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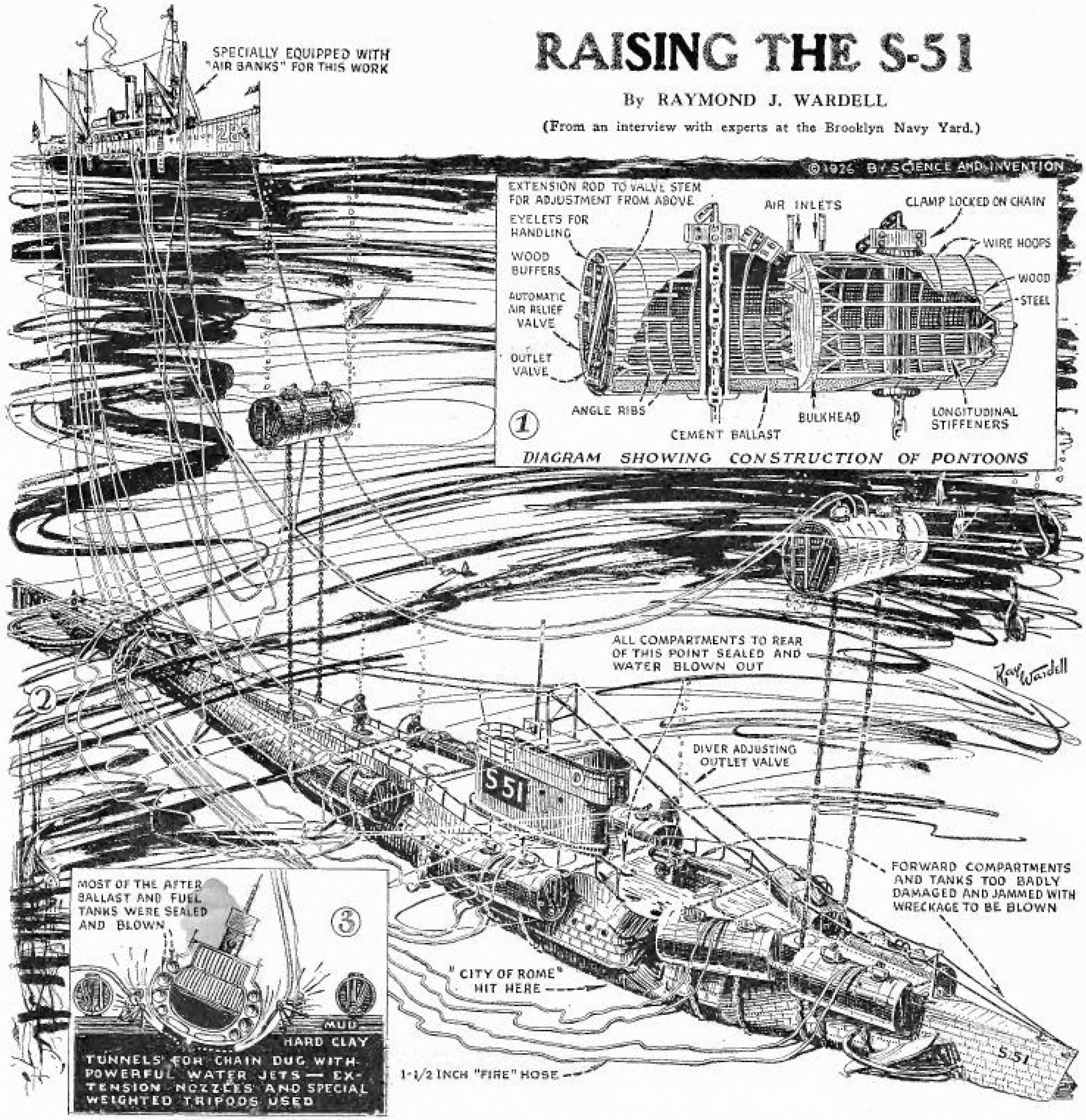
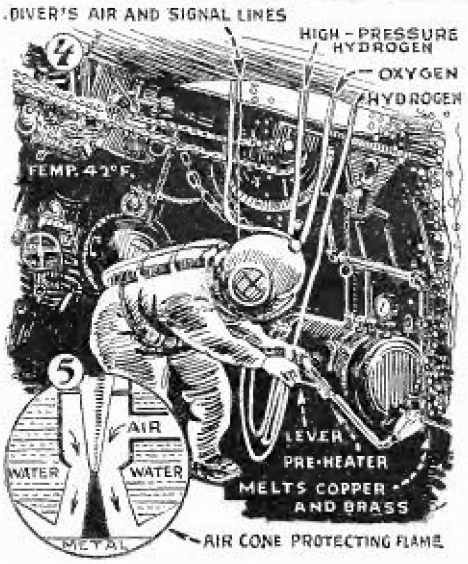
RAISING THE S-51

By RAYMOND J. WARDELL

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





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

$25.00 Prize for Human Aura Photo

NEW WAYS OF SEEING THE HUMAN AURA.

By FENN GERMER

IT is fairly easy to see the Human Aura—that peculiar atmosphere that surrounds each one of us, and which clairvoyants and psychic mediums say mirrors all our emotions in movement and color. It is so easy that it is a wonder that more people have not seen it without looking for it. A great many have, in fact, for those to whom I have attempted to show it have often confessed to having seen it before, but thought it was an illusion. The colors are not so easily seen.

So in the first place it will be necessary to define what the Aura is, and what it is not. Then, when we look for it, we will not get excited over an after-image and say that we have seen the Aura. Not everyone can see it, of course. Thinkers, artists, musicians, etc., are generally more sensitive than others.

WHAT THE HUMAN AURA IS

The Human Aura is a haze, a mist, a gaseous appearance that surrounds the human body on all sides. It is usually restricted to a space within a foot of the body, but on speakers of considerable emotional power (like a football coach I have seen) it may expand out three or four feet while they are delivering a stirring lecture. Ordinarily, however, we do not see the full extent of the Aura; we generally see only the denser brighter portion which extends about 2 to 5 inches from the body.

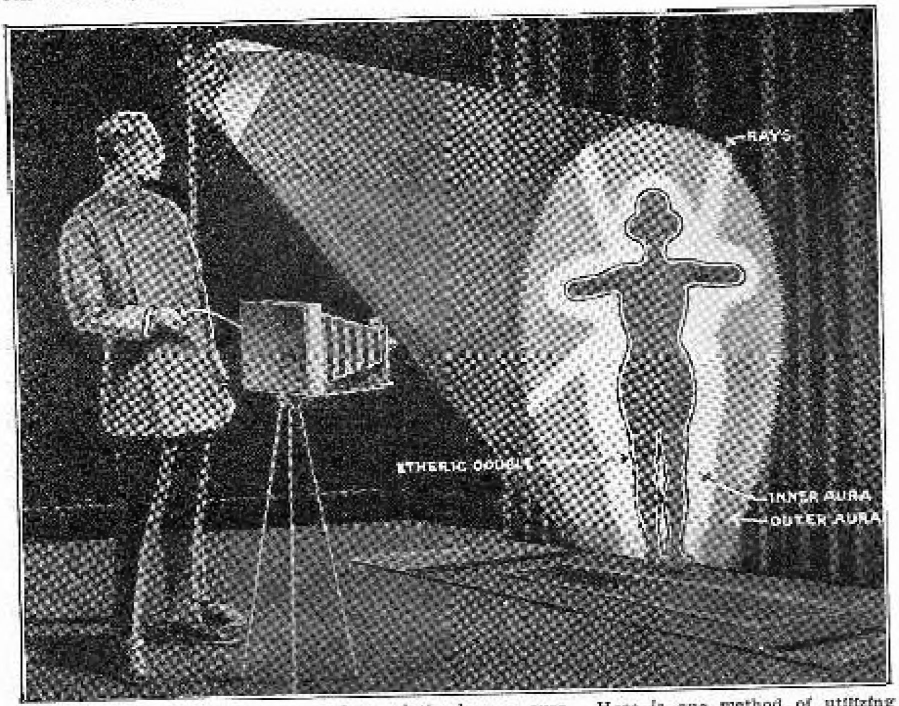
Very close to the body, about ⅛ of an inch thick, lies a grayish-violet line, the clearest and most definite part of the Aura. It looks like a "solid" gas, and is called the "Etheric Double" or "Etheric Body," because it is supposed to be the over-lapping or extension of a body almost exactly like our physical body except that it is made of much finer "etheric" matter which enables it to permeate the physical matter of our body and to seemingly exist in the same space. As this matter is supposed to be very tenuous—as much finer and more active than a gas as a gas is than a liquid—the activity of its particles causes the Etheric Body to press outwards a little further than the physical matter of the body, and thus we have the overlapping phenomenon.

THE INNER AURA

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

THE OUTER AURA

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



The Editors would like to see a photo of the human aura. Here is one method of utilizing ultra-violet rays, whereby it will probably become possible to photograph the aura. Other hints are given in the very fine article herewith, written by a keen student of the subject.

The means required to see the Aura are very simple and elementary. The first requisite is that the experimenter determine beforehand not to be led astray in his enthusiasm by any sort of illusion, as this is a very disappointing pitfall for one who is not used to observing the delicate phenomena. The second requisite is a suitable background, which should always be matt (that is, unpolished, like the surface of calcimine or velvet) unless otherwise specified, and as free from decorations or marks as possible. Decorations or marks on the background distract the attention and make it difficult to focus the eye properly on the air near the body. The best backgrounds are black velvet or velveteen; and, if in a diffused indirect light, white polished tile or porcelain. The black velvet, especially if made into a booth large enough to contain the whole body with outstretched arms, is best for detailed study and for carrying out Dr. Walter Kilner's experiments mentioned later on; the white tile is best for learning how to look for and see the Aura. One can easily see the etheric body and the aura around one's hand when washing in a porcelain washbowl, and a dim light is particularly favorable. Other good backgrounds are yellow, cream-colored, and blue calcimine. Green and orange are permissible too, the only unfavorable colors being red and brown. The background need not necessarily be calcimine, although that is best because there is almost no direct reflection of light to interfere with seeing the Aura. It may be marble, or colored wall-paper without design, or cloth without sheen, etc. The colors should be as light as possible, for a very dark background, with the exception of dead black, tends to render the Aura invisible. This is probably because dark colors absorb much light, and therefore reflect little back through the Aura. There is one exception to this, which is that if one stands in a balcony three or four stories above a sidewalk or an asphalt pavement—a cloudy day is best—one can look down on human beings, dogs, cats, horses, etc., and see them walking about in an envelope of mist or gas. This strikes one as very comical on first sight. The visibility of the Aura under these circumstances is probably due to the fact that when we look down on it, we see a much greater thickness of it than when we look at it from the front or the side. It is like seeing the effect of the atmosphere on the sun; when it is high in the heavens there is little atmosphere to pass through and it appears bright, but when it gets down near the horizon, the greater thickness of the intervening atmosphere begins to reveal itself in dimming the sun's light to a deep red.

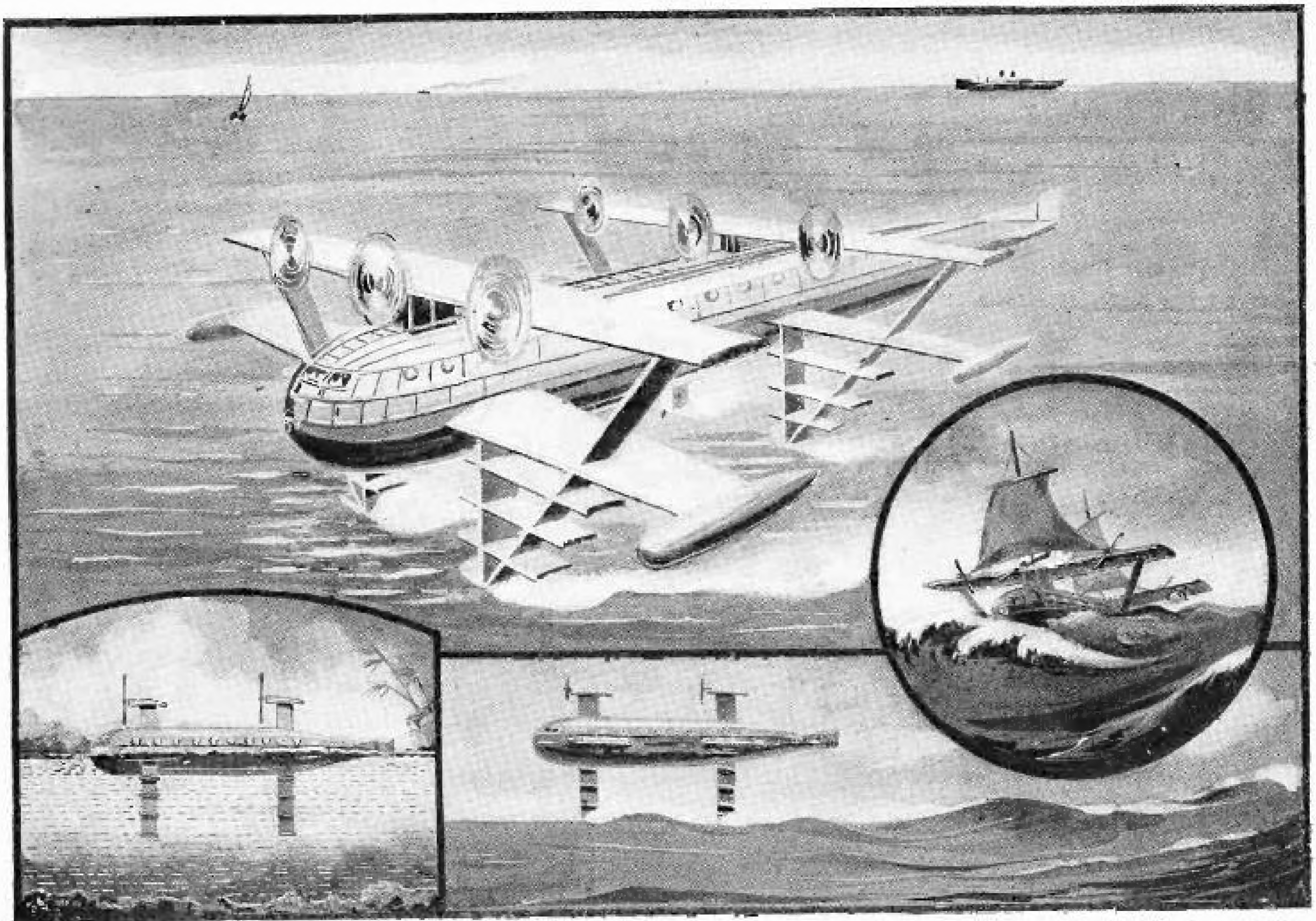
THE USE OF COLORED SCREENS

The Aura can also be seen by observing it through chemical or colored screens. Dr. Walter Kilner in his book "The Human Atmosphere" describes a screen made up of a glass water-cell (such as that used in lantern-slide machines to project the reactions of chemicals in solution) with thin glass sides, in which is put a solution of dicyanin (a rare coal-tar dye used in sensitizing photographic plates to infra-red light) in pure alcohol. He advises the use of two solutions, one rather light in color, the other dark. To use these screens, one first looks through the dark one at some source of daylight for two or three minutes; then one turns to look at the person whose Aura is being examined and who must be standing a short way in front of a black velvet background, either through the lighter screen or without any screen at all. The light should be dim and may be adjusted by raising or lowering a window shade. The observer should always have his back to the window when observing the Aura.

Dr. Kilner gives methods of seeing the colors in the Aura, but as they are rather complicated and not likely to succeed in the hands of an amateur, I refer those interested in his book, which is published by E. P. Dutton & Company, New York City. Simply stated, he creates a complementary-colored after-image in the eye by the use of a colored band of paper; then he looks

(Continued on page 275)

Aero-Hydro Glider

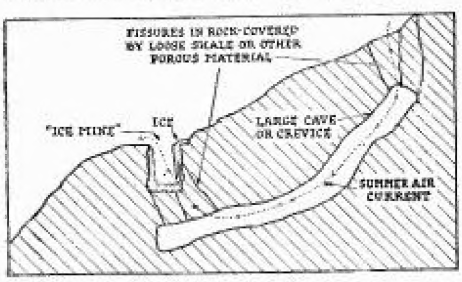


The conveyance illustrated in the diagram above is capable of a speed of 150 miles per hour over the surface of water and can carry a large number of passengers. It rises on the water until the lowest hydrofoils are in the water, while a large percentage of the lift is obtained from the air foils as well as the hydrofoils in the air. It is driven by means of propellers coupled to airplane engines. It is possible at the present time to construct a craft of this type large enough to cross the Atlantic at an average speed of 120 miles per hour, which is greater than the speed attained in actual flight. Because its skims the water it is entirely safe. Emergency sails are provided in event of engine failure. The propellers are of the regular aerial type.

—F. E. LOUDY, Aeronautical Engineer.

A Natural Ice Mine

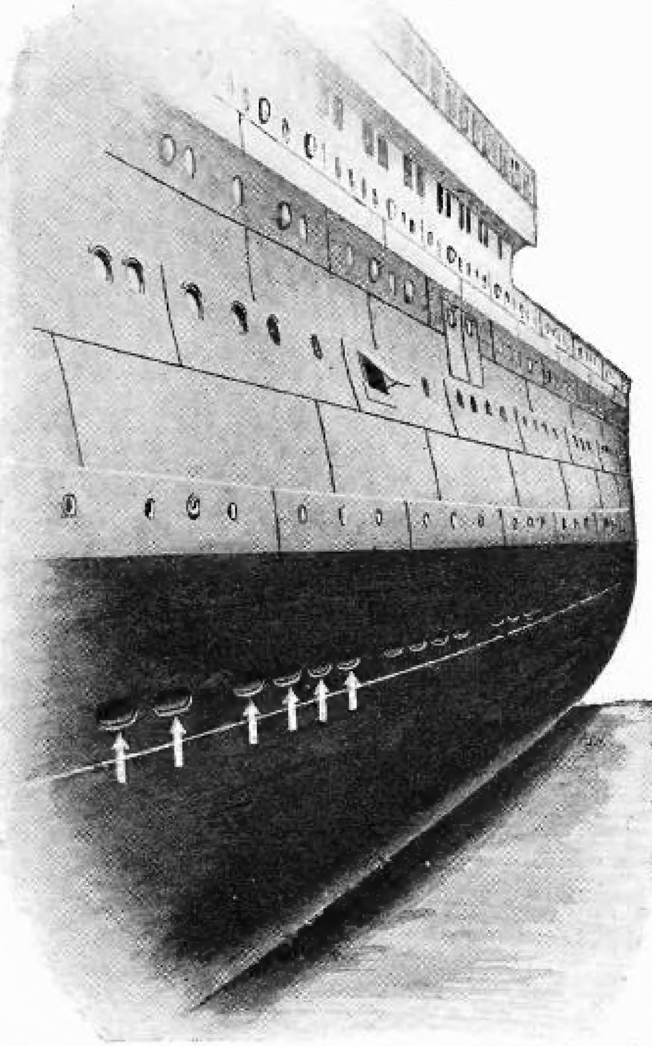
IN this ice mine the ice-forming process starts soon after the close of winter. The temperature inside is below freezing in the summer and higher than the surrounding temperature in the winter. The icicles are fifteen to twenty feet long. During warm weather a heavy fog-like vapor is seen to rise from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



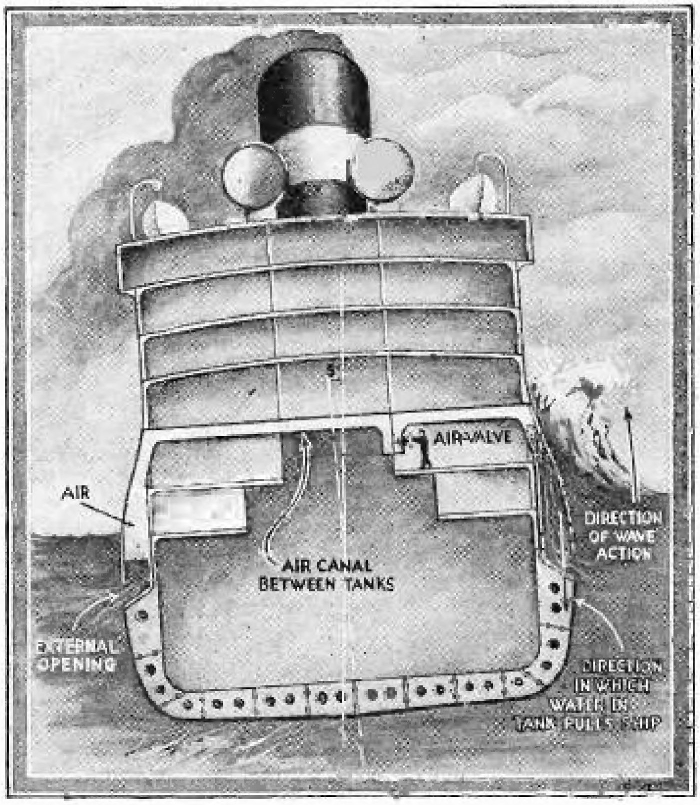
A schematic diagram of the ice mine is seen in the diagram above. Note ice formation.

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

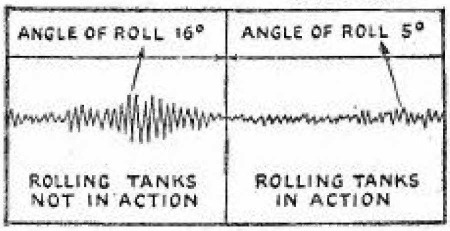
Preventing Ships From Rolling



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

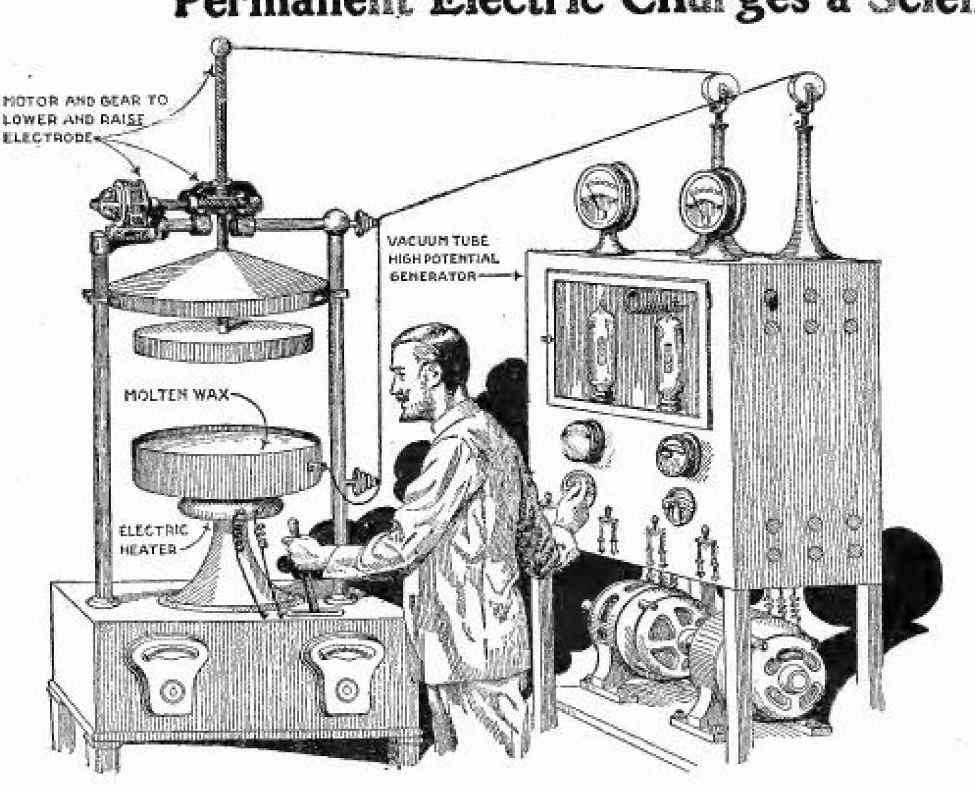


There is a chamber provided on each side of the hull and these two spaces connect by a pipe running across the ship, through a suitable reducing valve. As the ship rolls, water enters one or the other of the compartments, and the reducing valve retards the motion of the air or water, causing the water in either case to counterbalance the wave action.



The two diagrams at the left show in a vivid manner the great increase in stability of the ship when fitted with these new anti-rolling tanks. The results obtained by using a gyroscope on board the ship are also similar to the ones shown.

Permanent Electric Charges a Scientific Wonder



FOR many years we have known and used permanent steel magnets, but what would you think if a man handed you a small metal box containing a cake of wax, which he told you contained a permanent electric charge? In other words according to this idea, we shall before long be going into an electric shop and asking for a 100-volt cake of wax, or maybe they will be rated in kilowatt-hours. Thanks to the remarkable experiments of a Japanese physicist, Prof. Mototaro Eguchi, it has now become possible to impress a permanent charge of electricity into a cake of wax. Molten wax, as shown in the picture at the left, is allowed to harden by cooling in the presence of a strong electric field. The wax mixture employed by Prof. Eguchi usually contained 50 per cent. of resin, mixed with 50 per cent. of carnaüba wax. The electrostatic charge is applied to the wax by means of a metal plate lowered on to the molten wax, and also through the metal pan containing the wax. The high potential is obtained from vacuum tubes as shown in the picture herewith. As will be seen the metal pan and the metal plate lowered over the wax, constitute a high voltage condenser, and the wax mixture as it hardens, is acting as the dielectric of this condenser. One side of the wax is found to be permanently negative, and the other side permanently positive. Some of the charged electrets have lasted since 1919.

