sea have told the literal truth, but what they saw were slower and smaller waves, set in motion by the normal earth waves, waves, and immediately after an earthquake. The passage of these waves frequently leaves the earth's surface in permanent waves, broken into rows, as if some Titan had dragged his
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NEW YORK COIL COMPANY
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Practical Chemical Experiments
By FLOYD L. DARROW
(Continued from page 1036)

discover that bases reverse the color effects of acids and vice versa.

A Wine and Water Trick: Arrange three rows of glass tumblers on your demonstration table. In the bottom of each tumbler in the first row place two or three drops of phenolphthalein indicator. In the bottom of each tumbler in the second row pour two or three cubic centimeters of concentrated sulfuric acid. In the bottom of each tumbler in the third row put three or four cubic centimeters of strong sodium hydroxide solution.

*Now fill a pitcher with water and add to it 10 cc. of strong household ammonia. Announce to your audience that you will pour wine from a pitcher of water and at the same time fill the first row of tumblers. As you do so the water apparently changes to a deep pink color appearing in the tumblers. This of course is due to the fact that the ammonia is a base and gives the characteristic base color with phenolphthalein.

Then announcing to your audience that you suspect the presence of a government officer in the audience pour the contents of the first row of tumblers into the second row. The sulfuric acid neutralizes the ammonia and the pink wine color disappears. You have changed the wine back into water.

Prevently you may state that the meddlesome officer has disappeared and that it will be in order to bring back the wine. Upon pouring the decolorized wine into the third row of tumblers the wine immediately reappears. The sodium hydroxid, which is one of the strongest bases, neutralizes the sulfuric acid and with the phenolphthalein gives the characteristic pink color.

Since the quantity of liquid in the bottom of each tumbler is very small, to your audience the tumblers will seem to be empty. For rough measurements of volume it is convenient to have a standard test tube which contains about 25 cubic centimeters. If the colors do not change perfectly you will have to vary the concentrations of the solutions used. But the demonstration will work beautifully.

Preparation of Bases: One of the simplest bases to prepare is sodium hydroxid. Cut a piece of metallic sodium about the size of a pencil eraser. As you doubtless know a sodium is kept under kerosene. If your piece of sodium has any yellow incrustation carefully cut this away. Dry the metal quickly with a piece of filter paper, do not touch it with the fingers, and place it upon the surface of 25 or 30 cc. of water in an evaporating dish. Immediately it will mix and with a sputtering and hissing noise will run about upon the water in a very lively manner. The gas that escapes is hydrogen. If you wish to collect it wrap the sodium in a piece of lead foil, leaving a corner exposed. Grasp this capsule with a pair of steel pincers and thrust it beneath the mouth of an inverted test tube of water held with the left hand in a dissecting tweezers. The test tube will fill with the gas, which may be ignited by holding it to a lighted Bunsen burner.

Now place a piece of red litmus paper on the desk and dipping a glass rod into the solution in your evaporating dish touch the end of it to the litmus paper. The characteristic blue color of a base will at once appear. Feel of the water and you will note a slippery soapy "feel." Place a few drops in a test tube, dilute with water and add a drop of phenolphthalein. Repeat using methyl orange.

*(To be concluded)*
How to Build a Radiotrola
By H. Gernsback and R. E. Lacaunit (Continued from page 1042)

Tuning

To tune in a transmission only three adjustments are necessary; these are the tuning of the loop aerial circuit, the tuning of the primary of the radio frequency transformer, which is not critical and, last, the tuning of the plate circuits of the second step radio frequency amplifier, production a regenerative effect, as in an ordinary regenerative receiver. This last adjustment is more critical, but may easily be made. In case continuous oscillations are produced by the tube, owing to too much coupling or feed back effect between the circuits, the rheostat of the radio frequency amplifier and the potentiometer, should be adjusted to the proper value, so as to stop these oscillations. The adjustment of the detector depends upon the type of tube used, but it will be found that maximum audibility is obtained for a certain setting of the rheostat, once the other adjustments are made. With the constructional details given in this article, it will be possible for the experimenter to duplicate the Radiotrola. Of course, it could be simplified so as to reduce the number of adjustments or two into this tuning, but it has been found that better results were obtained over the complete range of wave lengths using the tuning radio frequency amplifier, and since this set was designed not only to receive radio music, but also radio telegraph transmissions this circuit was adopted. If only radio concerts are to be received, the windings could be designed so as to tune only the wave lengths used by broadcasting stations with a means of varying it over only a short range; furthermore, by using some other type of radio frequency transformers, the only adjustment would be the tuning of the loop aerial by means of a variable condenser reducing the number of adjustments to one. With the Radiotrola, complete radio concerts, lasting for hours have been received without having been interrupted by spark stations in the neighborhood, as the loop aerial has a directional effect, and the tuning of the circuit was sharp enough to prevent interference and statics.