Electricity Direct from Sunlight

By S. R. WINTERS

WORKING as a hired hand, for $1.25 per day, on a dairy farm near Youngstown, Ohio, a struggling youth was obtaining a livelihood and sharing his meager funds with the demands of an education. Thirty-five years later, this same individual has achieved the revolutionary thing of transforming sunlight directly into electricity. This remarkable discovery which may prove to be one of the far-reaching achievements of science within this generation, is to be credited to Dr. William W. Coblentz, Chief of the Radiometry Section of the U. S. Bureau of Standards. Delving into all sorts of substances and studying their reaction to radiant energy from sun, moon, and stars, Dr. Coblentz has discovered a mineral that performs the incredible feat of *changing light directly into electric current.* Molybdenite is the name of this magic mineral and, unfortunately, each sample contains a spot no larger than the point of a pin that produces this marvelous result of converting light into electricity. This sensitive spot, small as it is, when exposed to the sunlight, generates enough electric current to throw the needle of an electrical measuring instrument clear off the scale.

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

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

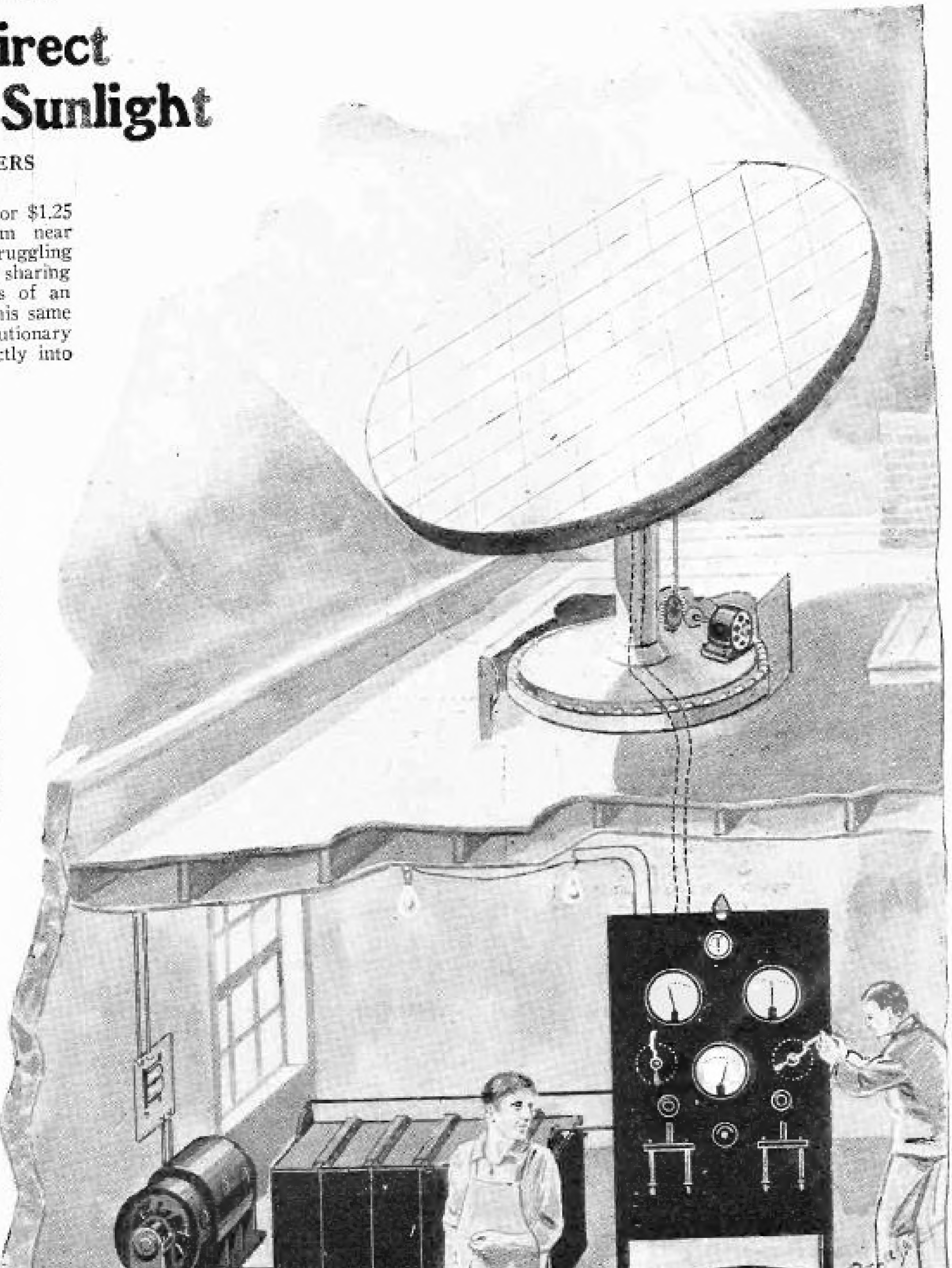
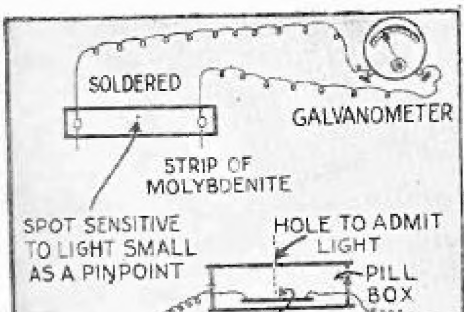


Photo shows Dr. William W. Coblentz of the Bureau of Standards at Washington, D. C., in his laboratory and he is examining several specimens of molybdenite, the mineral which he has found to be sensitive to light. Whenever the light falls on a piece of molybdenite, an electric current is set up within it which can be measured with a galvanometer, as shown in the other illustrations herewith.



Method of soldering copper wires to strip of molybdenite and connection to galvanometer.

The sunlight shines through a pin-hole in the top of pill box on to sensitive spot on surface of molybdenite strip. As long as the sun shines on the molybdenite, a deflection is noted in the galvanometer. Connecting several of the strips in series yields an increased voltage.

The Third Degree of Old

IN SPAIN

←

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

A BED OF TORTURE

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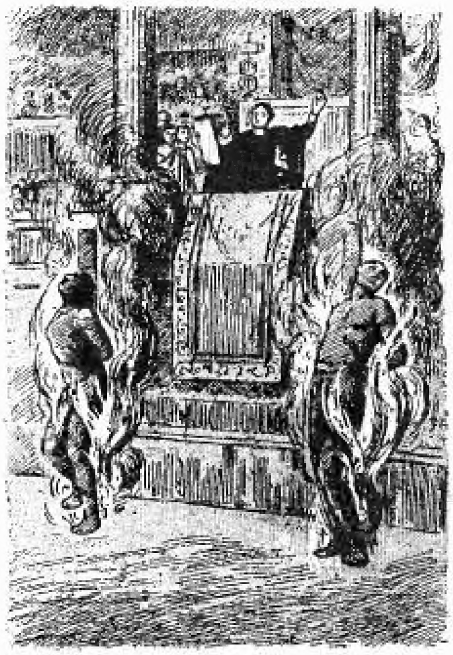
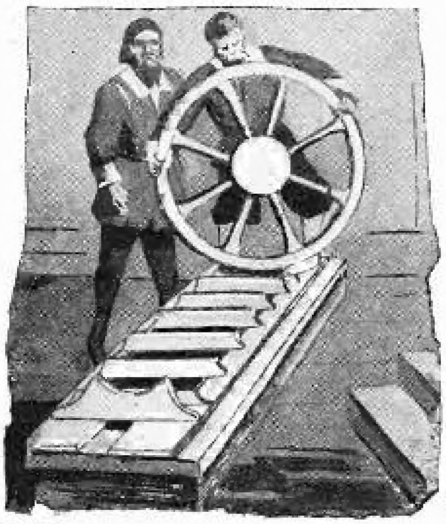
On the right: The unhappy victim lies prostrate on a plank driven full of pointed nails. One of the executioners is shown tying him down and the others are working upon his shoulders apparently to see that he escapes no whit of the torture. The general impression from this old engraving is that it was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

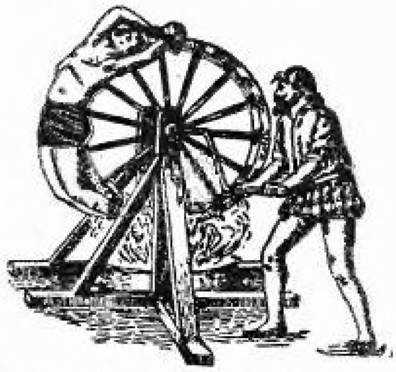
HUMAN TORTURE IN THE ROMAN ARENA



APPARATUS FOR BREAKING WITH THE WHEEL



TORTURE BY FIRE



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

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

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

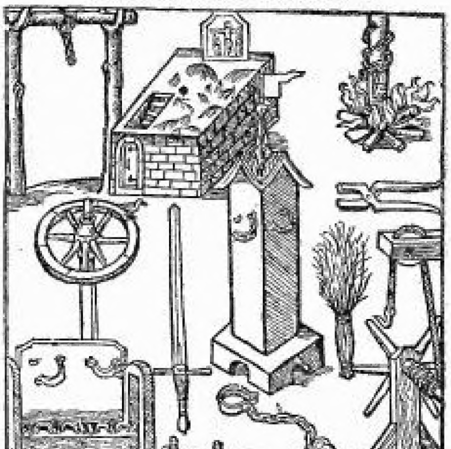
←

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

→

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

REPRODUCTION OF A CURIOUS OLD PRINT, SHOWING INSTRUMENTS OF TORTURE



TEARING APART BY HORSES

Ancient Torture Methods

PART II

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

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

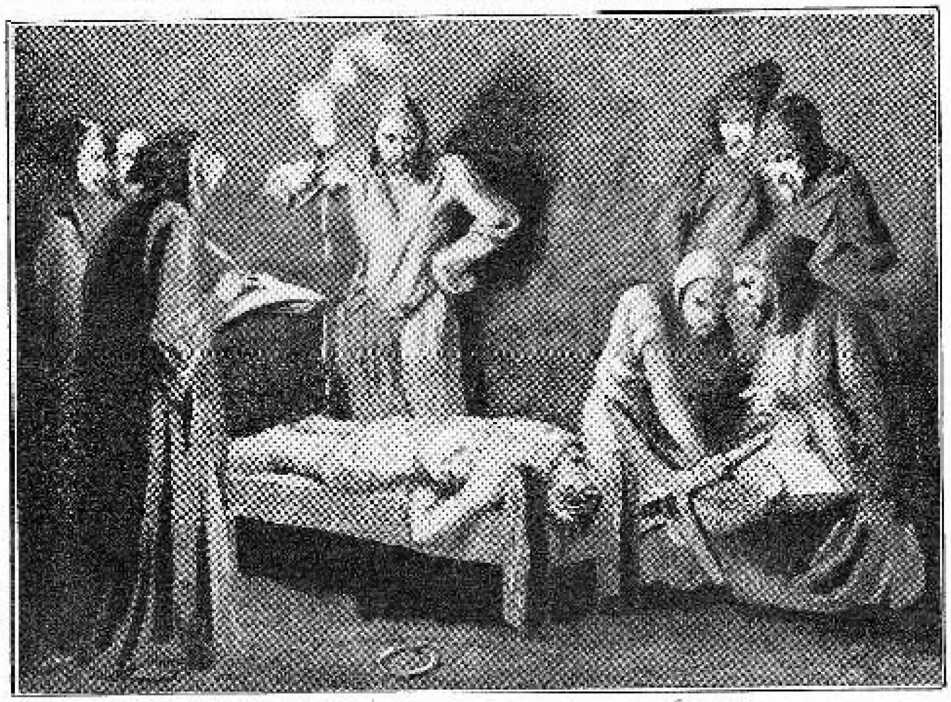
It is told of one of the English kings that he had the thumbscrews—a well-known instrument of torture—applied to his own thumbs; as he began to feel the pain, he called out to stop it, and said that another turn of the screws would make him confess anything. It is perfectly obvious that this was the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

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

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

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

The stocks were used in comparatively recent times. One of the pictures shows a man with one foot in the stocks, and the foot bare and a boy tickling it. And one of the most excruciating tortures is given as bathing the feet with brine and causing a goat to lick them with his rough tongue, tickling the epidermus. It is curious to read of Frederick the Great, who mounted the throne in 1740; he was supposed to have abolished torture in that year, but treason, rebellion and some other crimes were excepted, and even Frederick himself twelve years later ordered two citizens to be tortured on suspicion of robbery.



The examination under torture is shown in this old engraving. It may be a suspected criminal from whom an acknowledgement of guilt is sought, or it may be a witness. The strange idea seems to have been that a criminal should confess before punishment, and the statements of a witness under torture were considered the very best kind of testimony.

The strappado, one of the most famous tortures, was sometimes called the Moine de Caine, which means the Monk of Caen, the latter a city of Normandy. The hands were tied behind the back as shown in the gruesome illustrations and what was called the *question ordinaire*, the ordinary question, was carried out by fixing a weight not over 125 pounds to the feet, while the victim was pulled up into the air. Drawn up in this way the torture was very great and its brutality was increased by raising the victim a certain distance and dropping him part way to the ground so as to dislocate the shoulder joints. For the extraordinary question, a weight of 250 pounds was attached and three consecutive jerks would be given.

A clue to how the victims took all this, may be found in a story of a man who said he preferred the strappado to being hanged, for he could get a surgeon to put his shoulder joints back again after the dislocation, but he said he could not get him to fix a dislocated neck if he was hung.

Titus Oates' perjured testimony sent many an innocent victim to death just before the days of the restoration in England. When the Stewarts came in again he was convicted, and it might have been well to send him out of the world by the quickest method. Instead of that, he was led behind a cart through the streets of London from the Tower to Hyde Park Corner, a distance of about two miles. The latter was the locality of the famous Tyburn, where so many victims of the savage laws of those days were executed. All the way through the streets, he was lashed upon the bare back. He was sent back to prison, allowed to rest for a day and then the flogging was repeated, but as he was unable to walk he was put upon a hurdle and dragged along the ground and beaten all the way. The number of strokes given to him were counted and they were multiplied by six because there were six lashes in the whip, and it is told that the unfortunate man received several thousand stripes. He survived all this and lived for many years after. One of our illustrations in the last issue of SCIENCE & INVENTION shows him pilloried.

The Russian knout was probably the most terrible weapon of such chastisement, short of the chain scourge. It was a whip with a single lash about ½-inch square, of leather or hide which had been soaked in water to make it harder. The executioner was trained in its use. He practised upon a pile of sand, giving vertical strokes and by practising was able to lay them close against each other, so that a succession of strokes covered the whole back, leaving it a mass of mangled flesh, and if it did not kill the person, it ruined him for life. It has even been said that the second blow might be fatal.

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

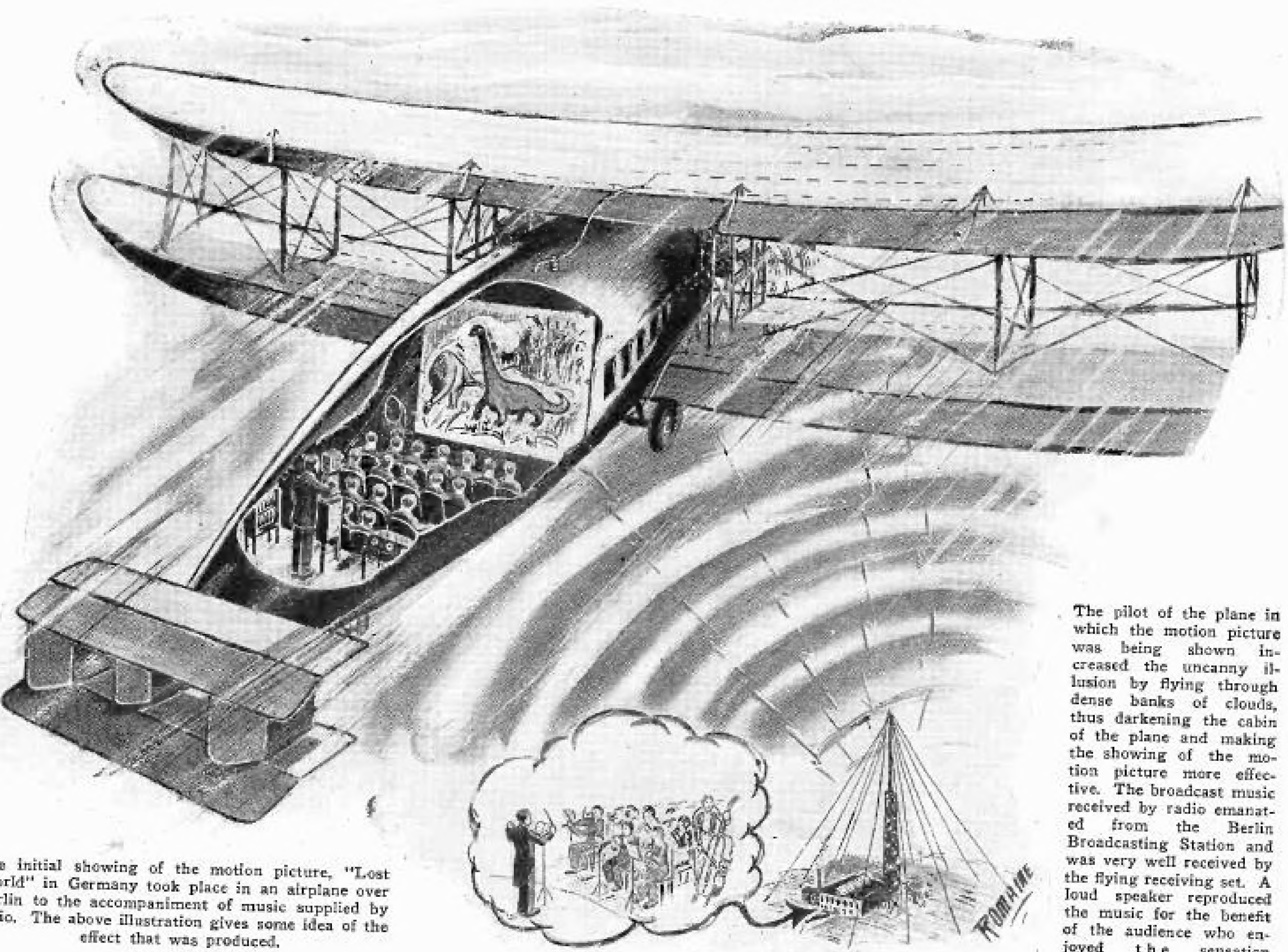
The pouring of cold water upon the head of its victim proved to be a very severe torture, and as late as 1858 it was inflicted with fatal results in Auburn Prison, New York.

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

(*Continued on page 278*)

"Lost World" Above Berlin

Movies and Music Aboard Airplane in Clouds



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

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

The Starvation Limit Illustrated

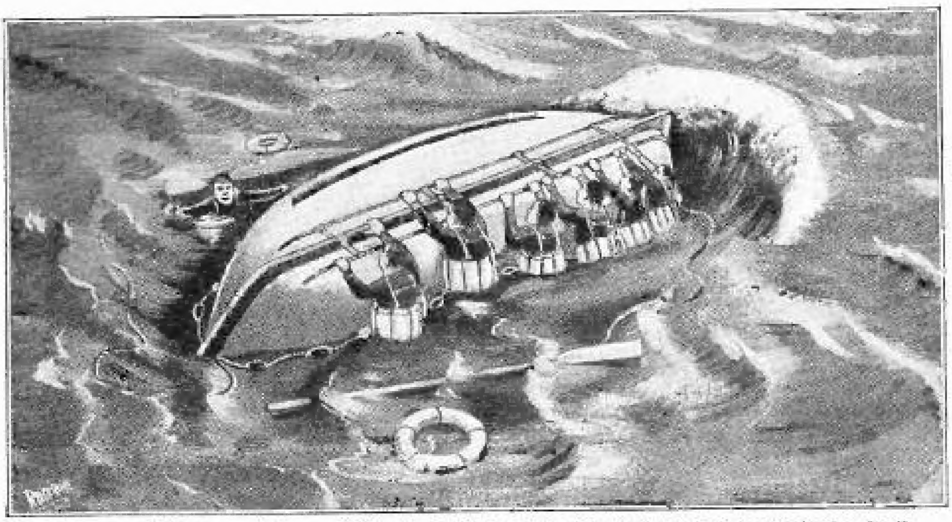
It is indeed strange to note the varying lengths of time which various members of the animal kingdom can subsist without food. The above illustrations show the average periods from that of a bird, which can exist for nine days without food, to that of an ordinary insect which lives without nourishment for a period of one thousand two hundred days, nearly four years.

Folding Umbrella

The photos reproduced here show the comparison between a newly invented folding umbrella when it is open and when folded for convenient transportation.

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

Invertible Life Boat



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

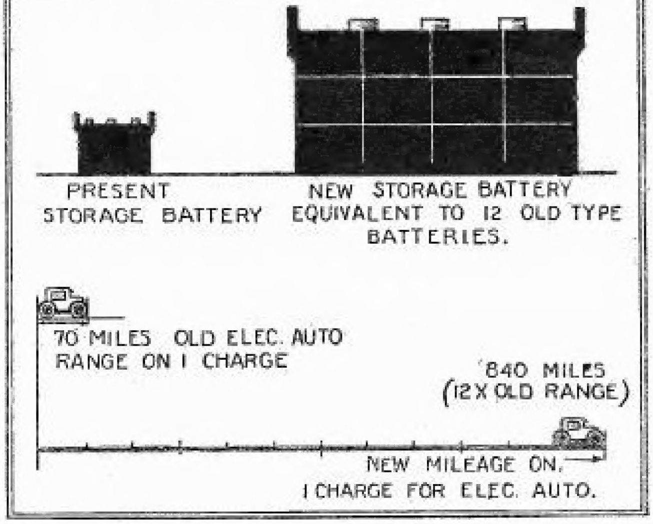
Above is shown the inventor of the invertible life boat with a small scale model of the device showing the special keel.

New York's Motor Vehicles

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

If all of the passengers carried by motor vehicles into New York City from the north were placed in a line they would reach from Ottawa to New York. Those entering by the same way on the East would extend to 15 miles beyond Halifax, Nova Scotia. From the west, the incoming passengers would reach to 15 miles beyond Harrisburg, Penna. All of these facts are graphically shown in our illustration at the left.

New Highly Efficient Storage Battery Promised



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

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

Aug.

RADIO PHONE WRNY STATION

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40 NON-TECHNICAL RADIO ARTICLES

HOW TO BUILD A ROWMOBILE

See Page 338

EXPERIMENTER PUBLISHING COMPANY, NEW YORK, PUBLISHERS OF
RADIO NEWS - SCIENCE & INVENTION - RADIO REVIEW - AMAZING STORIES - RADIO INTERNACIONAL

How to Build a Rowmobile

IF we compare the operation of a one horse-power motor on a rowboat with the operations of the same motor on a vehicle, we can see from the low speed of the motor boat which is only 2½ miles (four kilometers) an hour from the high speed of the motor shaft, while with the same horse-power as much as 30 miles per hour (50 kilometers) can be obtained on land, it shows how great is the resistance to be overcome in the water. Now if we compare a normal rowboat that does 1 to 2 miles (two to three kilometers) an hour to a shell or racing boat that attains a velocity of twelve miles (twenty kilometers) an hour, the thought forces itself upon us that in the first place the utilization of power in the racing boat must be of superior order, for it, in spite of the great resistance of the water, to attain so high a speed.

The secret lies in the sliding seat that gives the oarsman besides the power of his arm also the utilization of his leg muscles. These were the considerations which brought Curry to the invention of rowing on land; that is to say, to bring the same utilization of muscles shown on the shell or racing boat to the land vehicle. A bicycle is driven by the power of the legs. This power can only represent the utilization of one-third of the muscular power in speed, because the utilization is only complete when the pedal arm is in a horizontal position. These considerations make it clear that a vehicle which is driven by full leg power as well as arm power, plus the power of the body, must attain a much higher speed.

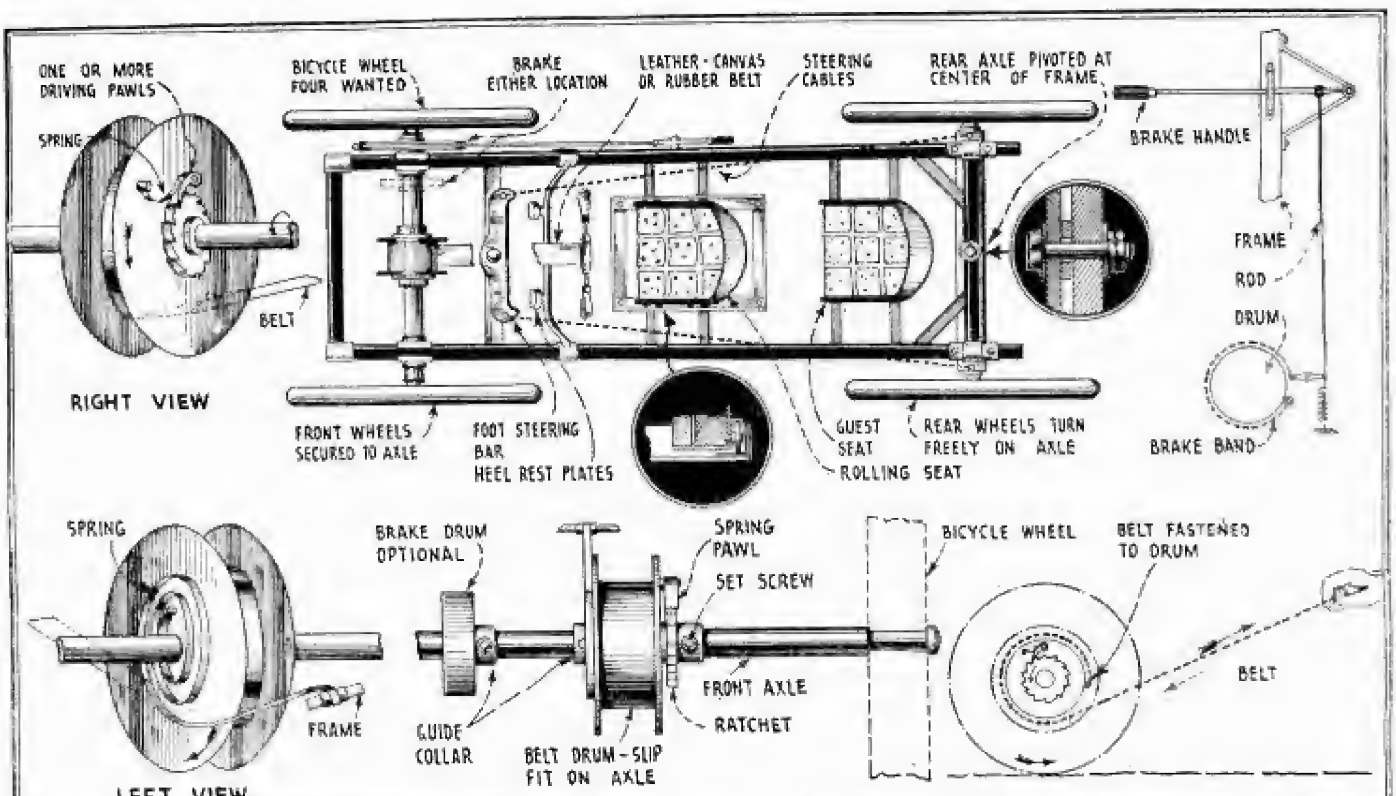
Now we come to the Curry landboat or Rowmobile; a vehicle with two to three gearings attains a speed of 30 miles an hour, a true sport machine for devotees of all kinds, especially for oarsmen as a training apparatus. From now on they can have their rowing races upon the open highway. The vehicle is equally well adapted for light athletics, for boxers, for reducing weight, and for medical application.

In this interesting street scene taken in Berlin, Germany, the latest vehicle, the Land-skiff, is to be seen. The Land-skiff or Rowmobile employs no engine but is propelled by the arm and leg action of the driver. Full details are illustrated below.

Moreover as a means for transportation, this machine is a rival to the bicycle. Not only is a much greater speed to be attained by better application of muscular power, but the muscles can be called upon separately in turn. For instance, one can work for a while with the arms only, or only with the legs, and so let the upper body rest. The body of the vehicle presents a great advantage. The little vehicle can be constructed as a closed limousine so as to be used in any weather. The air-resistance of the aluminum body built in streamline shape, is considerably less than the resistance offered by the air to a bicyclist. We all remember how hard it is to drive a bicycle against the wind.

Those desiring to build this interesting vehicle which is capable of an average speed of fifteen to twenty miles an hour, will find the accompanying drawing gives the necessary principles and details on which the machine is built. The four wheels may be of the bicycle type while the axles may be made from steel tubing or iron pipe. One idea for a simple brake is shown in the drawing, but other schemes may be used by the builder if desired. The greater the diameter of the belt drum, the easier will the vehicle be propelled, but at the sacrifice of speed, unless gearing is used. A fair diameter for the belt drum is six inches, the belt being two inches wide by one-eighth inch thick. The front seat rolls on wheels so as to give free motion to the legs as well as the arms. The vehicle is steered by pushing the toe against either side of the foot bar.

The parts for building the device can be found on the scrap pile or at bicycle shops



The Rowmobile can be made in many different ways, according to the material available to the constructor. The vehicle is propelled by means of a belt secured to a spring ratchet drum. As you pull on the belt handle, the pawls rotate the ratchet, which is rigidly secured to the front driving axle. Then the spiral spring retracts the belt, and the pawls slip over the teeth of the ratchet wheel freely, without exerting power on the axle.

Ancient Torture Methods

Part III

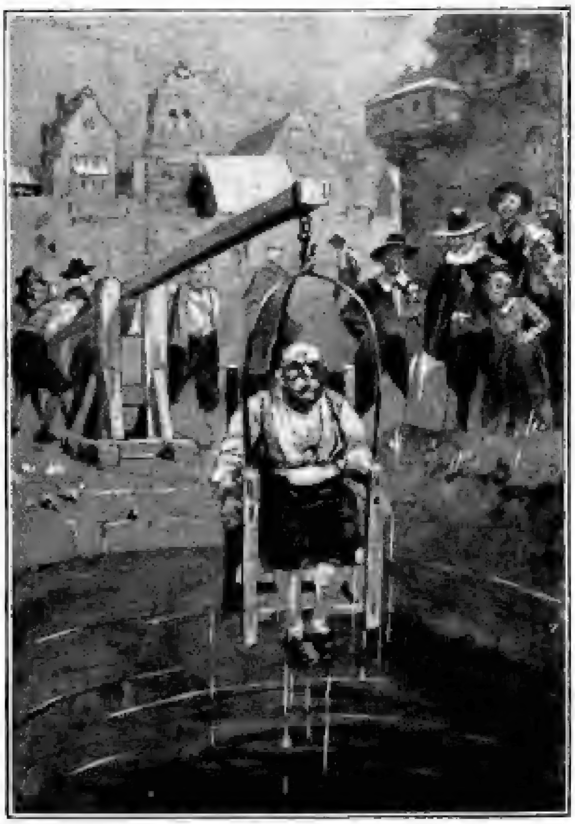
By T. O'CONOR SLOAN, Ph.D.

THERE is little doubt that if everyone followed at least the leading moral precept as formulated in the religious codes of the different peoples of the earth, or even if the golden rule would be literally carried out, government and statutory legislation might properly cease, but the awful crimes which are chronicled day by day in this country, Chicago's daily murder, lynchings and the infliction of torture ranging from flogging to burning alive inflicted by mobs whether named or nameless, indicate the necessity for statute law. A lawyer friend of the writer defines law as the "rules of the game," just as we have rules for playing card games. Within a few days of this writing, a foreigner who had been in prison for eight years for an alleged murder, which he never committed, and whose condemnation was due to the fact that the interpreter who served in court did not understand the dialect in which he spoke, has had his innocence recognized and published, and now society, often a monster of injustice, proposes to deport him, but not a word has been published of any proposal to remunerate him in any way, or give him any compensation for what was done to him.

Some years ago we could read in the papers of the burning of an unfortunate negro, alive, and it is said that he got free from the bonds enough to try and escape from the flames and was pushed back by the crowd, so it seems that legal statutes are insufficient to prevent crime, that the golden rule is held sacred by so few people that its effects are but slight, and that religion with its spiritual code has not yet reformed the world. And it is, at this epoch in the world's history, when such deeds as these are perpetrated over and over again, when the modified torture of the third degree is practised by the police that people go back four, five and six hundred years in the world's history and attack the methods of those days without apparently thinking of what is done in this 20th century in a civilized country.

The mixture of religion and politics is a bad one. This is pretty generally conceded, but the mixing process goes on at the present day and when our criticism of past eras is based largely on the specific desire to criticize unfavorably different religious tenets, the criticisms are not worth very much.

The most extraordinary discrepancies occur in the detail of the number of victims, so much so that one is forced to the conclusion that the statistics are of very little value and that the large numbers are grossly exaggerated. Thus it is stated that between 1308 and 1323 only 42 who were convicted of heresy were handed over to the secular authority which means that they were executed, and that in the same period of time only 930 were convicted of heresy.



The Ducking Stool. This may fairly be termed one of the milder tortures of our forefathers, although the feeling of utter helplessness when immersed in water and going through the agony of suffocation made it no light punishment. It seemed to have been applied usually to women. Here a man is the sufferer.

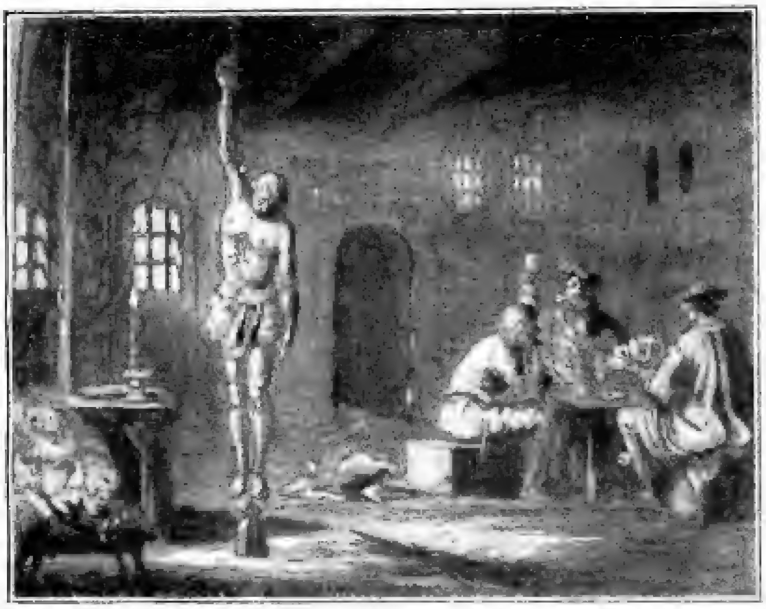
Now suppose that every murderer in the United States was executed, remembering that for one of our cities a murder a day is claimed, the deaths in the United States per annum as inflicted by law would run up into the thousands.

In the middle ages, religion and politics were very closely united, probably as closely as they are today in the State of Tennessee. So those who wish to condemn the ways of the Church of the Middle Ages, depict the dreadful doings of the Spanish inquisition. The doings of the Spanish inquisition were those which had been done since the centuries preceding the Christian era—torture for the purpose of eliciting confession or getting testimony from witnesses had been the custom for centuries, and is practically approved of by many people of the present day. The number of victims of the Spanish inquisition is not known, so it presents a convenient field for exaggeration and it is hard to abuse the customs of that day without dragging in the church, even if it were desired to do this.

In preceding articles of this series, some attempt was made to reveal the psychology of what is on the whole a rather dreadful subject. And we said something about the numbers affected by the wretched system, but it is probable that if people were asked at what period of the world, and for what cause or causes, the greatest number of victims were tortured and killed by fire, the first off-hand answer would be—in Spain, in the 13th and 14th centuries, and perhaps later. But there was an era when the burning alive of innocent people was carried out to a greater and frightful extent—when the law tortured and burned alive countless innocent victims and when a wave of it swept across the Atlantic and for what was fortunately a very brief period, stained the history of New England. The system was upheld as it was by the grim and celebrated clergyman of the period, the son of the President of Harvard University, the Puritan writer, Cotton Mather. We are alluding to the so-called "witchcraft."

The belief in witchcraft was widely spread in the early centuries and in the 16th and 17th century, superstition and the civil law, united in a firm union and attacked this subject. In carrying out the iniquitous proceeding, the old, illogical theory of extorting a confession by torture was applied right and left to numberless victims. If a person was accused of being a witch, or if suspicion attached to him or her, this was enough to justify in the iniquitous code of the time, the application of torture to extort a confession, and the confession meant hanging or burning alive. A person who was accused was supposed to plead guilty or not guilty. If he or she pleaded "not guilty," the victim could be tortured to extort a confession. In England, if an accused person refused to plead, the law, recognizing the hopelessness of doing anything, crushed the accused one under great weights, apparently with some

(Continued on page 371)



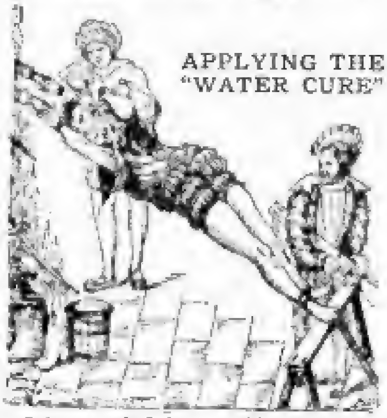
This is a variation on the Strapado, but a little in the direction of mercy. In the strapado both arms were dislocated at the shoulders, but here the agony is concentrated on one. The guards are enjoying themselves in the background.

As the Ancients Gave "Third Degree"

IN THE BASTILLE

A prisoner in the Bastille. In its last days there were very few prisoners in it. The revolutionary mob seem to have destroyed it as a symbol.

APPLYING THE "WATER CURE"

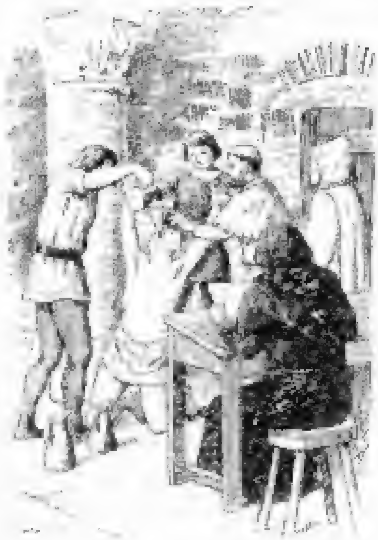


The victim stretched in a position involving the torment of the rack is having water poured into him. It will be remembered that during the Spanish American War the "water cure" was inflicted.

TORTURE IN RECENT DAYS

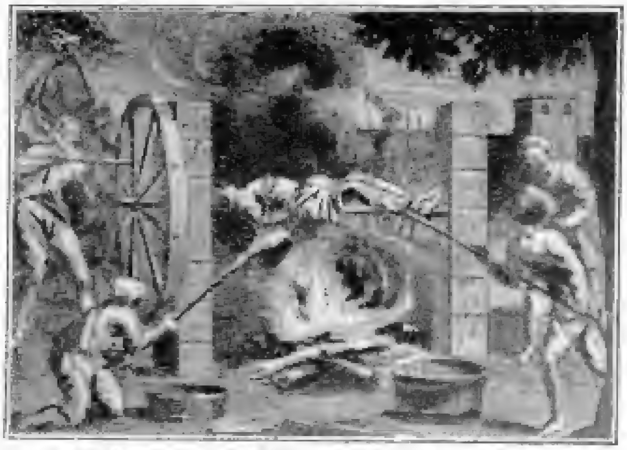
Upper right, a prisoner in Auburn State Prison in this state was subjected to the water torture, and died under the effects. The inquest and trial each had the aspect of a "whitewash." Many of the ancient tortures involved the use of water in various ways. Some of these water tortures were described in previous articles of this series.

THE "WATER CURE"



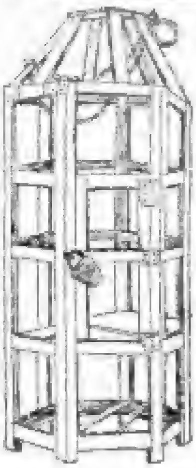
Here we have an example of the "water cure" plain and simple. It is supposed to have been a very severe torture.

THE HUMAN TURNSPIT



A victim roasted on the spit as if he were a joint from the butcher shop.

A CAGE

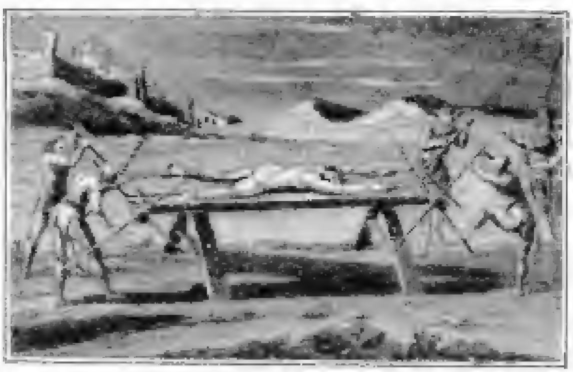


A cage in which the victims were locked up and exposed in public. It was often mounted so as to be turned by hand. The torture was in the direction of the character of mortification and disgrace.

LAPIDATION

The victim is dragged over the ground by a horse, while stones are thrown at him so as to kill him eventually perhaps by an accidental Coup-de-Grace. The Jewish lapidation was very specifically regulated.

TORTURE ON THE RACK

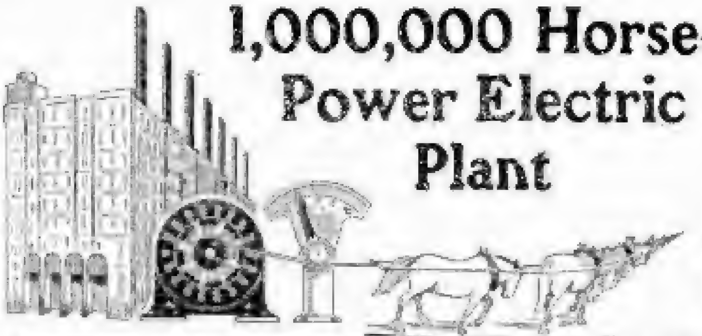


The illustration needs no description. It is the famous stretching the victim on the rack. Among the historical victims was the celebrated Guy Fawkes. His signature after the torture was so affected that it told the story.

THE WITCH'S BRIDLE

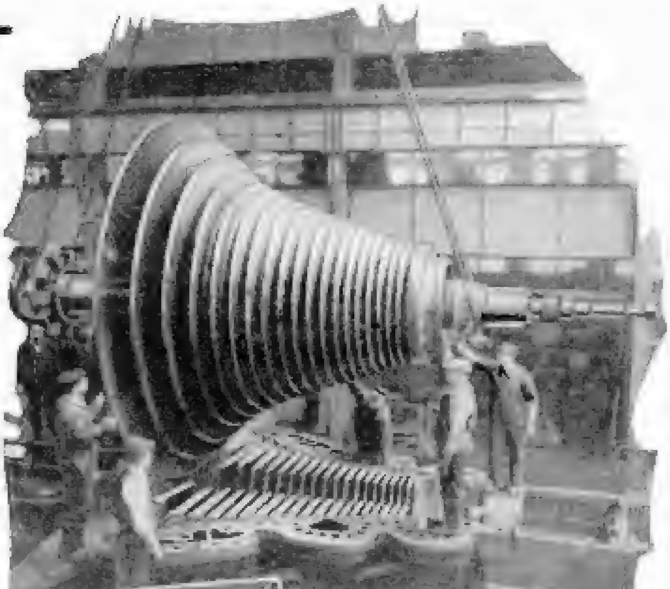
These cage-like metal masks were used on other criminals than witches, although they were given the title of Witch's Bridle. Here a modicum of torture was combined with the mortification and disgrace of the exposure.

1,000,000 Horse-Power Electric Plant



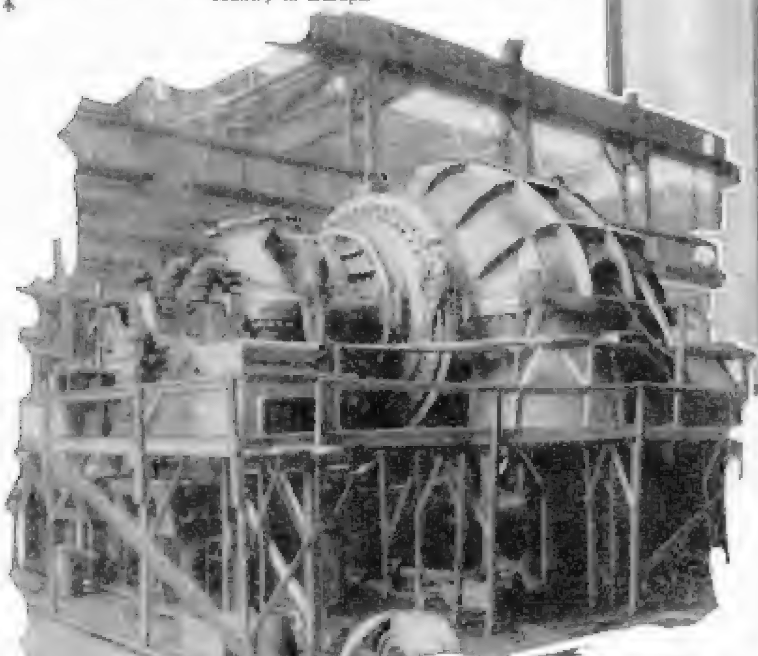
The new East River central station will produce as much power as that used in France last year; France is the best lighted country in Europe.

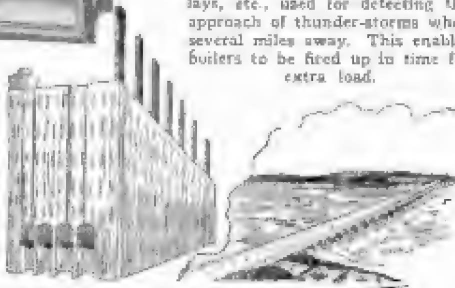
The 1,000,000 H. P. central station of the New York Edison Co. now building, could outpull 2,000,000 horses in U. S.



The photo above is a very exceptional one in that it shows clearly the remarkable steam turbine blades and relative size as compared with a man; these steam turbines will drive the huge electric generators in the new East River station of the New York Edison Company. The station will contain nine of these gigantic steam turbo-generators, each having a capacity of 60,000 kilowatts or 80,000 horse-power; together with additional equipment which will give a total capacity of 700,000 kilowatts, or 1,000,000 horse-power.

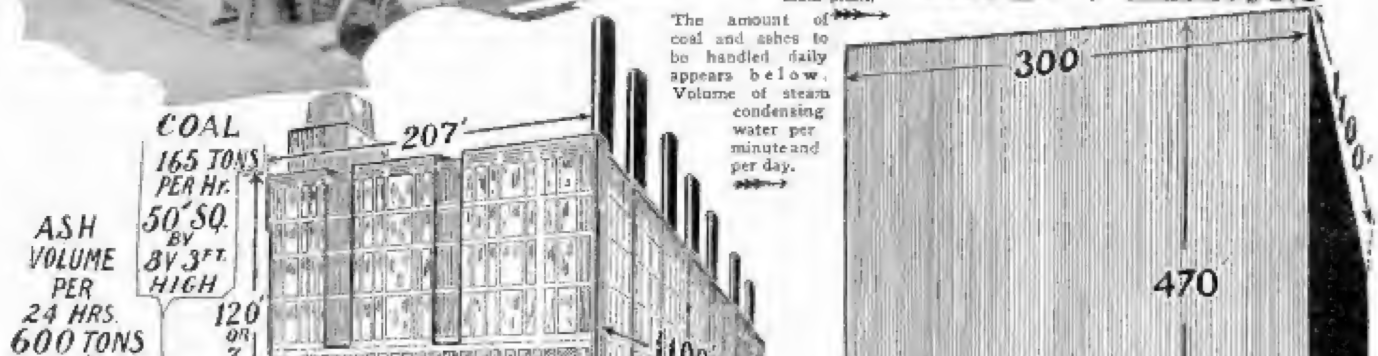
The photo at the extreme center left shows the relative size of a man in comparison to one of the huge 60,000 kw. steam turbines, which is shown under test. These mighty steam turbines will be the biggest units of their kind ever built. The glass door cabinet at the immediate left shows radio coherer, de-coherer, relays, etc., used for detecting the approach of thunder-storms when several miles away. This enables boilers to be fired up in time for extra load.





The new 1,000,000 H. P. central station of the New York Edison Company will produce 100,000 more kilowatts than Muscle Shoals' main plant.

The amount of coal and ashes to be handled daily appears below. Volume of steam condensing water per minute and per day.

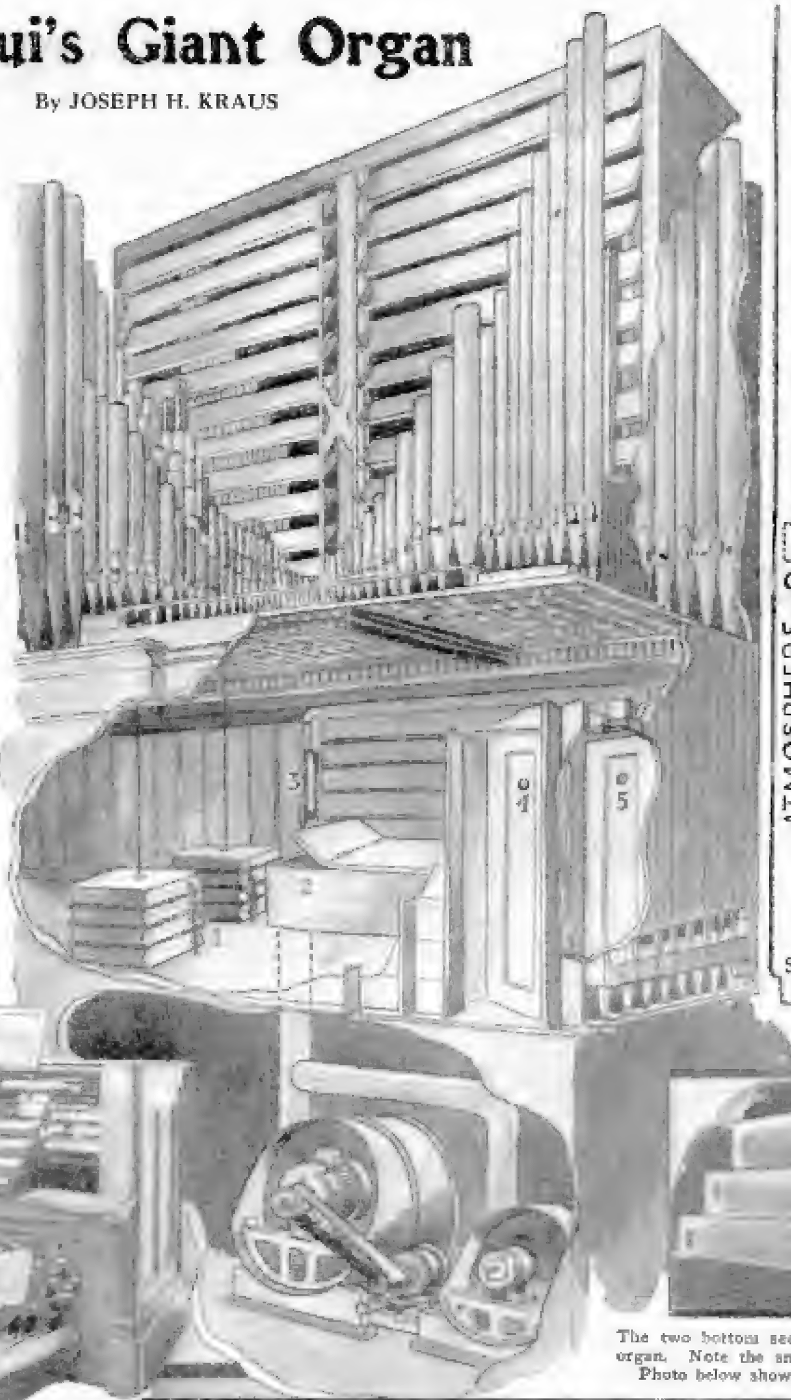


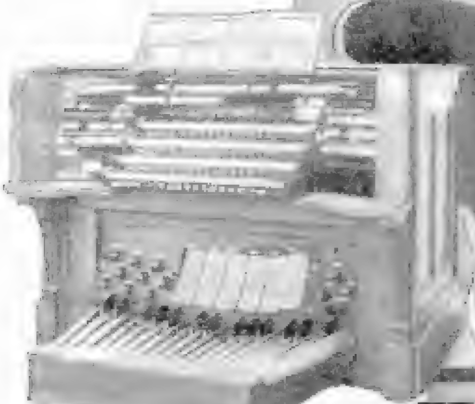
For steam condensing purposes the new central station will borrow and return 800,000 gallons of water from the East River each minute; volume 50x50x43 ft.