Blow Torch and Pipe Coil Heat Room
(Continued from page 1039)

against the inner sides of the coil at intervals of one-third the distance around the coil.

At the lower terminal of the coil a nipple of 3 inch pipe is attached to the end of the pipe by means of a pipe reducer and a sleeve union. The purpose of this attachment is to form a socket or receptacle to receive the flame of the torch, whose nozzle is inserted into the end of the nipple, which catches the entire volume of heat and conducts it into the coil. The torch is set on the floor, with its nozzle inserted in the hole just made, and the obvious that very intense heat is thrust into the coil and circulates through it. The flames of the torch extend only a few inches into the coil, but heated air continues thru it. The upper terminal of the coil is led perpendicularly to the floor of the room to exhaust the impure air from the room. The degree of temperature is readily varied at the torch.

Contributed by L. M. JORDAN.
Synura Gives Oily Taste to Drinking Water
By DR. ERNEST BADE
(Continued from page 1034)

dent known. It is believed to be related to the ethereal oils. It is not volatile at the boiling point of water. It gives to the water a disagreeable, fishy, oily, and sometimes cucumber-like taste, which is transmitted to the water during growth and also after the death of the colony. When the animal begins to decay, the oil is set free, and wherever the most favorable condition for the propagation of the animals exists, they readily multiply in such countless numbers as they have done in the Kensico reservoir of New York City’s drinking water supply system, so that the water becomes decidedly unpalatable. The quantity of oil produced by the animal is exceedingly small. On the other hand, Synura can readily be detected in a dilution of one part in 25 million parts of water. This means that one drop of oil in about 300 gallons of water is quite noticeable, and this is equivalent to a drop of water in a cube of water about five feet to a side.

The destruction of the Synura in the water offers no difficulties, but it is a decidedly different problem with the oil. How it can be removed is still an open question, and this is far more important than the destruction of the animal. Copper sulfate in a concentration of one part in 1,000,000 parts of water kills the Synura and does not injure any other plants and animals. On the other hand, the Synura is a perfectly harmless creature which requires its content of oil in the body in order to facilitate its swimming abilities, the oil, being lighter than water, causes the organism to partly float in the water. Other organisms will eventually destroy the Synura. One method employed in treating the oil-poluted water is to row a boat back and forth in the reservoir, allowing the boat to be filled with copper sulfate to hang over the side into the water. Ozone should be good.

"Skipping Boat" Contest Winners
(Continued from page 1035)

will the boat run and skip? I can say that it will run, but I wouldn’t say positively that it would skip; however, I believe it will.

BERT B. ANDERSON.

Second Honorable Mention

I am submitting a model of the skipping boat. The pontoons are driven by rubber bands. The boat will rise vertically about one-half inch when the pontoons are rotating in opposite directions. It will not move forward, however, due to the fact that two equal forces are continually countereffecting each other. Forward movement is necessary to produce the skipping effect desired. As you object to a propeller, I would suggest a disk to be placed above the pontoon on the same shaft. This disk is to have paddles at the periphery and to be attached at an angle to the vertical of about twenty degrees; also this disk will run at the same angle, so that one side of the disk will only touch the water. Thus with the pontoon and its partner, the disk rotating in an opposite direction to the other part, it should work.

SAMUEL HAGEMANN.
reflector may be removed by covering over the wire guard, or the whole opening in front of the heater, with copper or brass wire gauge, No. 24 gage.

Hot air heat in a garage is good, as is also hot water or steam, but don’t have the boiler or furnace in the garage.