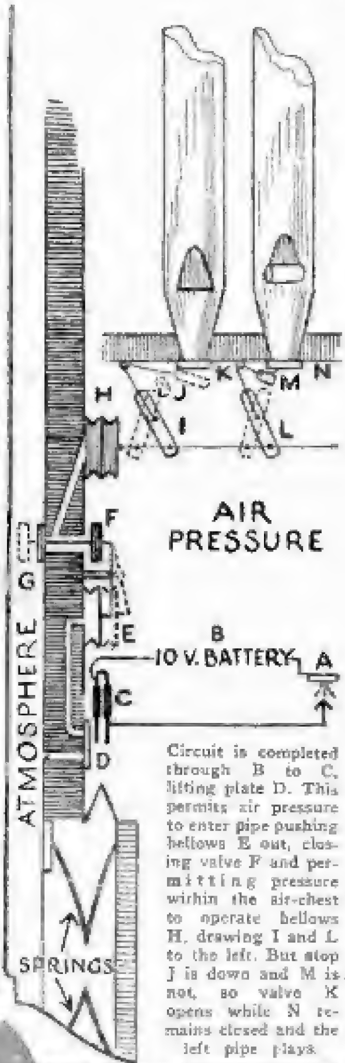
The Sesqui's Giant Organ

By JOSEPH H. KRAUS

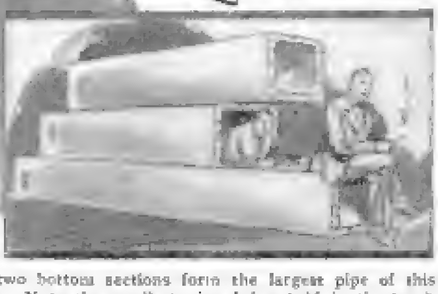
THE world's greatest organ is to be found at the Philadelphia Sesquicentennial Auditorium. This organ, built by the Austin Organ Co., contains over 11,000 pipes. The largest of the pipes is thirty-four feet long and the smallest three-eighths of an inch long. The air supply for the organ is obtained from two blowers, one operated by a 40-h.p. motor and another by a 2-h.p. motor. The diagram at the right showing the construction of the organ shows only a small part of this immense structure. Beneath the pipes one finds an immense chamber, access to which is obtained through doors four and five. Inasmuch as the air pressure in the interior of the chamber is greater than atmospheric pressure, the valve immediately above the number four on the door, must be opened before you can enter the air-lock. After door 4 closes, door 5 may be opened by permitting the pressure to enter the air-lock by lifting the valve on the door. Looking up toward the ceiling one sees masses of wires, magnets and valves and on the floor one finds several accordion-like boxes which slowly or rapidly move up and down. These are indicated by numeral 1. These devices control the louvres or swell shutters.







Circuit is completed through B to C, lifting plate D. This permits air pressure to enter pipe pushing bellows E out, closing valve F and permitting pressure within the air-chest to operate bellows H, drawing I and L to the left. But stop J is down and M is not, so valve K opens while N remains closed and the left pipe plays.



The two bottom sections form the largest pipe of this organ. Note the smallest pipe being held in the hand. Photo below shows size of the world's largest organ.

THE beauty of this universal air-chest system, as this large room into which the pipes open is called, is that repairs may be effected while the organ is in actual operation. In addition to that the rear wall indicated by 3 in the upper diagram is movable. Its purpose is to take up the space when a very large quantity of air is suddenly withdrawn from the air-chest. It will be noted in the detailed diagram in the upper right hand corner of this page, that this wall projects into the room and is held by a group of springs. Now, as the room becomes filled with air, the wall is pushed out. Should ten or more keys be suddenly depressed, immediately a great volume of air will escape. This moving wall permits of a sustained note of consistent volume. The photograph above shows the keyboard.

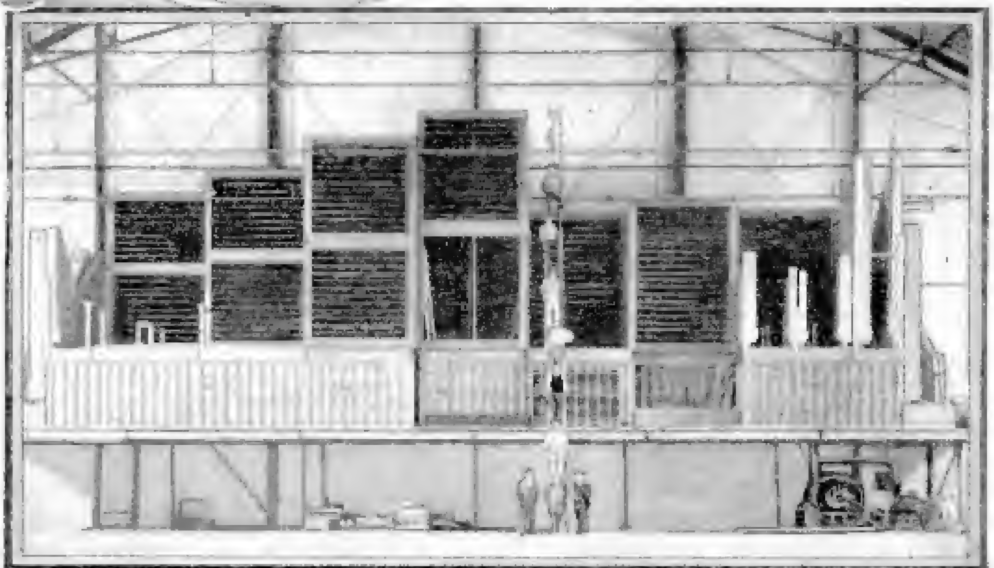


Photo courtesy Austin Organ Company.

Sept. 25 Cents

WRNY

Science and Invention

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THE DREAM RECORDER

See Page 398

40 NON-TECHNICAL RADIO ARTICLES

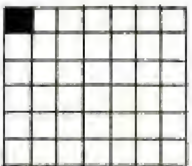
EXPERIMENTER PUBLISHING COMPANY, NEW YORK, PUBLISHERS OF
RADIO NEWS - SCIENCE & INVENTION - RADIO REVIEW - AMAZING STORIES - RADIO INTERNACIONAL

Microscopic Engraving

Lord's Prayer Engraved on Pin Head

By R. P. TOLMAN

Assistant Curator, Division of Graphic Arts, U. S. National Museum.



The micro-engraving of the Lord's prayer below was made in 1/781,250th square inch. The entire bible engraved on this scale would occupy but 1/49th square inch.

THE first micro-engraving that I ever read (I had seen others with the naked eye, but nothing but glass was visible) was one which was sent to me in the form of a letter, it was clearly seen through the eye of a needle. But before it could be read it was necessary to enlarge it 85 times by a high power microscope. This micro-engraving covered about 1/11250 of a square inch. The reproduction is enlarged about 70,000 times. This had been prepared by Alfred McEwen of New York City, for a Regents meeting of the Smithsonian Institution where it created much interest. It reads in part: "This is a crude, hurriedly prepared large sample of 'Micro-engraving.' The writing was done with pencil on a 4x7-inch tablet. One a little larger (Fig. 1), is one one-hundredth of an inch in diameter; the ruled lines are less than 1/1,000th of an inch apart; this illustration measures about 4¼ inches and if it was exactly 4¼ inches in diameter, it would contain 12.3518 square inches; and if it were possible to engrave all over a sheet of glass that big, this same letter with its illustration would have to be repeated 123,518 times to cover it.

The micro-engraving shown at right was done in 1/100 inch circle.

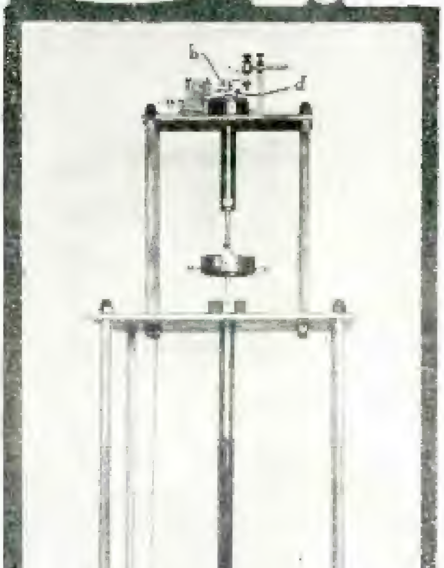
When we are confronted with statements like this we are all liable to use a little word of four letters. Before this article is finished you will probably want to use this little word several times, but every statement is fact.

Just one more illustration, before I tell you how these infinitesimal engravings are made. The Lord's Prayer is commonly used in things of this kind, for example, it has been engraved on the head of a large pin, and it has been cast on a typed body, one-sixth of an inch square and in micro-engraving it has been used extensively. Mr. McEwen sent one of his smallest engravings of the Lord's Prayer to the Bureau of Standards, Washington, D. C., to be measured. Their report gave the dimensions as 0.0016 of an inch by 0.0008 of an inch high.

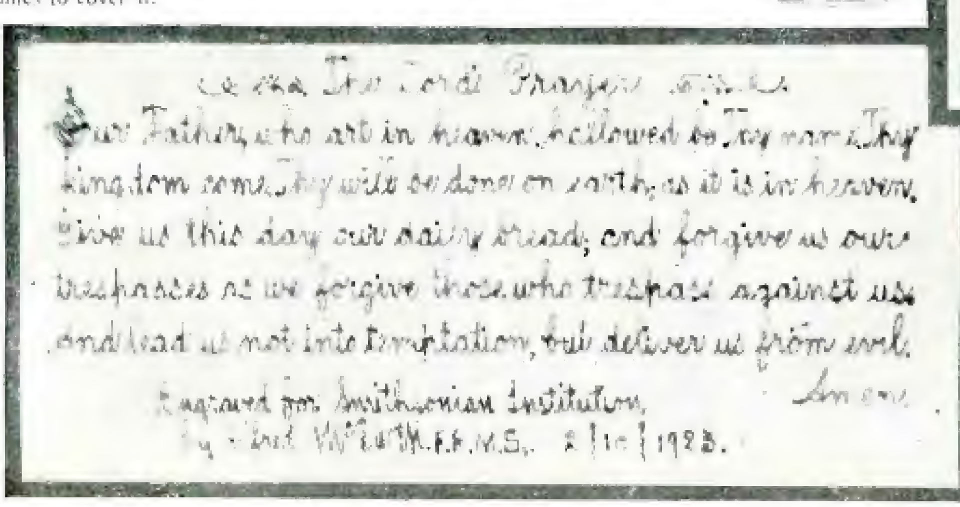
Now if you will multiply these figures you will find that one Lord's Prayer of this size will cover only 1/781,250th of a square inch, in other words the 227 letters in this prayer would have to be engraved 781,250 times to completely cover one square inch.

I don't blame you for shaking your head. Fig. 2 is a reproduction of this micro-engraving, it is not as clear as the larger ones, but it can be read. The distance between the top of the top line and the bottom of the last or seventh line is 1/1,250th of an inch. The paper on which this article is printed is about 1/400th of an inch thick, therefore the seven lines of this engraving could be repeated three times in a space equal to the thickness of one page of this magazine. It does not seem possible. To carry this comparison along a little farther. The fifty-six words of the Lord's Prayer contain 227 letters and on this scale 177,343,750 letters could

(Continued on page 450)



The diagram at the right shows in simplified fashion how micro-engravings are made. The person doing the writing takes the pencil in hand and writes out in ordinary sized letters the sentence or other material to be engraved in a fraction of a square inch. As will be seen at once the short length of the upper arm with respect to the greater length of the lower arm, causes the handwriting to be markedly reduced in size. The micro-engraving is done by means of a highly polished diamond point made with the finest precision.



The Lord's Prayer
Our Father who art in heaven, hallowed be Thy name, Thy kingdom come, Thy will be done on earth, as it is in heaven, Give us this day our daily bread, and forgive us our trespasses as we forgive those who trespass against us, and lead us not into temptation, but deliver us from evil. Amen.
Engraved for Smithsonian Institution,
by Alfred McEwen F.R.M.S. 2/10/1923.

The Dream Recorder

By HUGO GERNSBACK

The dream-recording machine attached to the sleeper, who is under observation. The dream, in changing the heart beat, makes its presence known immediately. If the sleeper sleeps peacefully, without dreams, the heart action is normal. See Fig. 2.

"WELL, how did you sleep last night?" says your host, as he pats you on the back.

"Fairly well," you retort, "But that Welsh Rarebit gave me such a beastly nightmare I couldn't go to sleep again for a few hours."

This is the sort of conversation we hear very frequently, but we laugh it off, and the world moves on.

Few people, if any, ever give a thought to the *reason* for our dreaming. From ancient times on, dreams have been looked upon with great superstition, and even today dream books are consulted for an interpretation of this or that dream. The mechanics of the dream itself, from the psychical viewpoint, have been studied by many philosophers and scientists, but few, if any, ever gave any thought to the primary cause of dreaming.

PRIMARY CAUSE OF DREAMS

It may be said that 90 per cent. of our dreams lead right back to our stomachs. That this has not been recognized more widely has always been a mystery to me. It is, therefore, not the brain that is primarily responsible for dreams, but, rather, the stomach. If you go to sleep with a comparatively empty stomach, that is to say, after your food has been digested, and has left the stomach, the chances are that you will have a good night's sleep and that you will not dream at all. Of course there are exceptions to this, as to anything else, but in the great majority of cases you will find that this is the truth.

When you have slept "like a top," it simply means that you have not dreamt. The person who sleeps best, and is most refreshed by sleep, is that person who does not dream. The term "pleasant dreams" should be abolished, as soon as possible. There is no such thing, in my opinion, as a "pleasant" dream. *All dreams, whether pleasant or unpleasant, interfere with your rest,* and if you do need the rest and do wish to wake up refreshed in the morning, then it is best to stop dreaming.

This seems a rash statement, but the point is that it is possible to prevent dreams, if dreams are harmful, as I shall show. Most foods take anywhere from two to six hours to digest. Some foods take even longer than this. The table reproduced herewith shows this clearly. Due to means not exactly understood today, there is an unusual nervous reaction between the stomach and the brain, while we are asleep, so that a full stomach with slow-digesting food causes constant dreaming, often of the nightmare kind.

My own theory is that the process is somewhat as follows: The minute you lie down and sleep, and the stomach is still working while digesting its food, the gases usually thus developed, press against the heart, causing an oppressed feeling, which is then, by nervous reaction, reflected to the brain, thereby inducing harmful dreaming.

FATAL DREAMS

This kind of dream is distinctly dangerous, often even fatal. A great many people die in their sleep. For instance, Mr. William Jennings Bryan died in such a sleep. It is quite probable that sleepers of this kind meet their death directly due to nightmares, or other fear-inducing dreams. For example, if, during a nightmare, as happens to all of us, we fly through space, or fall down a precipice, we usually wake up all covered with perspiration, and the heart beating violently. If the heart is sound, no

DIGESTION OF DIFFERENT FOODS IN STOMACH

These foods leave the stomach in two to three hours:

Boiled Milk, Eggs, raw, poached, or omelet: Beef Sausage, Sweetbreads, Oysters, Whitefish, Shellfish, Asparagus, White Bread, Rusks, and Biscuit.

These foods leave the stomach in three to four hours:

Chicken, Lean Beef, Boiled Ham, Roast Veal, Beefsteak, Salted Caviar, Coarse Bread, Boiled Rice, Boiled Cabbage.

These foods leave the stomach in four to five hours:

Smoked Tongue, Smoked Beef, Roast Goose, Salt Herring, Lentil Porridge, Pease Porridge.

An ordinary dinner leaves the stomach in four to five hours. Foods are divided into four groups, according to the ease with which they are digested. The first group contains the most easily digested foods:

(1) Beef Tea, Milk, Soft or Raw Eggs, Biscuit.

(2) Boiled Calves' Brains, Sweetbread, Boiled Fowl, Pigeon, Calves' Feet.

(3) Scraped, underdone Steak, Potato Puree, Stale Bread.

(4) Roast Chicken or Pigeon, Roast Veal, Cold Roast Beef, underdone, Whitefish, Macaroni, Rice, Chopped Spinach.

NOTE: There are exceptions to all of these, because food is digested more quickly by working men who consume energy than by those who sit still or lie down.

damage results, but if the heart is defective, often a heart stroke or the bursting of blood vessels occurs, with the immediate death of the victim. *Any one with a weak heart, therefore, should never indulge in heavy food before going to sleep,* whether it be an afternoon nap, or the night sleep. If he does, a fatality may result, directly due to a dream.

Even the most pleasant dreams, which have nothing to do with the digestive organs, affect the heart action. You may sleep with a totally empty stomach and still have a dream. In that case it probably never is a fear-inspiring or nightmare type. It is of the variety termed a "pleasant dream." A dream may be induced in a sleeper by scent, or perfume, by a slight noise in the room, by touching the sleeper's body at any point, by a change of temperature, by a change of barometric pressure, by a nervous shock during the day, and a thousand and one other means. Such dreams are of a very short duration, as a rule, and do not greatly interfere with the sleep itself, although I maintain that it is best not to dream at all.

IF YOU DREAM—SEE YOUR DOCTOR

For that reason, if you are inclined to dream much, you should consult a physician and re-arrange your diet in such a manner that through the experience which you will shortly gain you will dream less and less. You will have to experiment on yourself, as no two individuals are the same. Some people find that they sleep much better by drinking a glass of hot water or milk before retiring, or some other harmless liquid. All of this will have to be experimented with until you find the correct formula.

The sleeper's position in bed is also most important. Some people dream excessively when sleeping on their left side. This is but natural, because the heart, under compression, gives rise, very often, to fear complexes, especially in nervous and excitable people. It becomes then a matter of training to sleep on the right side or in such a position that no dreaming is induced. This is a matter of experience also, and here a little self-hypnosis often does wonders. If you are inclined to sleep on your left side, and if you know this induces bad dreams, all you have to do, before retiring, is to keep on repeating, *with as much will and concentration as you can muster,* that you will positively not sleep on your left side that night, and keep on repeating this in the well-known Coué form, nightly for several weeks. You will find that by willing strongly enough, you can cure yourself from sleeping in any position that you do not wish to assume.

ACTUAL DREAM RECORDS

In order to test what has been said before, I decided to make actual tests upon sleepers, and the illustrations here show the results of these tests. Recourse was had to a heart and pulse testing machine, known as the "Polygraph." The Polygraph is a very sensitive instrument, which, when strapped over the heart or on the wrist, will give an exact record of the heart beat. The instrument is exceedingly sensitive and records not only the breathing, but the heart action as well.

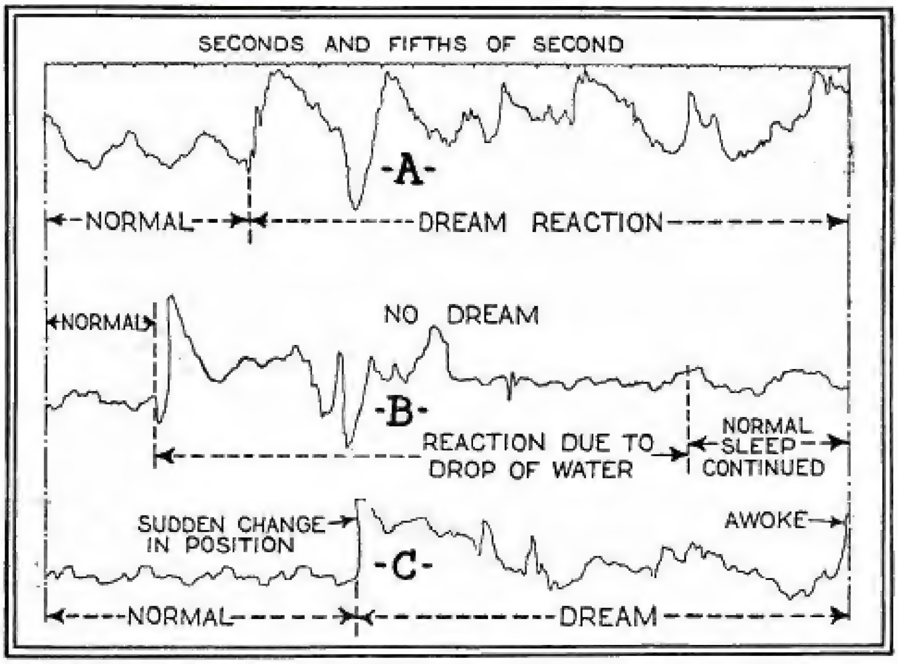


Fig. 2. Actual records of dreams taken with the Polygraph. Note the dream reactions, which increase heart fluctuations above the normal.

In order not to go into any great technicalities, it may be said here that a great number of records were made in our laboratories, and my theory that dreams could actually be recorded is now a fact. While the technique of dream recording has not been carried to a logical conclusion, I wish to state here that whatever results we had in the laboratories were very encouraging, and I hope that much good will come from the future recording of such dream actions. I believe that in due time physicians will find it necessary to record the dream actions of their patients if they dream too much, which consequently interferes with their health.

At this point I also wish to explode an old theory that dreams are of a very short duration. We actually found the reverse true, at least the polygraph recording the heart action, showed that a dream lasts at least a number of seconds, and not fractions.

It is obvious, from the records obtained in our laboratories, that during the process of dreaming, the heart action is materially stimulated, and respiration is also accordingly increased. All of the cases which came under our observation produced the same effect, when a dream actually occurred.

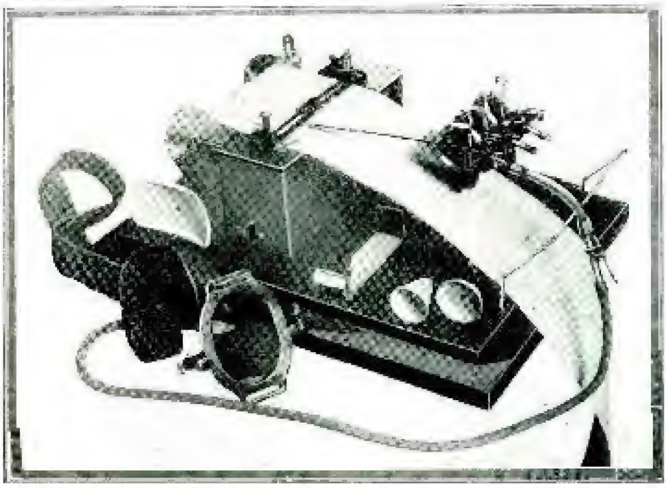
The tests not having been carried on over an extended period, we had no chance to observe a *nightmare* or startling dream, but it is quite apparent from our records that if there had been such the resulting action would have been greatly increased. In our illustration, Fig. 2, we show actual records taken by the polygraph.

In case "A" it will be observed that the apex beat increases almost instantly to four times the normal sleeping rate. In "B" and "C" on our graph it becomes difficult to actually note the apex beat because of the influence which breathing has upon the heart record.