Speaking of automobile hints, one should never operate the engine in a closed garage, as the exhaust gases contain the deadly carbon monoxide which is liable to asphyxiate one. Never use a lighted match to read gasoline tank gages or when shooting trouble about the car—use a flashlight.

Extinguishing Fires

House or outbuilding fires happen now and then, and it is well to observe a few simple rules in regard to fighting them. Use carbon tetrachlorid solution to fight gasoline, kerosene, or electric fires. Never throw water on any of these, as it will only spread the conflagration. Sand or dirt are very good to fight these and other fires with, or they may sometimes be smothered successfully with a blanket or carpet. If a person’s clothes catch aflame, endeavor to throw them by rolling them on the ground or carpet, or by wrapping a blanket around them and pounding on them. There are a number of dangerous situations that arise from contact with electrical transmission lines, and even in our household electric lighting systems. Never touch a faller with a current, as it may be charged with a sufficient voltage to kill. Don’t throw a wire or even a kite string a tremendous distance. If the kite string is damp, a sufficient current might leak to prove fatal or give a severe shock. Never touch electric fixtures whether switches, chandeliers, heating or violent ray apparaus, etc., while standing on a hot air register, or while touching a radiator or any plumbing fixtures whatsoever. Nor touch an electric light fixture or switch, while standing in a bathtub filled with water, as several deaths have resulted in this way.

Eyglass Don’ts

A few practical hints with regard to eyeglasses, particularly nose-glasses, would be worth the consideration of some of the glasses we see people wearing every day. Fig. 11 shows some of the reasons why people complain of severe headaches before half the day’s work is done. 1—Shows pupils too far apart for lenses; 2—Shows lenses too far apart for the pupils; 3—Shows glasses tilted or staggered—very bad; 4—Shows nose-glasses in correct position, while 5 shows the most comfortable glasses or specs, with ear hooks, which are perfectly acurate for reading, studying or work, as they always hold the lenses in the correct position in both horizontal and vertical planes before the eyes, just as the oculist intended they should when he measured them in a similar frame.

In handling poisonous medicines, a few hints may not be amiss. Bichlorid of mercury (corrosive sublimate) solution should not be used for washing open wounds, and Fig. 12 shows how these may first be closed with new skin or collodion mixture to prevent the solution getting into blood, and which might cause mercury poisoning. Instead of this antiseptic solution to kill infectious germs one may use tincture of iodine, either solid or potassium permanganate; any of these may be used in water, the proper proportions being obtained from your druggist.

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**Household Science**

By H. Winfield Secor

(Continued from page 1017)

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supernormal, Lohr fought hard to avoid conviction. For hours he sat there, his mind in turmoil, seeking an answer that would dissipate his growing belief in the supernatural origin of the figure in the print.

He could find none. And eventually he locked up the darkroom and went to a restless bed to wrestle futilely throughout the night with the problem.

Ere twenty-four hours had passed the thing had become an obsession. Captivating perforce to the spiritistic theory, he sought at further angle informing proving the reality of the phenomenon. If it could happen once, he argued, it could happen again; could he help to happen at all, the law governing its production was understood and applied. He reasoned that by accident all conditions necessary had been fulfilled at the moment of exposure, and his negative, therefore, was not a freak, but proof that a definite result must follow definite procedure.

He began a series of exhaustive experiments. Unable to determine whether the secret lay in the mediumship of Miss Meredith or the peculiar virtue of the camera or some psychic condition of the location or possibly a combination of all three, he attempted a tedious process of elimination.

Plate after plate he exposed under every condition he could conceive. Sometimes Miss Meredith was posed, sometimes he shot mere landscape. He employed many cameras, tried many makes of plates. Fast ones, slow ones, very slow ones, high speeds he worked up time, bulb, snapshot exposures. Interiors, flashlights, combinations of former experiments were made hourly upon hours passed in the darkroom, assisted by the indefatigable Miss Meredith, who was as determined as he to get at the truth. But they were futile hours. Not one plate coming dripping from the bath, showed a visitor on its surface.

One thing only gave him hope that he was drawing close to the riddle’s key. When he used the camera that he had employed on that memorable afternoon, almost always a faint fogging of the plate occurred, a tantalizing mistiness, sometimes a blurred, vague, provokingly suggestive outline, hence convinced him that this particular lens had much to do with the miracle, although he was unable to determine how, and eventually he came to call it his passion. Thereafter he abandoned other cameras, and made all his exposures through that particular lens. Lohr had now decided to keep his experiments secret. He had allowed many to view the mysterious prints and plate, and had quite openly admitted his belief in the genuineness of the spirit figure. Consequently there was much gossip in the little community, much argument in the hotel lobby and at the general store. The censure fell in with Lohr’s view readily, the sceptical ridiculing stoutly what they deemed nonsense. And by the time Jimmy Morris was registered at the little hotel it was a regular evening topic with the lobby loungers.

Morris, suspicion from his strenuous duties as a camera man for a big moving picture company, had chosen the little town at random, from among a number of others, when he arrived with the avowed intention of just resting. After months of intensified movement it seemed good to be more than a mere thrall in the thought that he could do nothing and in being unable to find no good reason why he shouldn’t.

Tiled back in the hotel, deliciously comfortable, he listened in contentment to the chatter of his neighbors. Lazily puffing his cigarette, a listless attention, the thread of argument around him, mentally taking sides, applauding silently each well-taken stand, maintaining
silece, lest he be drawn into active effort. When his delight seemed to know no bounds, when the cup of contentment appeared ready to overflow, Lohr's experiments came on the carpet. At the men's profession of spirit photographers, Jimmy sighed. He rolled his eyes in the direction of the speaker and gave unindulged attention. At the end of a half hour he had absorbed the details of the case. He sighed again. His chair legs thudded to the floor. Re-}

“Where does Mr. Lohr live?” asked the man nearest him. The village obligingly gave directions. “Interested in photography?” inquired, with the air of one who would relish discussion. Jimmy sidestepped the offered view. “You see the reason he moved toward the door, “I'd like to see a spirit photograph. Just one!”

Jimmy found himself welcome in Lohr's darkroom. To Lohr the quiet little expert, who could follow understanding his theories, who could appreciate the object of all his experiments, came as a Godsend. He talked freely and frankly, giving the little camera man a detailed account of the affair from the beginning, exhibiting his photographic spirits, openly avowing his belief in the reality of the spirit picture, and stating clearly the arguments that forced him on him. As he listened Jimmy became convinced of two things. There could be no doubt of Lohr's sincerity nor of his honesty. Morrison realized that he had been needlessly trickery here, no manipulation. And he quickly found that the man was a clever and accomplished photographer, one of whose views were to be respected.

Studying the print thru half closed eyes, he listened to Lohr's earnest dissertation. He thought he could see the truth in the print, or, from Lohr's description of the exposure, he could account for the presence of the very clear figure. He had made many trick prints himself, had examined many more. But he was forced to admit that this was something different from anything he had so far encountered.

Finally, arising to go, he tucked the print under his arm. "Look here, old man," he said, slowly, "do you mind my butting in?"

"You are not butting in," protested Lohr, warmly. "I would appreciate your assistance. I am more than anxious to have my theory definitely proved or disproved, and I am eager for competent help.

"Well, then," replied Jimmy, "I'll confess I'd like to take cards in the game. You seem positive that your psychic lens, as you call it, has a lot to do with this business, and I'm going to ask you to lend me that camera.

Lohr offered him the instrument. "Gladly," he said, "and I feel confident that you will come to agree with me." "I don't know about that," rejoined Jimmy, dubiously. "I'm not strong for this spirit stuff. But I'll give it a fair try.

Two days later, late in the afternoon, Morrison ambled into Lohr's darkroom, the borrowed camera under his arm. Fishing into his coat pocket, he drew out a plate holder and dropped it on the table. Sinking into the chair, he mechanically rolled a cigarette. He had surveyed Lohr thru half closed eyes.

"If that plate," he remarked, laconically, "waving his cigarette toward the holder on his left arm, "if that plate is but a darning old cow, I'm wrong and we start all over again.

"Have you found something?" cried Lohr, eagerly, picking up the holder with trembling hands. "Don't know," Jimmy retorted, calmly. "Run it thru, and let's see what I've got.

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Lohn switched on the red light, spun the plate into the bath, and rocked the growing outlines. Watching him, Jimmy saw him stiffen. There came a startled cry.