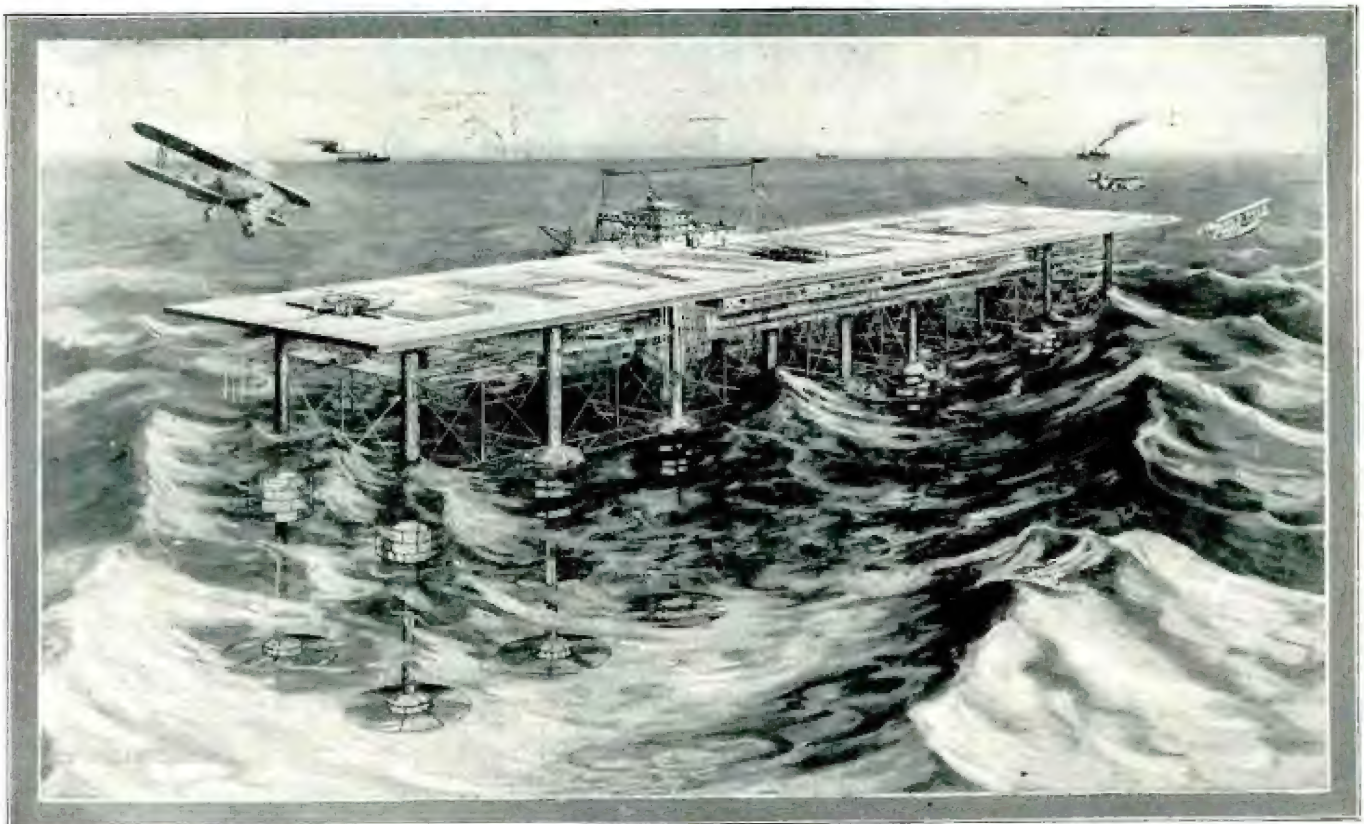
The gradual undulations of the curves in the normal record are produced by the process of inhaling and exhaling. The inspiration in all of the cases is much greater under the excited reaction of a dream than in the normal sleeping state. Notice also that the respiration is changed when the subject changes his or her position during sleep, and you will also see that when dreaming, in case "C" the heart rate was stimulated immediately after the change of position.

In "C" an electric bell was used to awaken the subject, being rung softly at first and then permitting the bell to remain quiet until the subject again assumed normal respiration and heart curves, and then the tone was increased until the subject eventually awoke. Although a slight disturbance took place every time, it was not as marked as just before awakening, at which time this patient recalled a dream of an alarm clock awakening her and summoning her to work.

It is obvious from records which have been obtained that dreams do affect not only respiration but also the heart beat, and that the dreams of some subjects stimulate the heart to a greater extent than those of another. It is believed that this is the first attempt made to record heart action during sleep, laying particular stress on the heart action of subjects who dream a lot. The experiments have not yet developed to a point where a record was taken during a nightmare or one taken of an individual who frequently walks in his sleep.



The Polygraph Recorder — primarily built to record the heart and pulse actions, and used here for the first time to record dreams.
Photo, courtesy of E. Leitz, Inc.



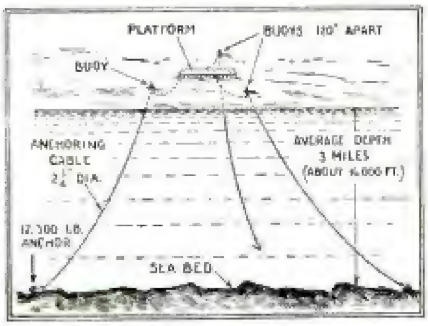
Above we behold one of the eight seadromes or airplane landing stations spaced 400 miles apart across the Atlantic Ocean, as proposed by a well-known American engineer, Mr. Edward R. Armstrong, of Wilmington, Delaware. These huge landing stages would be about eleven acres in extent, measuring 200 ft. by 840 ft. They would have deep draught, as great as 150 ft., so as to have their buoyancy chambers and legs below the wave depth.

Ocean Stations for Airplanes

Photograph at left shows scale model of the Armstrong ocean landing stage under test in tank with waves 70 ft. high. Note that this remarkable design of platform preserves a practically level surface, while the waves break through it rather than against it.

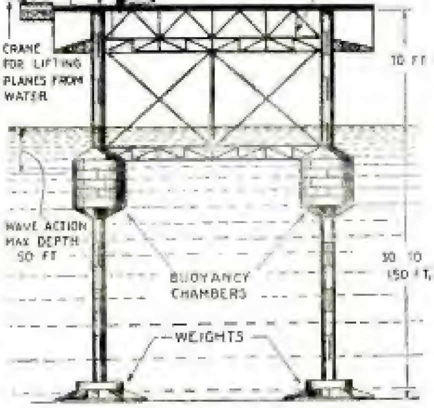
Photo at right shows model of seadrome and also model of steamship "Majestic" under test in tank with 50 to 60 ft. waves; note that platform is practically level, while steamship "Majestic" is diving downward, practically overcome by the huge waves. The average height of ocean waves is 50 ft.

STARTLING as it may seem, a prominent American engineer, has actually worked out the technical details for an ocean landing platform or seadrome, on which Trans-Atlantic airplanes can land. One of the most interesting questions that arise in connection with such a project is that of anchoring the seadromes along the route across the ocean. Mr. Edward R. Armstrong of Wilmington, Del., chief research engineer for the famous Du Pont Powder Company, is the man responsible for this latest development in trans-oceanic air travel, and as the accompanying drawings show the platforms are to be anchored by three steel cables, extending down through three miles of water in some cases to 12,500 pound anchors. The platform can shift back and forth as waves and storms may dictate, and plenty of latitude is permitted due to the long cables. If the platform should move half a mile or more, it would make no difference to the airplane pilots.



Method of anchoring seadrome, utilizing stranded steel cables 2¼ inches in diameter.

As the picture on the opposite page shows, the seadromes would be marked at night by powerful colored searchlight beams, each station having its own particular color. Located fifty miles apart along the airplane route would be marker buoys, each buoy being illuminated automatically as darkness approached. The eight large seadromes, each measuring 200 ft. by 840 ft. and covering 11 acres, would be veritable floating hotels. Repair shops and storage space are provided for in the present designs of Mr. Armstrong, and radio as well as other signalling means are arranged for. Each station has its own name which is illuminated at night. The inventor has prepared tabulated data proving that this is the only feasible method for transporting passengers across the ocean for the principal technical reason that if no such sea stations are utilized, then the planes can only carry about four passengers, the balance of their carrying capacity being occupied by fuel; the same airplane using Mr. Armstrong's scheme can carry forty passengers. Based on 100,000 passengers per year, the annual difference in cost in favor of the sea station route is $14,080,000. Mr. Armstrong's scheme calls for 24 planes total, while without sea stations 240 planes are required.



End view of seadrome. The buoyancy chambers can be placed below the wave action depth.

How Airplanes May Skip Across Ocean

THE realistic night scene above shows two of the Armstrong seadromes or landing stations for airplanes, as they wing their way across the Atlantic from America to England. Each station would have its own colored searchlights, enabling the pilots to distinguish each station if necessary. Located 50 miles apart along the aerial route are illuminated buoys anchored in position by cables and anchors. The large plane shown above has a capacity of 40 passengers and luggage and carries signal as well as landing lights. Hotel accommodations are provided on each platform for those desiring to stay over night. Owing to the clever design of these landing platforms, the waves break through them rather than against them. The buoyancy chambers supporting the platform are placed deep enough to escape the wave action, extending about fifty feet maximum.

The most gigantic and terrifying cataclysm ever witnessed by man was probably that which took place when the Aegean Continent subsided so that water completely covered everything except the highest mountains. As the picture above shows, the onrushing tidal wave swept everything before it. Earthquakes caused giant cracks to open in the face of the earth, while volcanoes belched forth smoke, rocks and boiling lava. Imagine such a catastrophe occurring today, especially in the vicinity of our larger seaports like New York City or San Francisco.

The World's Greatest Cataclysm

By PROF. DONALD H. MENZEL, PH. D
(Department of Astronomy, Ohio State University)

THE most gigantic cataclysm ever witnessed by man doubtless occurred when the Aegean Continent subsided, as the picture above shows, and as the map drawing below and on the opposite page also illustrates. The time of this cataclysm is comparatively recent, contrasted to the millions of years that constitute every geological period. This subsidence occurred since the last glacial epoch. A flint knife discovered in deposits laid down before the catastrophe, proves that man was present. Cross in map below shows where flint knife was found. The contour in depth-map below shows what the general shape of the continent was.

The two views herewith showing cross sections of the caves of Capri, Italy, give proof of the sinking of the coast.

While the original subsidence was probably quite rapid, accompanied by floods, earthquakes, and volcanic eruptions which would destroy all life in the basin, it is interesting that it is still slowly continuing in spots.

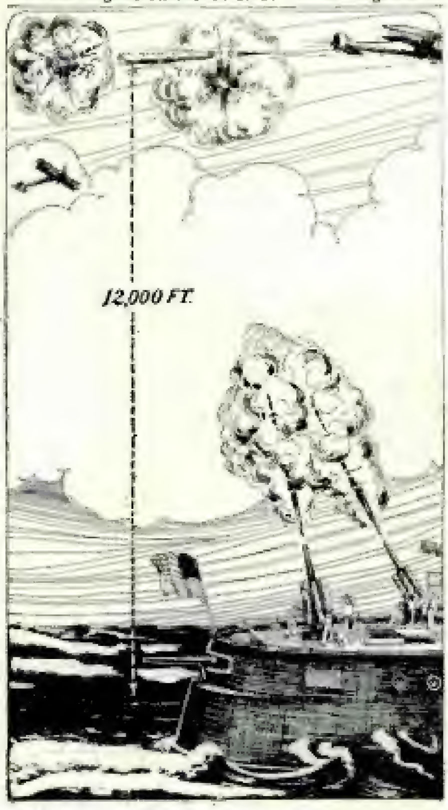
The two pictures above show the effect of the subsidence in the caves of Capri, Italy. The formations known as stalactites and stalagmites take place only in air. The fact that we find them submerged in caves proves that the water level has risen considerably since they were made. The unsettled condition of this region is further evidenced by the number of active and extinct volcanoes which surround the Aegean. It is not a coincidence that the three great prehistoric civilizations surround the vanished continent. From the similarity of their arts the parent race apparently was scattered in all directions.

The physical map above shows the positions of the centers of ancient civilization at the time of the great flood, caused by the subsidence of the Aegean Continent. It is thought, due to the similarity of their arts and legends, that the parent race was scattered as arrows show.

THE maps at left and above show centers of ancient civilization. It seems from a study of the subject that the parent race living in the center of the continent was scattered in all directions by the catastrophe. The origin of the flood-myth common to many peoples, the cradle of civilization and the source of language and art, by this theory, rest at the bottom of the sea. The location of the ancient seas and the land bridge to Africa are shown clearly on the map.

Air Bombers Beware

In recent aerial target practice sleeve targets were shot down from a height of 12,000 feet by five inch guns on the U. S. S. "West Virginia."



Grass-Growing By Electricity

EXPERIMENTS in the use of electric light at night for promoting the rapid growth of grass have been tried under outdoor conditions on the Jumping Brook Golf Club's course in New Jersey. A clay gravel site was dug, and the top soil from another portion of the land used to provide about fifteen inches of soil for the green, which was sown early in June, and over a portion of it were erected 24 special reflectors, each containing a 1,000-watt tungsten bulb. The reflectors were hung four feet from the ground and gave a continuous even light. The light was switched on on June 6th, and for the next 21 nights. The weather was unfavorable to the rapid germination of grass seed, but the first seed came through under the electric light five days after planting. Nothing came through on the unlighted portion of the green until two days later. At the end of three weeks the grass under the electric light had attained a general growth of nearly four inches, while on the portion of the green outside the lamps there was a growth of about one inch. This system saves at least 40 per cent. in the time between planting and cutting the average green, and after cutting it thickens the growth.

Hunting Whales with Airplanes

By H. WINFIELD SECOR

Fig. 1 shows latest method of hunting whales. Plane spots whales and radios the news back to mother boat equipped with harpoon gun.

Fig. 2 above shows scheme for killing whale with explosive bomb dropped from airplane. Whale floats shortly after being killed.

Fig. 3 at left shows how airplane can use depth bomb on whale, which is visible at considerable depth. Whale would rise to surface afterward.

THE very latest news in the science of hunting whales is to the effect that Captain George L. Marquand, manager of a whaling company of Victoria, B. C., has chartered an airplane for each whaling venture. The airplanes will be used it seems mostly for spotting the whales, when the pilot will radio back to the whaling vessel equipped with harpoon guns as to the whereabouts of the whale or whales. Other possibilities of the airplane in hunting whales are shown in the accompanying pictures. As whales when killed putrefy very rapidly, due to the large amount of gas developed, they would rise to the surface even if killed with explosive bombs from an airplane or by a depth bomb, as shown in Fig. 3. A better scheme perhaps is that shown in Figs. 4 and 5 where an inflatable rubber bag is fitted to the harpoon shot from an airplane. With several of these fastened to the whale, he will eventually be tired out and the bags also serve as markers.

SOME ODD FACTS CONCERNING WHALES

On most Cetaceans (whales) traces of the hairy covering of ordinary mammals are present, showing in a few short, scattered hairs on certain parts of the head. The forelimbs, (represented by the fins, or "flippers") are like those of other mammals in structural characters; they are used as balancing organs. The hind limbs are never to be seen externally, and are present only as small vestigal bones (see the skeleton of the Dolphin).

The tail ("flukes") is horizontal, and not vertical as in fishes; it is probably used as the sole means of propelling the animal. The dorsal fin is totally absent in some Cetaceans, but in others, the dreaded killer for example, grows to a great height. Unlike fishes there are no bones in the back fin or tail. Between the smooth skin and the flesh the entire body is covered by a thick layer of fat or "blubber," which prevents the loss of animal heat (it is from the blubber that the oil is "tried out.") The nostrils, or "blowholes," which may be either single or double, open from the top of the head, save in the sperm whale. When a whale comes to the surface to breathe, it at once expels the air from its lungs. This warm air is saturated with water-vapor, and, when it is discharged, condenses; thus a column of steam or spray is formed, which is forced to a considerable height (20 feet or more). It is this spray which gives rise to the common belief that the whale actually spouts water. Cetaceans are found in all the oceans from near the Antarctic regions to within the Arctic Circle. Many of the smaller forms (porpoises and dolphins) ascend rivers for a considerable distance, and all the members of one family are exclusively inhabitants of fresh water.

The whales of the world may be divided into two great classes, viz:

1. Whales without teeth.
2. Whales with teeth.

Those of the first group (the toothless whales) are all characterized by plates of so-called "whalebone," or baleen, hanging from the roof of the mouth. The plates are of use in straining from the water the often almost microscopic animals upon which these whales feed. Whalebone varies greatly in length in different species. Whalebone was of considerable commercial value, the better grades at one time being worth from six to eight dollars per pound. The blue or sulphur bottom whale, a life size model of which hangs from the ceiling of the museum, the Finback and the Right whale are representatives of the toothless or whalebone whales. The

(Continued on page 476)

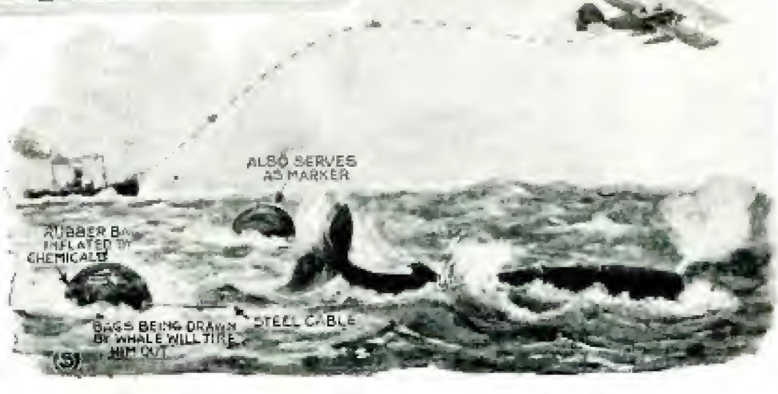


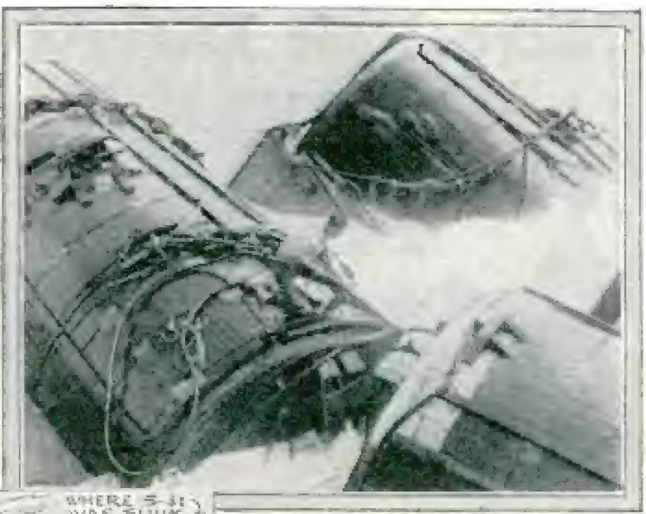
Fig. 4 shows scheme employing inflatable bag and harpoon dropped from airplane on whale.

Fig. 5 shows bags inflated to tire out whale and give vessel chance to capture him.

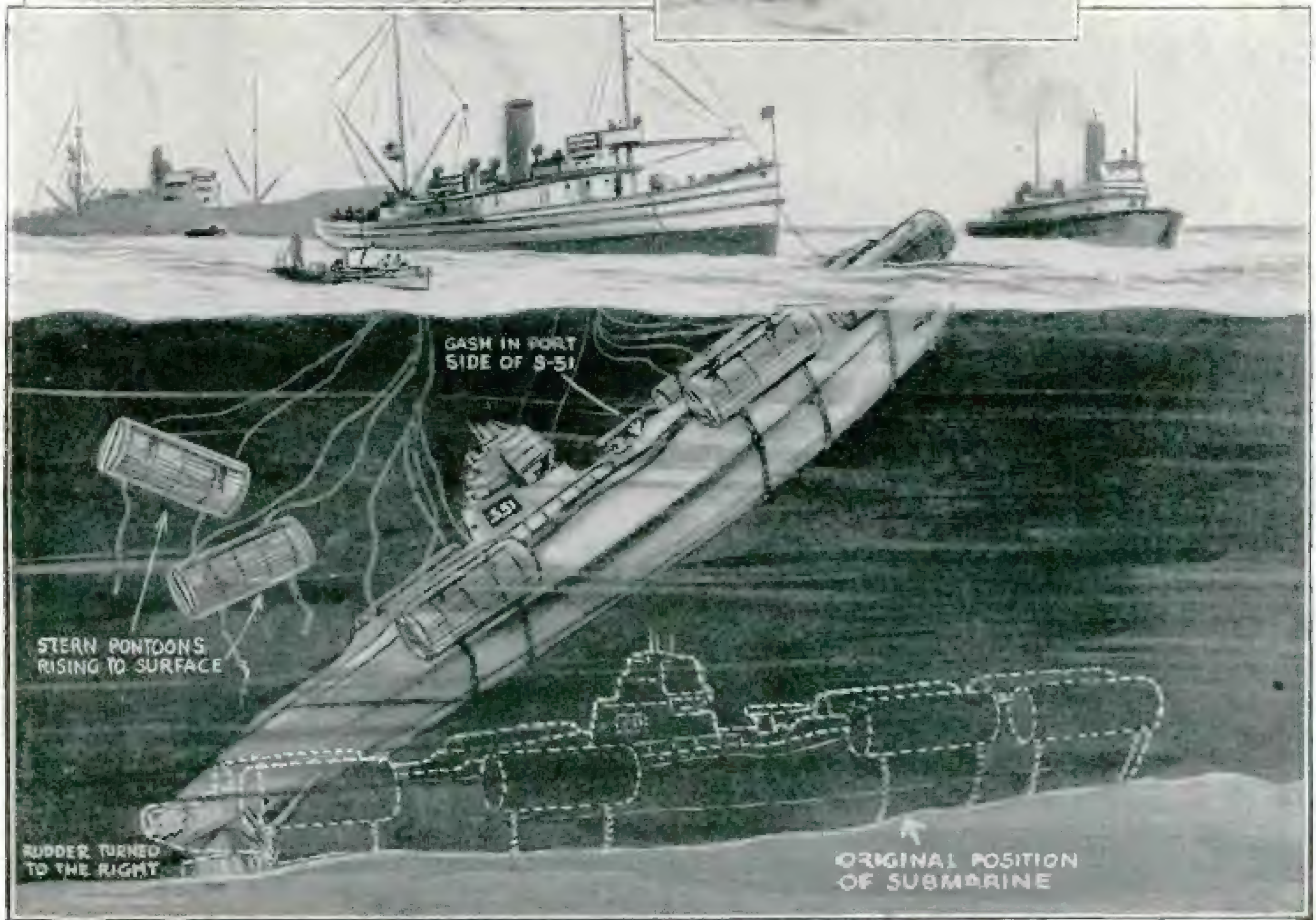
S-51 Finally Raised

Grounds on Way to Navy Yard

THE ill-fated submarine S-51, sunk after a collision with the S. S. "City of Rome," off Block Island, has at last returned to her home port after having appeared to be hopelessly jinxed. The first attempt to raise her from her resting-place 150 feet below the surface resulted in failure when the chains connecting the rear pontoons parted. Their breaking-away threw an additional load of 150 tons on the other pontoons, and it was found necessary to permit the S-51 to sink again so that a new "bite" might be taken. The specially-equipped "Falcon," under the command of Commander E. Ellsberg, recompressed air from the air-banks of the submarine S-50, which stood-by near at hand, and pumped it to the lifting pontoons which finally succeeded in raising the sub to the surface. In towing the S-51 to the Navy Yard she was grounded for a time on Man O' War Reef in the East River, but the next day she was placed in dry-dock.



The bow of the S-51 can be seen between the forward pontoons in the above photo of the first salvage attempt. The figure on the near pontoon is one of the courageous divers who risked their lives to keep the hose-lines from fouling. At the left is a chart of the route followed by the salvage party, showing where the S-51 grounded after having passed what were considered the most hazardous points. The photo at the left gives an idea of the risk entailed in the work of salvage. Here one of the rear pontoons is crashing upward after breaking away.



The drawing above illustrates the method of placing the pontoons so that they would exert the greatest possible lifting power on the wreck. Commander Ellsberg decided, after the rear pontoons had broken away and barely missed a surf-boat in rising, that the sub should be lowered again.

Oct.

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THE TRUTH ABOUT ASTROLOGY

See Page 494

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RADIO NEWS - SCIENCE & INVENTION - RADIO REVIEW - AMAZING STORIES - RADIO INTERNACIONAL

Houdini Outdoes Fakirs

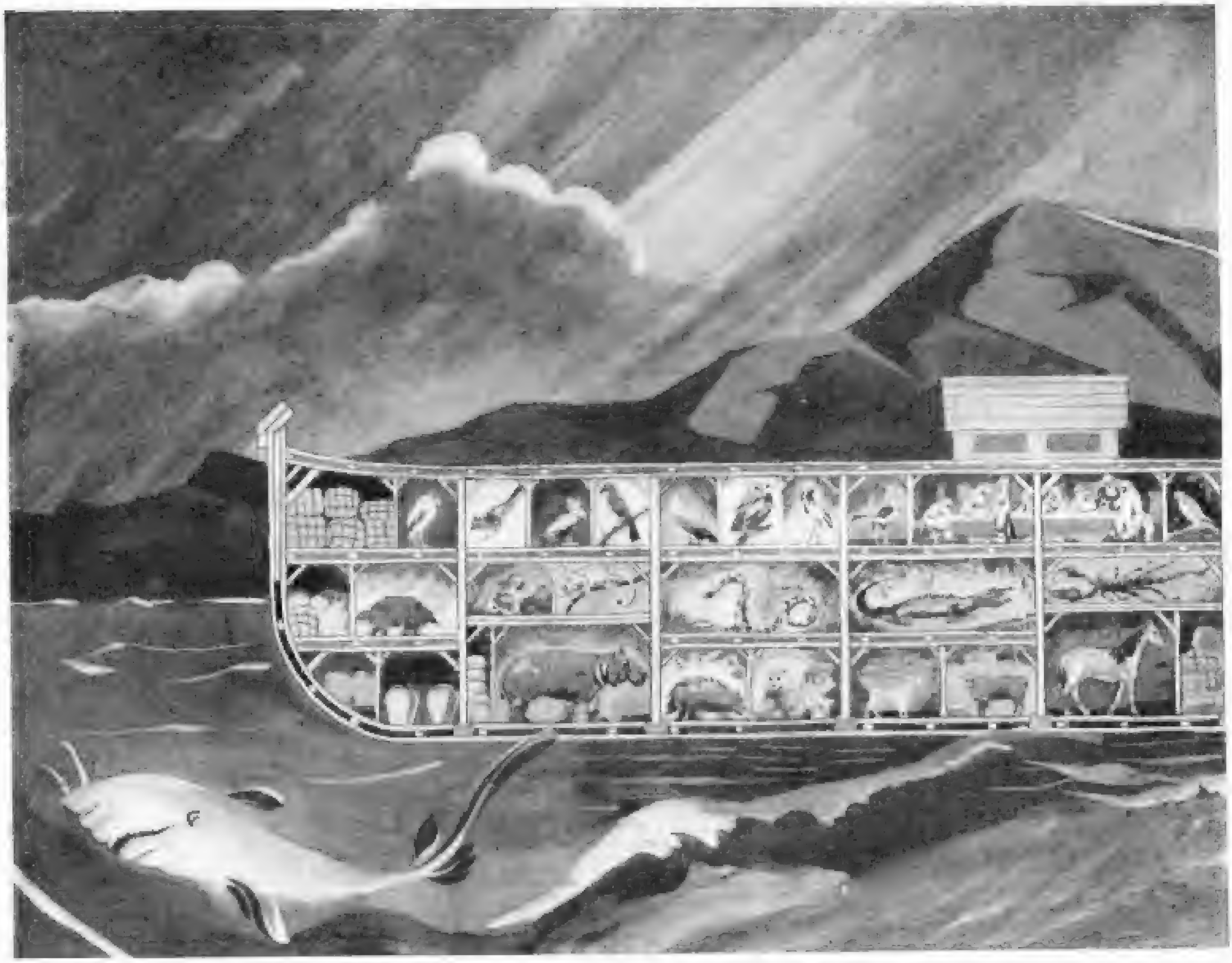
Houdini—The World's Most Famous Handcuff King, Proves That There Is No Trickery in Remaining in a Sealed Coffin for One and a Half Hours. Claims Cataleptic State Unnecessary.

FOR quite a few months a Hindu fakir, Rahman Bey, has been demonstrating his powers of producing uncanny effects. He would entered a cataleptic state, would have himself buried in a coffin for from ten minutes to half an hour or thereabouts, and then would receive the attention of scientific men who would write up the "phenomenal feats." Harry Houdini, known throughout the world, demonstrated to a body of scientists and physicians that he could duplicate, and in fact do even more than the Hindu fakir without entering the cataleptic state, and thus proved that no man is superhuman. Houdini remained in a sealed coffin for one hour, thirty-one minutes and thirty seconds, surpassing the stunt of the Hindu mystic.

THE photo above shows Harry Houdini stepping out of the casket at the close of the experiment. The one at the left shows the size and arrangement in the casket, and the one below is a picture taken in the Hotel Shelton pool with the casket submerged

Scientifically this experiment is of great value. It demonstrates that miners could remain underground in a closed area or that men could survive in a submarine much longer than was at first supposed, if they will keep their wits about them. During one hour approximately twenty-nine cubic feet of air is breathed. Approximately one and a half cubic feet of oxygen is absorbed, and one and a quarter cubic feet of carbon dioxide is excreted. Pulse on opening casket was too high to count and about 90 seconds later dropped to 142. No objectionable stuffy odor was noticeable. When the covers of the coffin were removed, the air rushed in violently, showing that the carbon dioxide did not replace the oxygen absorbed. In sand pit burials there is a sufficient amount of air penetrating between the grains of sand to permit of life over many hours.

DR. HEREWOOD CARRINGTON wrote about Rahman Bey in the following terms in a newspaper article. "All medical authorities agree that it is impossible for a human being to live more than three to five minutes in a sealed coffin." Yet Houdini entered a sealed coffin at the Hotel Shelton pool and he remained therein for one hour, thirty-one minutes and thirty seconds, thus proving to Dr. Carrington that he is not an authority on medical subjects. Houdini disclaimed the exercise of any super-natural power and stated that every normal human being could get in the same coffin and stay there as long as he did, if the individual took care to breathe lightly and did not exert himself. Two editors of SCIENCE AND INVENTION Magazine carefully examined the casket before Houdini entered the same, and can attest to the fact that there was absolutely no deception practiced. No oxygen in any sealed containers entered the coffin. No air could get in. Houdini stripped, donned a bathing suit, and entered the casket, after which the cover was soldered in place. The caps were screwed on and then the entire casket was sunk into the pool. Weights were applied and men stood on the cover to prevent the casket from floating. Communication was had with Houdini by means of a telephone and a signal bell. The editors placed a thermometer in the casket. It read 99.2 at maximum.



Was Noah's Ark Possible?

". . . . . . In the six hundredth year of Noah's life, in the second month, the seventeenth day of the month, the same day were all the fountains of the great deep broken up, and the windows of heaven were opened.

"And the rain was upon the earth forty days and forty nights.

"In the self same day entered Noah, and Shem, and Ham, and Japheth, the sons of Noah, and Noah's wife and the three wives of his sons with them, into the ark;

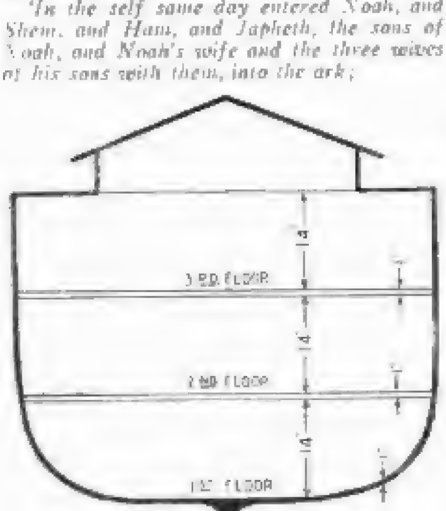
"They, and every beast after his kind, and all the cattle after their kind, and every creeping thing that creepeth upon the earth after his kind, and every fowl after his kind, every bird of every sort.

"And they went in unto Noah into the ark, two and two of all flesh, wherein is the breath of life."—(Genesis 7:11.)

THIS immortal quotation has always given rise to more or less of puzzlement in the minds of modern students of the Old Testament. How, you ask yourself, could Noah get all the animals, all the birds, all the insects into the ark and then store away enough food for this multitude and for the eight human passengers to last them three hundred and forty-six days? Yet it is all not quite so fantastic as it seems.

We are indebted to a keen student of Bible lore, Rev. J. Fleming Atkins of Ramsey, N. J., for a quantity of interesting information which he has compiled from Biblical records with the intention of showing that the Biblical account of the ark and its contents is quite plausible.

The actual dimensions of the ark are mathematically stated in Genesis 6, 15 and 16, where they are given as: length, 300 cubits; width, 50 cubits; depth, 30 cubits. Translated into modern terms, we have length, 450 feet; width, 75 feet; depth, 45 feet. Three stories or decks are specified, each story being—after allowing one foot for the flooring—14 feet high. Multiplying 450 by 75 gives us 33,750 square feet of surface per story, total 101,250 square feet of floor for the entire ark. This is slightly



The diagram above, showing cross-section of Noah's ark, will give an idea of the amount of headroom and floor space available.

The average size of animals is about that of a common house cat. For each of the animals in the ark we have reserved ten sq. ft. of floor space and fourteen feet of headroom. Inspection of the drawing at the right will make it plain that more than sufficient room is provided.

Our artist's impression of the way Noah probably placed the animals may not suit your ideas on proper housing, but a glance at the drawing above will help you to visualize one of the possible methods which might have been employed by the builders to provide space.

more than two acres. According to the best modern tonnage space rating, which allows about 1,000 pounds per square foot of deck space, a conservative estimate of the tonnage of the ark would be 32,000 tons, with possible extreme rating of 42,400 tons. The R.M.S. "Mauretania," rated at 30,969 tons, offers a modern comparison.

Dr. Alfred Russel Wallace, in his "Geographical Distribution of Animals," tells us that there are about 1,700 species of animals, 10,087 species of birds, 987 of reptiles, and approximately 100,000 of insects. The Bible tells us that at least two specimens of each species were included in the roster; in some cases seven pairs were listed. Now, the question is, how did Noah house all these creatures in the ark?

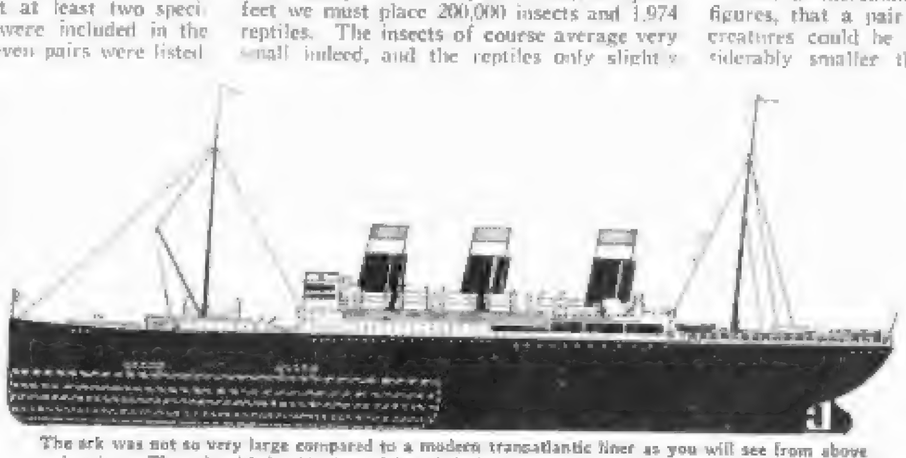
The steamers that carry livestock out of New York City allow about 20 square feet for each cow. We must consider, however, that the animals of the earth vary much in size. Dr. Wallace gives the average size as that of the common house cat, so we will take this as the average for the animal species. There are 33,750 square feet to each floor, so we will put the animals on the first floor; 3,400 animals would have nearly 10 square feet each, and considering the average size we have agreed upon, that would be quite a palatial cabin. Of course we must allow for a great deal of food storage, but remember that we are considering only one layer of animals and the rest of the 14 feet of head room may be used to store the food.

The second floor we will allot to the insects and reptiles, for themselves and their food supply. In this space of 33,750 square feet we must place 200,000 insects and 1,974 reptiles. The insects of course average very small indeed, and the reptiles only slightly larger. Computation shows us that we have about one-sixth of a square foot for each, that is, about 24 square inches. That should certainly be plenty of space.

We have remaining the entire upper or third floor for Noah and his family of seven, with 20,174 birds to sing for them. The birds would average very small, since the smaller species predominate, but we can allow about 1½ square feet of floor space for each to call his own, so the larger birds should be able to find plenty of room.

It seems incredible, even after reading these figures, that a pair of each of the world's creatures could be housed in a vessel considerably smaller than the average trans-Atlantic steamer. We have, however, the evidence of the measurements given in the book of Genesis and the testimony of mathematics to assure us that the ark may be more than a legend.

". . . . And in the second month, on the seven and twentieth day of the month, was the earth dried. And God spake unto Noah, saying, "Go forth of the ark . . . ."



The ark was not so very large compared to a modern transatlantic liner as you will see from above drawing. The ark with its 450 feet of length is just about half as long as the "Leviathan."

Nov.

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Science and Invention

THE HEALTH METER

See Page 590

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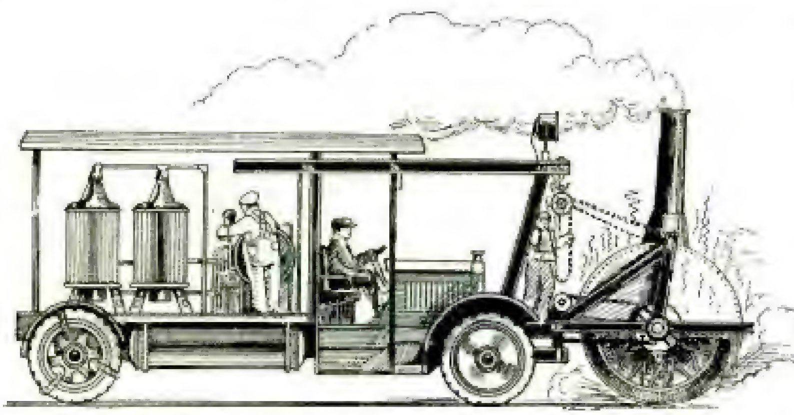
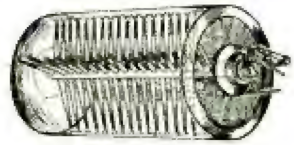
New Snow Removal Methods



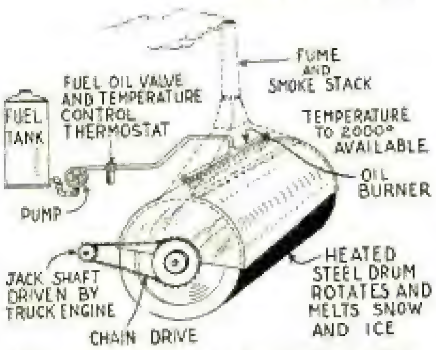
The illustration shows the new type of snow remover known as the Snow Converter, which has actually been built and which will remove one cubic yard of snow at a cost of \$.20 compared with the present price of \$1.65.



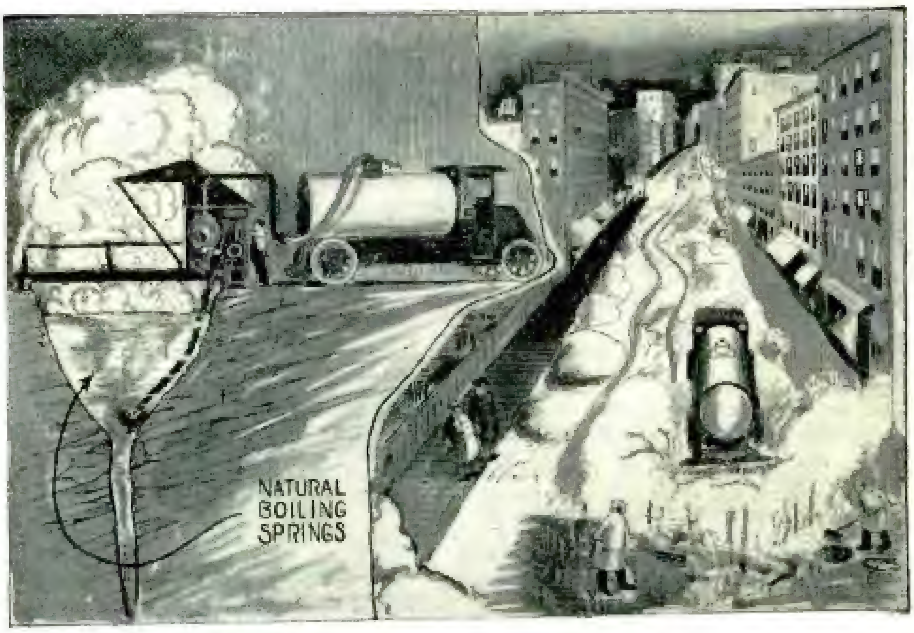
Oil passes to the inside of the cylinder through the shaft. A series of oil burners heat the drum which, rolling along the snow, melts it and converts it into water. The system is quite speedy and very cheap.

On this page are shown two of the most important methods of removing snow which have actually been employed during the winter months. The Snow Converter consists of a large automobile truck which has a heavy steel roller seven foot long, one and one-half inches thick and five feet in diameter attached to the front of the truck by means of suitable rigging. The drum is heated internally by a series of oil burners fed with oil from supply tanks on the truck. A temperature of 200 deg. Fahrenheit can be maintained if desired.

The illustration below shows how snow has been removed in Salt Lake City, Utah. In the days of warm weather the thought of snow makes us wish that winter were here again.

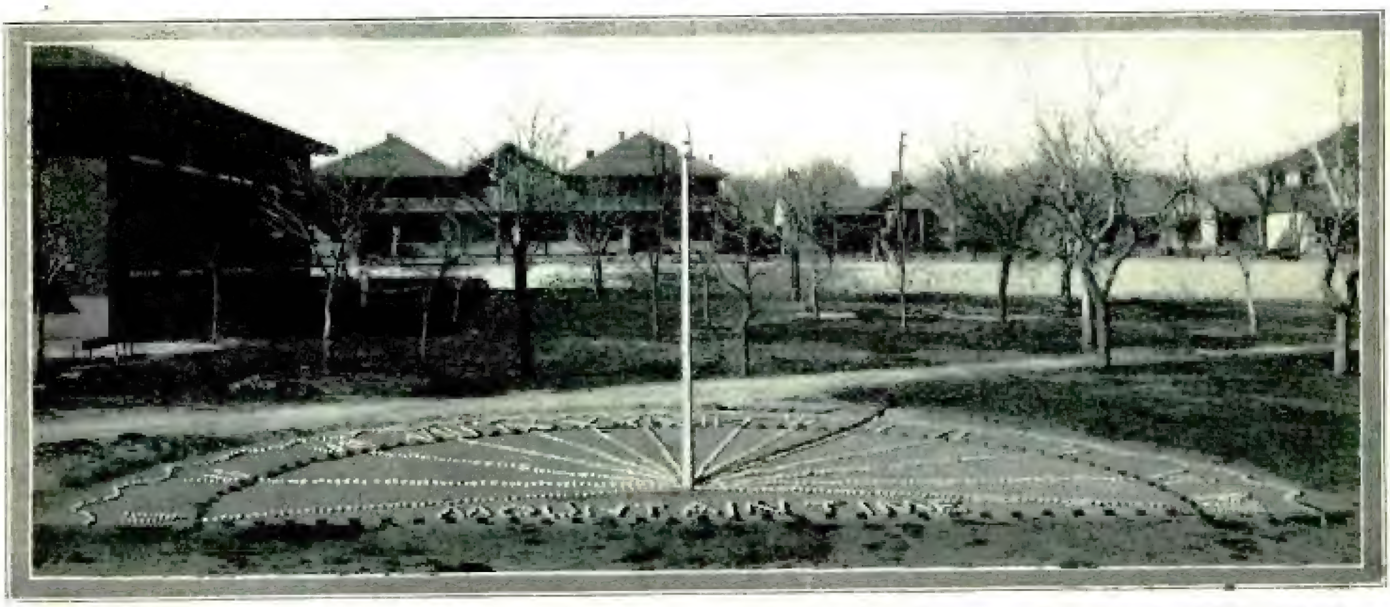


The diagram above shows one of the methods of heating the gigantic roller which melts the snow coming in contact with it. The water runs into the sewerage system.



In Salt Lake City, Utah, snow has no terrors, for the City Departments. Water is taken from municipally owned boiling springs and by means of regular sprinkler trucks the hot water is sprayed upon the streets and the snow disappears as if by magic. Nature heats the springs to approximately 106 deg. Fahrenheit. The sprinkler trucks are equipped with high pressure pumps which eject the hot water. A cloud of steam rises and when it vanishes the snow seemingly goes with it, water alone being left.

World's Record Sun Dial



A pair of the world's largest sun dials tell the time for tourists at Dodge City, Kansas. In this city the change from central to mountain time is made. One of the sun dials gives central time and the other casts its shadows on mountain time. The thirty-foot dials are made of cobblestones painted white. Large Roman numerals designate the daylight hours. The dials are side by side in a park in the centre of the city and are visible by all railroad and automobile tourists. In this way they remind the tourists passing through the city to re-set their time-pieces.—Ralph C. Taylor.

THE AUTOMATIC DOCTOR

By HUGO GERNSBACK

IN China, the doctor is paid to keep the patient well. He is not paid in case of sickness.

As progress goes on, we come to realize more and more that it is the *prevention* of diseases and of all the trouble that human flesh is heir to, and the warding off of diseases before they have made any inroad into the system, that is of the greatest value. Once a disease has started, it is difficult for even the best doctor to check it. Just as once a fire has gained headway, it is difficult to bring it under control.

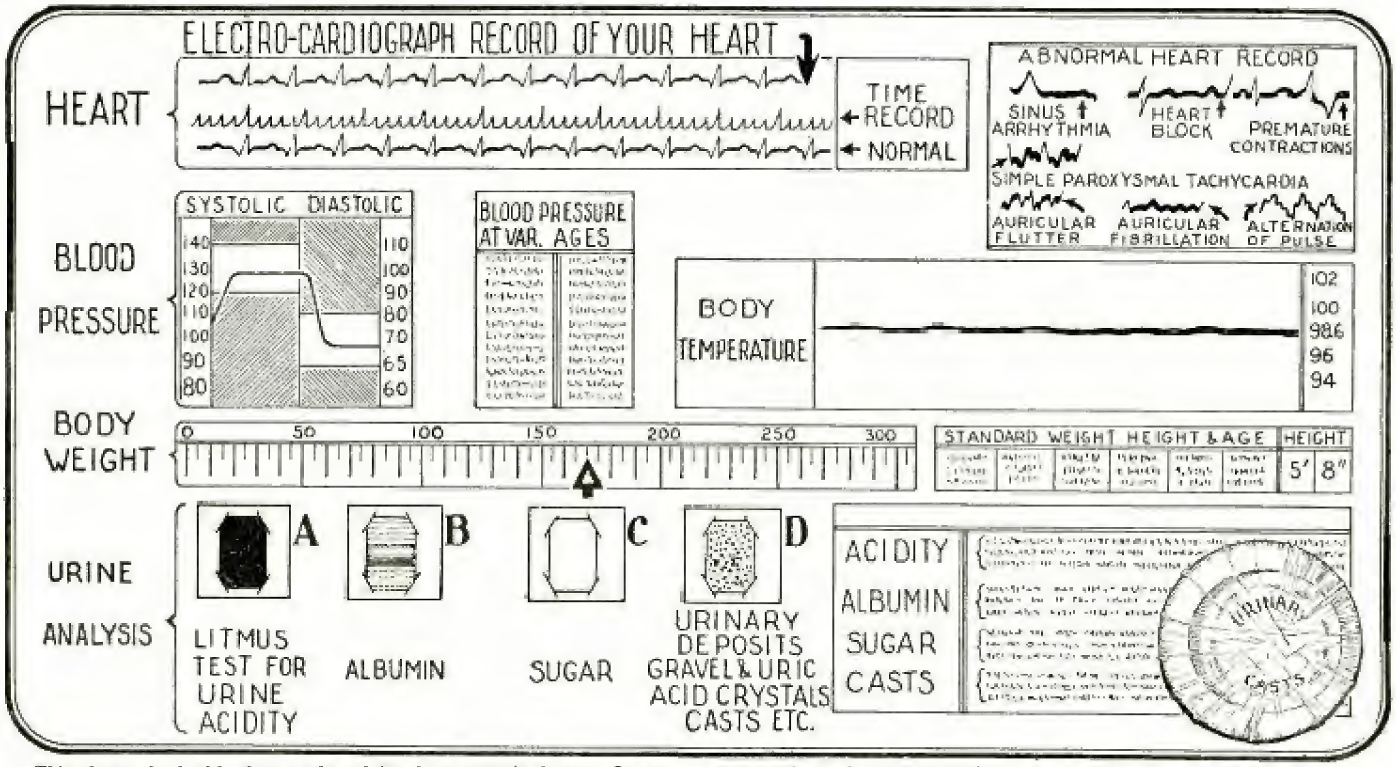
Before a life insurance company takes a chance and gambles on your life, a doctor is sent to examine you, which examination, while superficial, indicates whether there is anything vitally wrong with your human machine. The tests that a life insurance doctor usually makes are the following:

He tests your heart to find out if it is sound. He tests your respiration, in order to ascertain that you have no lung or other respiratory diseases. He then tests your blood pressure in order to find out if your arteries are in good condition, and then he takes a sample of your urine, in order to determine whether your kidneys are in good condition. This examination, while it may appear incomplete, tells a whole world of facts about the human machine. If these four tests are anywhere near satisfactory, the life insurance company will take a chance on you, and you pass the test.

Curiously enough, very few people ever think of having themselves examined regularly, that is, let us say every six months, by a doctor, in order to find out whether their human machine is functioning normally. If they did, humanity would live a great deal longer. The trouble is we are usually too busy to go to a doctor, and then we suddenly find our human machine breaks down. We are puzzled and distressed, and often it is too late.

A good doctor can usually rectify many of our physical ills while they have still not progressed too far, but once they have made inroads into our system, it is often most difficult to check the disease.

We may in the near future see an automatic doctor, which does exactly the same work as is done by the life insurance doctor. A machine of this kind could easily be rented in most public places, swimming institutions, barber shops, and even in private homes. It would seem that our great corporations, always interested in keeping their employees in the best physical condition, would be interested in using such a machine. Such machines could be constructed at a relatively low cost, and I estimate that the cost of the machine need not exceed $300.00 in quantity production. Perhaps it could be made much more cheaply.



This shows the health chart as issued by the automatic doctor. It automatically gives the heart action of the subject, shows whether his blood pressure is good, whether his lungs are sound, and, from the urinalysis, if the kidneys and urinary tract are in good condition.

The machine would duplicate exactly the four tests made by the life insurance doctors, that is, tests of the heart, blood pressure, respiration, and urinalysis. The machine can be made in such a way that it can be operated by a layman, and by comparison of the charts, which the machine issues, he can see immediately whether his record is normal or abnormal. If not normal, he knows that a doctor should be seen immediately. If normal, he need not worry.

The illustration on Page 591 shows how the machine is actually used, and the illustration on this page shows the health chart, which is automatically delivered within a few minutes to the subject. These cards can be kept by the subject, and if dated and filed away, subsequent charts will give very interesting data on the functioning of the subject's health.

This is not a visionary scheme, as a machine of this kind can be built today by means which we already know, and it is my belief that sooner or later such machines will be used commercially.

HOW THE MACHINE IS ACTUALLY USED

It will be noted from the illustration that at the very top of the machine there is an electro-cardiograph check which indicates whether or not the right or left hand of the patient is grasping the handles firmly enough. This instrument would undoubtedly be regulated by thermo-couples within the handles of the electro-cardiograph electrodes. At the left of the middle dial and slightly below it we have a "stage of test indicator." As soon as the instrument has completed one test, the needle of the instrument jumps to the next position, and thus in this way tells the patient to inhale or exhale, or to insert the bottle of urine in the urinary container, as the case may be. The dial at the right is a body temperature indicator, which not only gives him a visual representation of his temperature, taken at the hands or at the arm, but also has located behind it a correction factor for these points of the body. It is known that the rectal temperature differs from the axillary and mouth temperatures; consequently, the correction factor must be employed. The extension at and immediately below the center dial has an aspirometer affixed to its distal or free end. This will give the capacity of the lungs when the patient inhales and exhales.