"Another ghost?" he queried, interestedly.

"Florence!" cried Morrison, his voice quivering with excitement. "Again! I don’t have to print it to make sure. It’s she! Morrison, you have found it! What are the conditions? What is the law?" Jimmy turned to the shoulder and shook him, almost roughly.

"Now look here, old man," he cried.

"You want to get this spook business out of your head. That isn’t a picture of Florence. But it is a picture of Florence’s daughter. Remember those three girls that watched you in the window this afternoon? Well Florence’s daughter was one of them. If you hadn’t been so blamed lazy with your posing you would have noticed the striking resemblance. I nosed around until I found those three girls. I found that Florence’s husband is dead, and has been for three years. There is a girl of about ten, second wife. And as soon as I clapt eyes on that girl I knew that you had somehow got her into your picture.

"Now, let me tell you what you really did do that afternoon. You fust around posing Miss Meredith until finally you got her just to your liking. Then you went over to the camera, put the plate holder in, and—pulled out the slide. At the last moment you saw something you didn’t want her to see. Over to her to change it. Of course, the shutter was closed. But remember, the slide was off of that plate," answered Jimmy, "I seem to "red", and call that doing, but the shutter was shut. Of that I’m positive."

"Sure!" agreed Jimmy. "It was shut all right, but just the same it was right there that your psychic lens got lens and did its dirty work. Those girls were well out of focus, you know, but by pure, blessed luck Florence’s daughter was absolutely and almost unbelievably in the focus of your psychic lens. You were away from your camera say thirty seconds. Maybe it was a little more, maybe a little less. In the nice light you had it was a ample time for a peak of an exposure with that psychic lens."

"The psychic lens?" murmured Lohn, questioningly.


He ript open the back of Lohn’s camera, snapping where the shutter. Pressing in, open back end against Lohn’s face, he threw the focusing cloth over his head, shutting out the light.

"What do you say?" he demanded.

For awhile Lohn was silent, as his eyes accustomed themselves to the darkness. Finally he said, "A leak," he said, slowly, "A small leak."

"Yes, a leak," echoed Jimmy. "A pinhole! That accounts for the mysterious fog on your plates when you use this camera, and it betrays the secret of your psychic lens. You didn’t get a spook picture, Lohn, but you did get one darning fine PINHOLE PHOTOGRAPH."

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One of the advantages of the system as shown during the demonstration is that the energy required is practically negligible, as it is guided by the transmission lines instead of being radiated in all directions through the ether, as in wireless telegraphy. The system is free from inductive interference and atmospheric disturbances such as static. It does not of itself produce interference to a degree that would cause disturbances in other communicating systems. No elaborate antenna is required, and, finally, even when the transmission line may be broken, the system will work satisfactorily.

The system thus constituted, we might say, is wireless. The trolley or other electric wire acts as a guide to the etheric waves, which thus follow and surround the wire for a considerable radius. The message is received at the station or signal tower by means of a loop antenna, connected with a suitable vacuum tube detector and amplifier apparatus.

Commenting on the tests, W. B. Potter, engineer of the Railway and Traction Department of the General Electric Company, said:

"These tests at Schenectady and on the C. M. & S. P. Railway, indicate the early perfection of a practical telephone system utilizing the power wires as a conductor, which will provide for the usual call and telephone communication between different locomotives in the same train, between the locomotive at the head and the caboose at the rear of the train, or for communication between different trains. This system is equally applicable to communication between the train dispatcher and the trains in operation on any one railroad. This is an important development which we feel sure will contribute materially to the facility and safety of railway operation."

The transmission line may be used on the head and rear locomotive of a long freight train will be able to tell the engineer of the pusher at the beginning of the train, without resorting to bumping the rear locomotive thru the long train, as is sometimes necessary when the wireless signal wires are not audible. The train conductor can communicate with his engineer in case of anything happening to his own train, which the engineer is not in position to observe. The engineers of different trains, on the same track, can communicate with each other. In general, greatest lessen the liability of train collision. While train orders will continue to be issued as a matter of record, they will not be beyond countermand by the train dispatcher in case of an emergency. The train dispatcher could, in fact, stop every train on his division, should occasion arise re- quiring it."

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