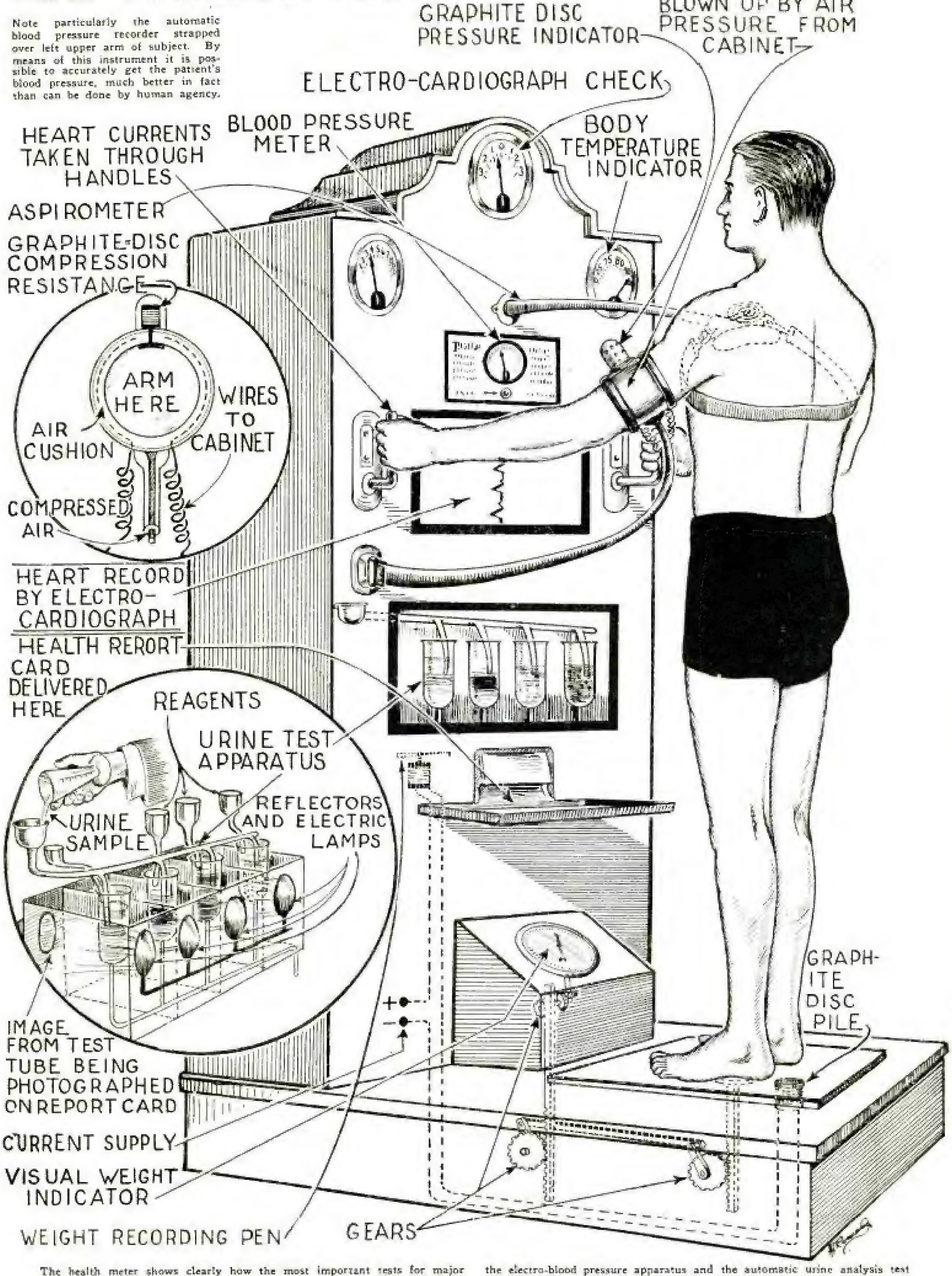
A blood pressure meter will be found immediately below this with instructions for the use of the complete instrument at either side thereof. The blood pressure meter tells the pressure in the blood vessels in two ways; first, it will give the systolic pressure, normal 120 to 140, and by turning the left handle of the electro-cardiograph, it will give the diastolic pressure, normal 65 to 80. The graph in front of the patient is an enlarged view of the electro-cardiograph which is also recorded on the health report card. The weight of the patient will also be recorded, and the height is to be registered in back of the machine when the patient walks around to the back of the instrument and stands with his back against the same.

The patient's urine is deposited in a small receptacle at the side of the instrument, and it is distributed into four test tubes which are previously automatically prepared with litmus solution, nitric acid, Fehling's solution, and the last test tube is for the microscopic examination and detection of any

(Continued on page 663)

AND HEALTH METER

Note particularly the automatic blood pressure recorder strapped over left upper arm of subject. By means of this instrument it is possible to accurately get the patient's blood pressure, much better in fact than can be done by human agency.



The health meter shows clearly how the most important tests for major diseases are obtained. Even the weight of the subject is charted electrically by the graphite disc pile (rheostat). The inserts show construction of the electro-blood pressure apparatus and the automatic urine analysis test instrument. The health meter does not replace the doctor—it only supplements him and helps to ward off disease and sickness.

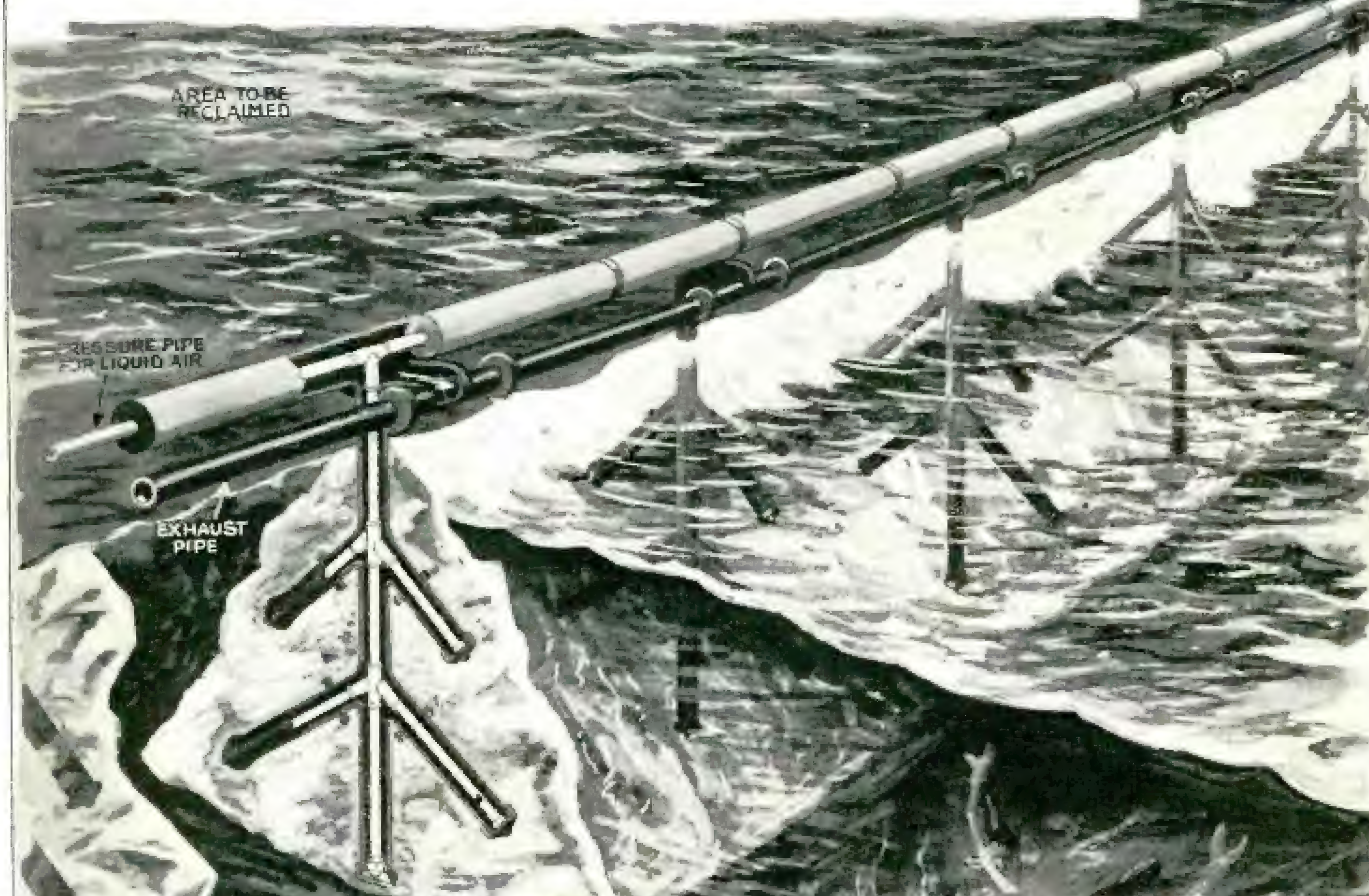
A Tidal Dam of Ice

HOW ICE DAM WILL RECLAIM VAST TERRITORY—DARING ENGINEERING FEAT

IN the United States the question of utilizing the latent water power of the ocean tides has taken great importance. Among the numerous plans which have been discussed, a German invention is extremely interesting and promises much for the future.

The idea represents a kind of freezing process by which a wall or dam of ice firmly connected to the bottom is created in rivers, lakes and seas, which, thanks to the strength of ice, can be used for tidal impounding. According to the plans of the inventor, a new province can be won on the German coast line for the Fatherland. The process serves also for improving the protection given by dykes against the flooding of the land, and is a useful adjunct in the building of hydraulic power plants.

The plans for utilizing the invention in Germany are already fairly well detailed. The new process is to be used in Lake Watten where for centuries land has been won from the North Sea, by erection of dykes and dams for the development of "polders" as in Holland, whose presence gives to the Schleswig-Holstein coast the characteristic appearance of a hedged-in landscape. The method used hitherto has been very expensive and slow in execution. It takes several decades before a tract of land of a few hundred meters is won from the



The illustration above shows power plant supplying liquid air to pipe lines as well as exhaust pipe system, to be used in forming an ice dam. While the ice dam is in place, a regular concrete dam is built inside the barrier so formed, the ice structure being allowed to melt away afterward.

sea. Constantly the operatives on the dyke who carry out this recovery of land and community improvements have a heavy burden. In following the new system, the winning of land will be quicker and easier, the years of work for building the dykes and dam, where storm-tides often enough destroy in a few minutes the work of months, will be done in a few days. The description of the new system follows:

Only a short while ago an invention was presented to a small circle of interested people, by which it was proposed within a few days to construct dams a kilometer long in the water and at low expense. The proposal was simply to freeze the water in a determined direction and of a definite width. This mass of ice freezes fast to the bottom, so that a solid wall of ice is produced. This is absolutely impermeable. To carry out this process, liquid air is fed into the water, partly through a system of pipes and in part is sprayed into the water from boats. According to the proposal of the inventor for carrying out the invention, such a system of pipes will be set up in a German inland lake. The pipes in part are laid upon the bottom of the sea: in part they are to rise to a proper height through the water, and in this way form a connection between two points of land three hundred meters apart. Within three hours after work begins on the production of liquid air, a wall of ice two to four meters high was produced that had a thickness on the bottom of two meters (over six feet) and which reaches from ten to fifteen centimeters (four to six inches) above the surface of the water. The commission was convinced that every claim indicated by the experiment was carried out and determined to organize a company to develop the invention. As a first practical attempt in the next few months a bay on the coast of the North Sea, in the vicinity of the city of Husum, is to be closed by a dam of twelve hundred meters (about 4,000 feet) long, and is then to be pumped out. Next the ice dam is to be replaced by a long wall of concrete where the attempt is to be made to avoid the expense of the elaborate false work and sheet piling of the area. Technicians believe that before the melting of the wall of ice, the ocean will carry so much sediment to the place, that in the locality of the mass of ice, before its melting, the ocean bed will rise steeply to the summit of the concrete wall, so that only a slight reinforcement by buttresses will be required. It is hoped that this dam can be made within fourteen days and only cost a third of the probable cost of the ordinary construction.

If the first practical application of this project is successful, many North Sea communities will be interested in putting Halligen into connection with the mainland. To carry out this work in small divisions about four years will be required. The territory reclaimed would about equal in size the lost provinces of Alsace and Lorraine, which would return the invested capital within a few years. All those who live near the locality where the first trials were made, have no doubts as to the carrying out of the plan. A few hours after the first experiment, the means for carrying out the first practical trial on the Baltic Sea were in hand, an indication of great progress in German finances. Naturally various technical and learned objections to the invention have been made public. Doubt for instance has been expressed if it would ever be possible to secure the wall of ice suffi-

(Continued on page 665)

The picture above shows sea-covered land area being reclaimed, huge floating centrifugal pumps withdrawing the water impounded behind the ice dam. The ice is formed by pumping liquid air from the power station on shore through the long semicircular pipe line shown above.

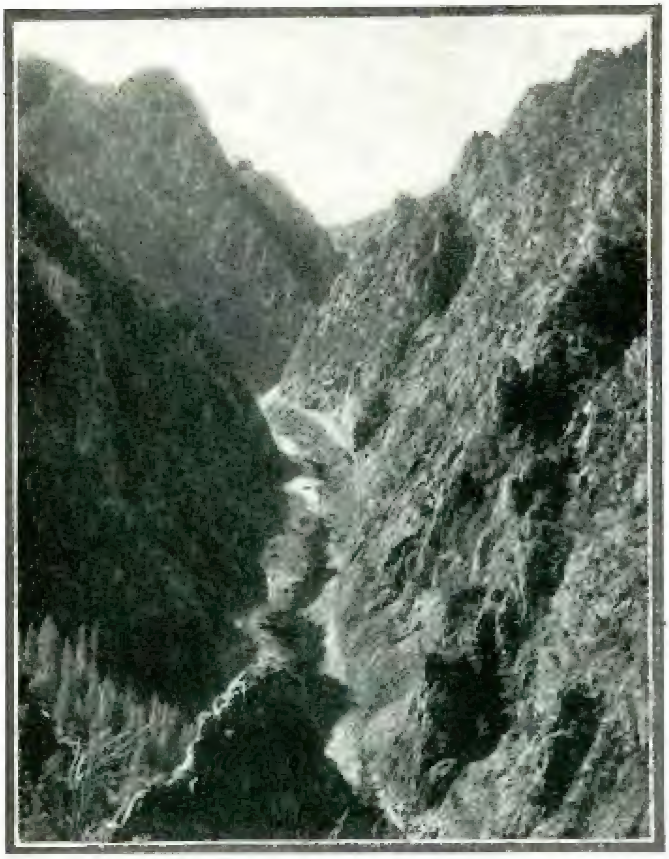
Picture at right shows semi-sectional view of the new land reclamation scheme proposed by a German engineer, and which has actually been tried out. The concrete dam is seen inside the area walled off by the temporary ice dam and fertile silt is being pumped into the reclaimed basin.

Here we see the newly recovered land with the concrete dam holding back the sea. The houses on the bluff in the foreground represent the only buildings that previously existed on dry land. Note the huge reclaimed area now under cultivation and also the old coastline at the left.

Our Longest Railroad Tunnel

The Longest Railroad Tunnel in America Will Be 6.1 Miles Long and Will Shorten Distance Between Denver and Salt Lake City 173 Miles.

By H. WINFIELD SECOR



The accompanying view at the left shows the kind of mountains through which the famous Moffatt Tunnel is being driven. At the center of the tunnel there is about one-half mile of rock above the bore.

FOR a number of years one of the greatest railroad developments in the western United States has been the famous Moffatt Tunnel project in the state of Colorado, the east portal of which is located approximately 50 miles west of the city of Denver. By looking at the accompanying map, those who are not familiar with the western railroad routes, will see that the optional routes heretofore have been to go either north to Cheyenne or else southward to Pueblo on the way to Salt Lake City, or from that city eastward to Denver. When the Moffatt Tunnel is put into operation and trains operated over the 41 mile Dotsero cut-off, or else over the proposed extension of the Denver and Salt Lake Railroad, indicated by dotted lines on the map, the distance between Denver and Salt Lake City will be shortened by 173 miles of travel, equivalent to one-quarter day of traveling time. Not only this, but the terrific climb over the Corona Divide, comprising 30 miles of four per cent grade, will be eliminated.

When completed the Moffatt Tunnel will be the longest railroad tunnel on the American continent, being 6.1 miles long; the main bore will be for single track railroad, and is 16 feet wide by 24 feet high, as one of the accompanying sectional views shows. A so-called pioneer bore, which will eventually be used for a water tunnel to help supply the city of Denver with water, lies 75 feet south of the main railroad bore and it measures 8 by 9 feet. It runs parallel to the main bore and at regular intervals there are cross-cuts between the two tunnels, the pioneer or water tunnel being used to help remove water and in the building of the railroad tunnel. By the time the tunnels are finished, nine million feet of timbering will have been used. World's records in tunnel building are repeatedly being made on the Moffat Tunnel, so the engineers report, the best records so far having been 1583 feet of headings in thirty days. The average advance of the two tunnels per day has been 24 feet, as one of the accompanying illustrations shows.

A recent visitor to the Moffatt Tunnel, in describing his visit into the tunnel said:

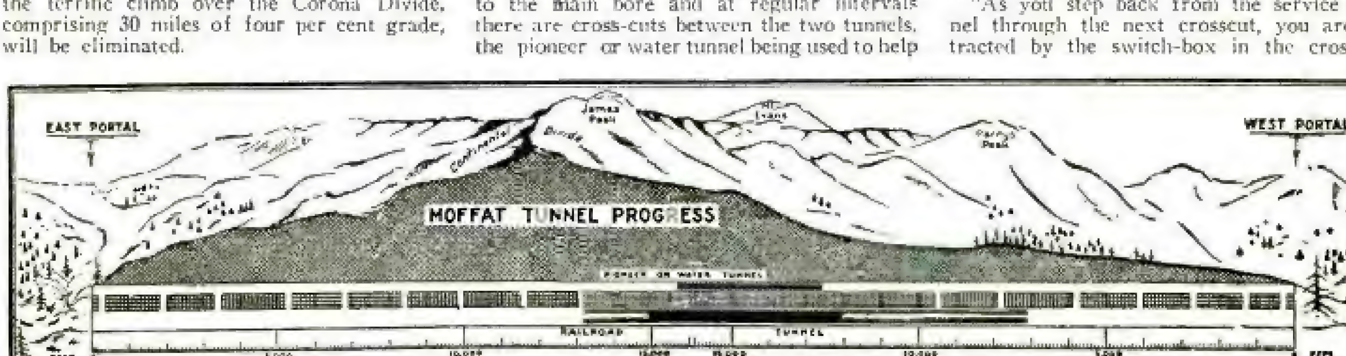
"You have now stepped over into the water tunnel. It may be well to explain that the other name for the water tunnel is the service tunnel. While the water is carried through this tunnel, this is also where the present transportation of men and tools and all the service work connected with building the tunnel takes place, so that in the regular tunnel there is nothing going on save the actual work of construction.

"Following along in the service tunnel, you are stepping off the track continually to let the trains go by; and, as they come along, you get the various orders shouted from man to man as they carry on the operating details of the work—you get the spirit and the rush of building this great tunnel.

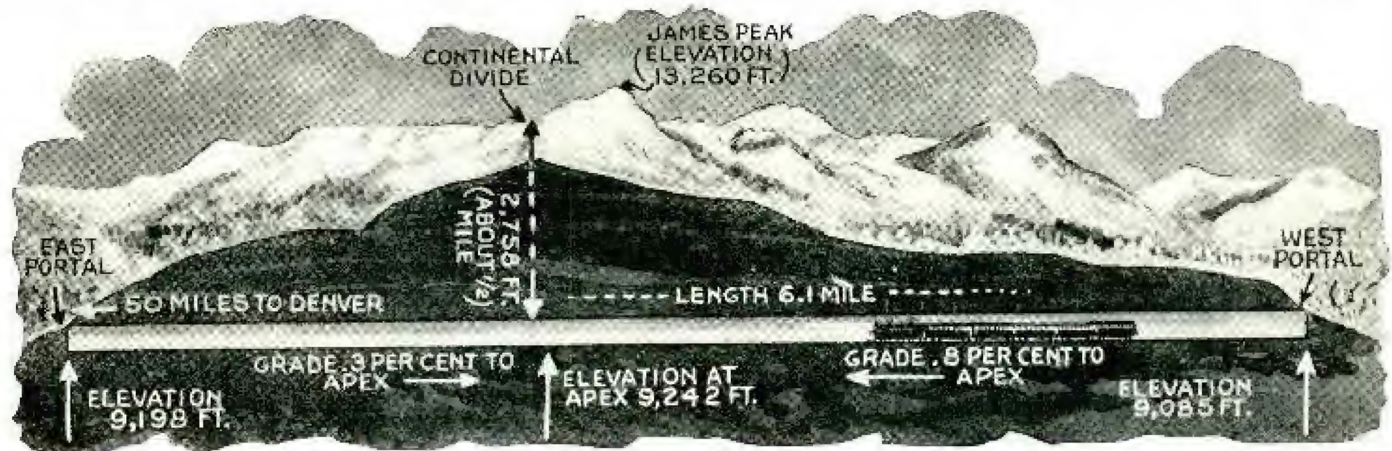
"As you step back from the service tunnel through the next crosscut, you are attracted by the switch-box in the crosscut,

The picture above is an actual photograph taken inside the Moffatt Tunnel and shows how the blasted rock is carried out on cars running along tracks to the entrance.

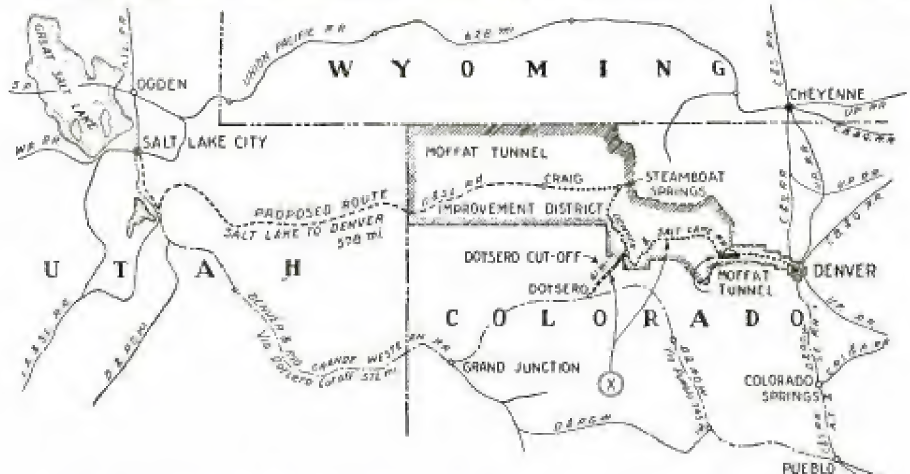
The photo reproduced at left shows appearance of one of the portals of the Moffatt Tunnel in wintertime. The workers live in two towns situated at either portal.



Combination sectional and plan view of Moffatt Tunnel above shows progress up to July, 1926. The tunnel will be completed by January, 1927, it is said. The black portion of the water and track tunnels is the part still to be removed. This tunnel is 6.1 miles long.



The sectional view above shows the outstanding features of the Moffatt Tunnel which pierces the famous Continental Divide, the crest of which is 2758 feet above the track bore. The train is shown out of proportion of course, as also is the height of the tunnel.



The Moffatt Tunnel, as map above indicates, will enable trains to operate between Denver and Salt Lake City via the Dotsero cut-off by route marked "X", over the Denver and Rio Grande Western Railroad, saving 173 miles, equivalent to one-quarter day of traveling time.

mounting four drills, with a manifold, which feeds air, oil and water to all four machines with but one connection to the supply lines, cuts the set up time from forty down to fifteen minutes and enables the drill crew to move their drifters from heading to heading through the nearest crosscut. An electric mucking machine, with belt conveyor, loads two cubic-yard cars in two minutes each, saving both time and cost over hand-mucking. An air-hoist car-switcher facilitates the moving of empty cars to the mucker. Above all, however, the alternating system has been perfected under the stimulus of a bonus to a point that has never before been reached.

THE WATER TUNNEL

The water tunnel carries the 8-inch compressed air feeder pipes for the drills, sump pumps and air shovel, the 2,300 volt power line to the motor-generator sets near the heading, where the 250-volt D.C. circuit is turned out for the trolleys, muckers and blowers, the 110-volt lighting and firing circuits, the 3-inch water supply line and the 12-inch ventilating pipes, in addition to serving as an outlet for the narrow-gauge (24-inch) muck trains, hauled by storage battery and trolley locomotives from all headings.

In the hard rock at East Portal the water

(Continued on page 657)

carefully locked. Not a shot (dynamite) will be fired until the order has been given and until it is certain that there are no men ahead. Due to such strict precautions is the fact that during the entire work on the tunnel there have been but four fatal accidents.

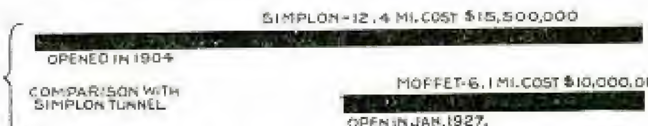
"On the way back, you observe the perfect ventilating system that keeps the air continually fresh the entire length of the tunnel, and the dry clothes house, where men may change and shower before going out into the weather."

The construction of an 8 by 9 feet water tunnel, 75 feet to the south of the 16 by 24 feet standard, single track railroad bore and parallel with it, is peculiar to the Moffat Tunnel, although pioneer tunnels for transportation, ventilation pipes and wiring have been successfully used in Europe and Canada. The twin heading alternating system of driving, together with the machinery necessary to carry out this method, has also been first developed here. For the soft ground, the Lewis cantilever needlebar has solved the worst problems. Outside in the timber yard, a framing machine has been devised to save time and labor.

TWIN HEADING ALTERNATING SYSTEM

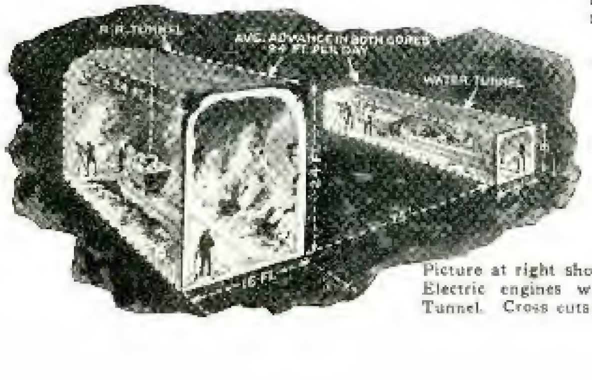
The Moffatt Tunnel is the first to apply the alternating system in the twin headings, a method enabling the same crew to drill both water tunnel and main heading in one shift, alternating with the mucking crew and thus, unhampered by each other, to do about twice the amount of work possible in a single heading. It is customary for each of the three eight-hour shifts to "pull" at least one complete round, which makes the average daily progress in each heading about 24 feet. Machinery has been adapted, or developed, on the job to obtain these results. A drill carriage on wheels and

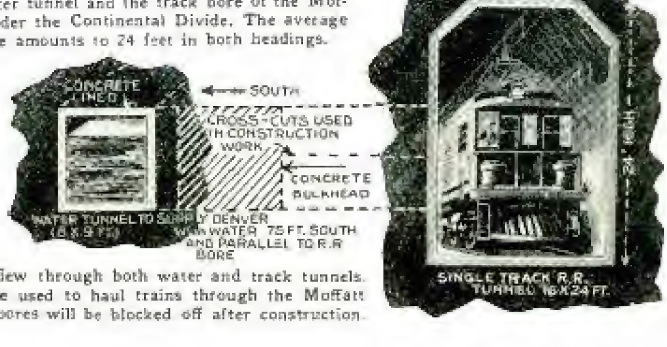
Not only will the Moffatt Tunnel route, via the Dotsero cut-off, or over the proposed D. and S. L. Railroad, via Craig, save 173 miles of travel between Denver and Salt Lake City, but it will also eliminate the terrific climb of 30 miles of 4 per cent. grade over the Corona Divide.



The two graph lines above illustrate comparison between the length and cost of the Moffatt Tunnel and the famous Simplon Tunnel in Europe.

The picture at the left shows the average daily advance in both the water tunnel and the track bore of the Moffatt Tunnel under the Continental Divide. The average daily advance amounts to 24 feet in both headings.





Picture at right shows sectional view through both water and track tunnels. Electric engines will probably be used to haul trains through the Moffatt Tunnel. Cross cuts between two bores will be blocked off after construction.

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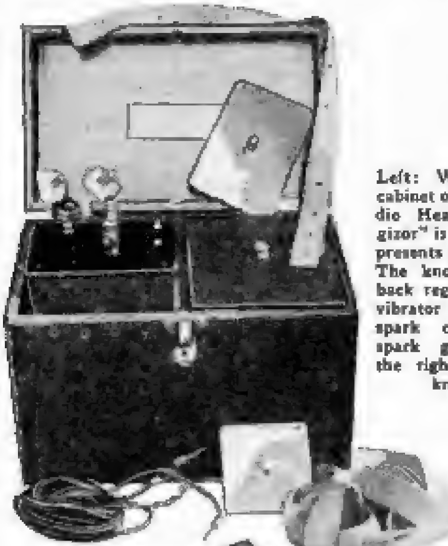
RADIO NEWS - SCIENCE & INVENTION - RADIO REVIEW - AMAZING STORIES - MONEY MAKING - RADIO INTERNACIONAL

Beware the Fake Radio Doctor

By HUGO GERNSBACK

MEMBER AMERICAN PHYSICAL SOCIETY.



Left: When the cabinet of the "Radio Health Energizor" is opened, it presents this view. The knob at the back regulates the vibrator of the spark coil. The spark gap is to the right of this knob.

How treatments are supposed to be effected by the aid of what Dr. H. M. Farnham and his "Laboratories" located at Detroit, Mich., prefer to call a "Radio Health Energizor." This method of taking treatment is here being demonstrated by Miss Gene Livio. It will be observed that two electrodes are applied over moist gauze pads and connect directly with the operating mechanism. And this remarkable force which ostensibly stores up vital energy in the body and which, according to one of Dr. Farnham's pamphlets cannot injure you, even if you overtreat yourself, is radio!

The internal appearance presented by the "Radio Health Energizor" after it was taken apart in our laboratories.

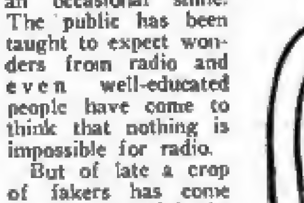
RADIO has come in for a good deal of abuse since it took the public by storm. We have Radio Tires, Radio Shoes, Radio Hats, Radio Razor Blades, and even Radio Restaurants. Such terms as these are harmless publicity stunts, which do nothing worse than arouse an occasional smile. The public has been taught to expect wonders from radio and even well-educated people have come to think that nothing is impossible for radio.

But of late a crop of fakers has come along that exploit the gullible with *radio cures*. It may be set down as an axiom at the present time, that if you receive a pamphlet or see an advertisement of any doctor or medical institution which promises cures, wherein the instrumentality of radio is used, *you should make up your mind immediately that such are pure swindles* and not worthy of any serious consideration.

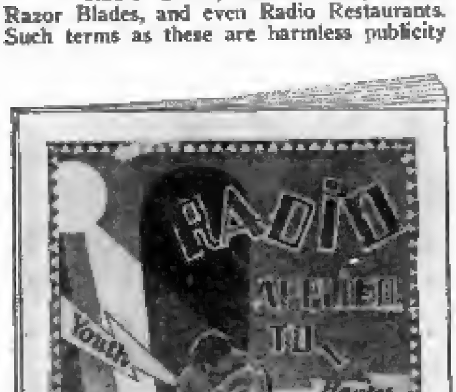
SCIENCE AND INVENTION has in the past exposed a number of medical frauds, while its sister magazine, RADIO NEWS, is now actually being sued for one million dollars by one "Dr." George D. Rogers, of San Antonio, Texas, for exposing a radio swindle. The Rogers machine, *which was supposed to cure all ills*, was nothing but an ordinary radio outfit, which was connected to a metal headpiece. It was claimed that almost every kind of disease could be cured with the contraption. Needless to say, the thing was a fraud.

Of late the exploiters of public gullibility

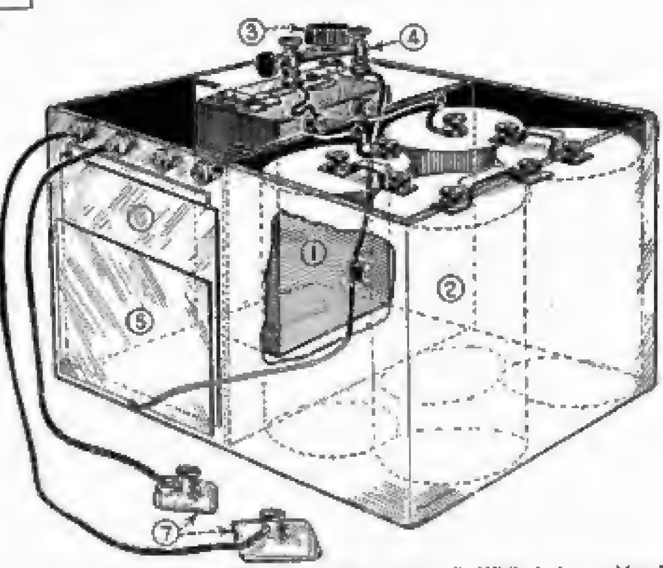
(*Continued on page* 850)



The circuit diagram of this hoax. The usual condenser is placed across the vibrator points.



Actual reproduction of the cover of the pamphlet distributed by the Dr. Farnham's "laboratories." Note his claim "Radio applied to health, success, beauty and youth."

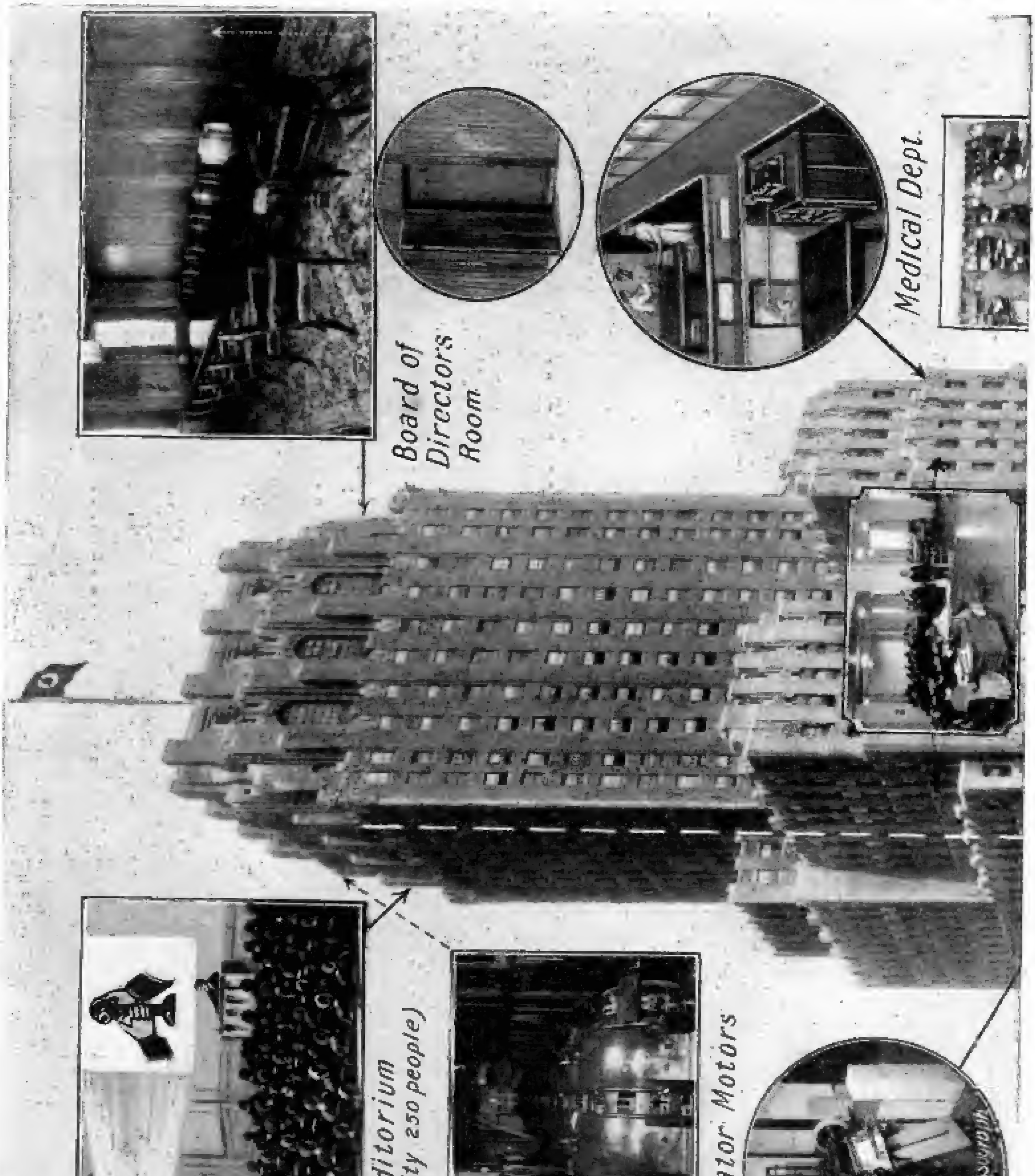


Here is the layout of the "Radio Health Energizor." While it is considered a remarkable piece of engineering by the manufacturers, any technical man will realize that it is nothing more than a joke. 1 is a marine type (common ignition) spark coil. The secondary lead goes to the spark gap, 4, and to a metal plate, 5. This plate acts as one side of a condenser the other side being plate 6 to which the treating electrodes, 7, are attached. 2 is the battery compartment in which are found four dry cells and 3, the knob for adjusting the vibrator.

New York Telephone Company Has Largest Home of All.

The Greatest Telephone

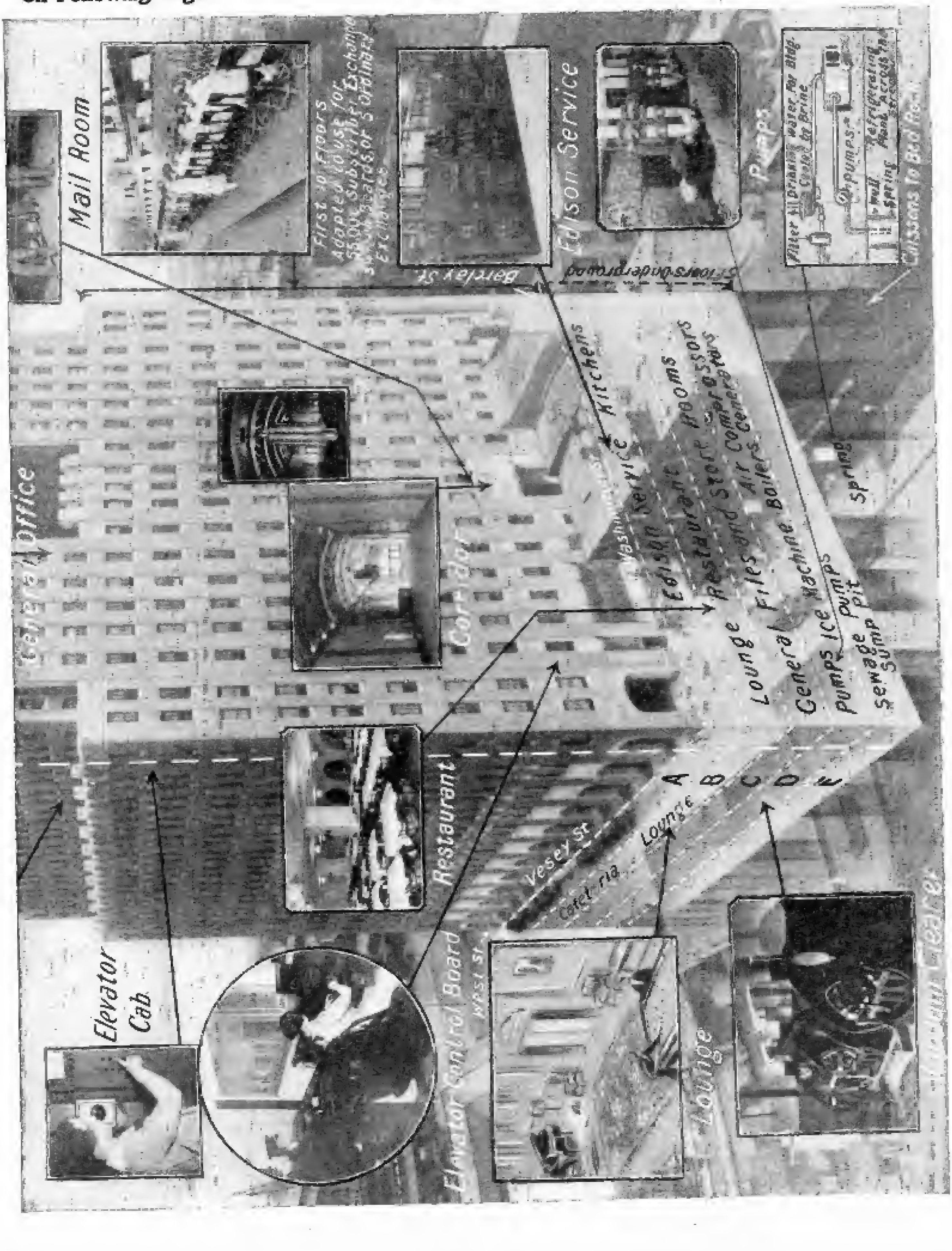
See Text Description

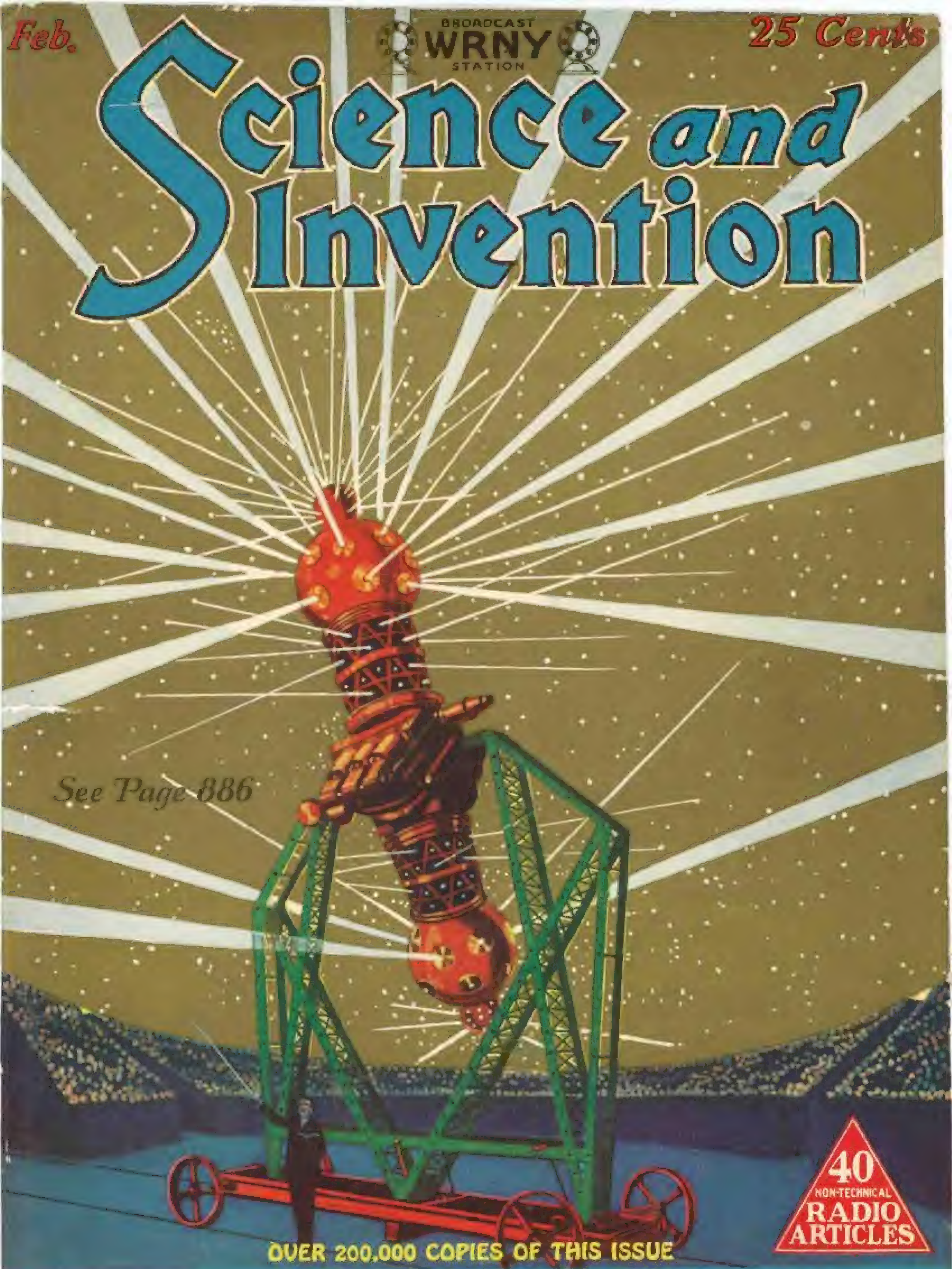


Building on Earth

on Following Page

Huge Central and Office Building Houses 6000 People





EXPERIMENTER PUBLISHING COMPANY, NEW YORK, PUBLISHERS OF
RADIO NEWS - SCIENCE & INVENTION - RADIO REVIEW - AMAZING STORIES - MONEY MAKING - RADIO INTERNACIONAL

Why High Voltage is Desired

LOW VOLTAGE 500 TO 2000 VTS. D.C. OR A.C. TRANSMISSION, GOOD FOR 10 TO 20 MILES. WIRE 1¾" DIAMETER

ONE of the principal objects that electrical engineers have in mind in the development of such high voltage testing laboratories as that illustrated on the opposite page, is the gradual lengthening of the circuits over which electrical energy may be transmitted efficiently. A glance at the three accompanying picture diagrams shows where we stand today and what the future may bring forth, when our engineers are able to adapt potentials of one and one-half million to two million volts to our transmission line problems. The corona or stray leakage loss along high voltage tranmission lines becomes excessive when the potential is increased much above 250,000 volts, as the diagrams below show. Another problem which high voltage, once it is harnessed to transmission lines will solve, is the reduction of the size of the copper wire, the diameter of which decreases as the voltage increases, with the same load in each case. In other words to transmit 10,000 kilowatts, the engineer who uses the highest voltage possiible will build the cheapest transmission line, as the three diagrams herewith clearly indicate. In the third example of 1500 miles transmission with 2,000,000 volts, a wire the size of the lead in a pencil could be used theoretically, but to stand mechanical and wind stresses it will have to be about three-eighths inch in diameter. With greater knowledge of high tension currents, our engineers in the next few years will doubtless be able to place high voltage transmission lines underground instead of on towers exposed to the weather, especially high winds as well as snow and sleet storms.

WIRE ¼" DIA. [THEORETICAL]

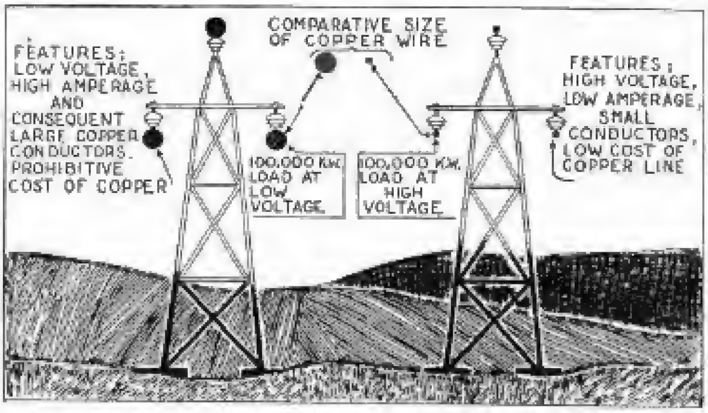
PRESENT HIGH VOLTAGE A.C. (220,000 VOLTS) POWER TRANSMISSION

WIRE ⅒" DIAMETER (Theoretical)

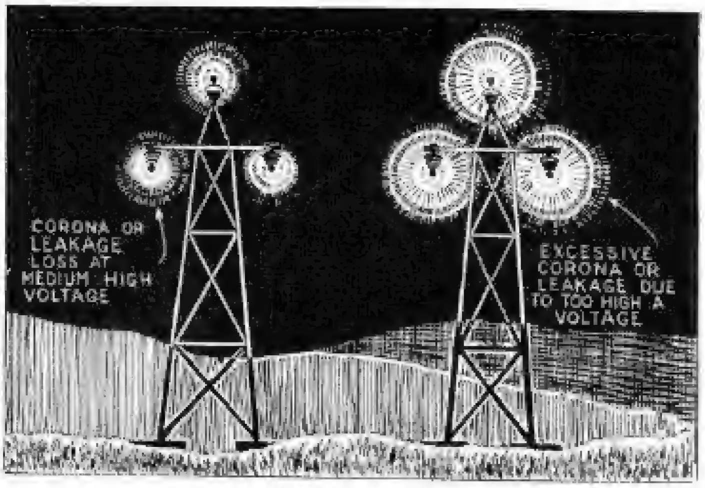
FUTURE HIGH TENSION A.C. (1,500,000 TO 2,000,000 VOLTS) POWER TRANSMISSION

FUTURE USEFUL POWER 1500 MILES FROM CENTRAL STATION.

The three diagrams above show the great difference in diameter of copper wire necessary for low voltage transmission, compared with the present high voltage (220,000 volts) transmission, and what we may expect in the future when 2,000,000-volt power transmission over 1500 miles or more, may become a reality instead of a dream. The main thing that keeps the voltage down is the high corona loss.

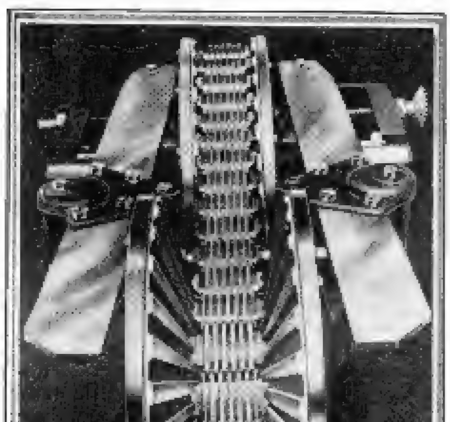


In the picture diagram above one can see at a glance why it is that to transmit 100,000 kilowatts, engineers would rather use 100,000 volts for example, than they would 10,000 volts. The size of the copper wire decreases as the potential increases, with the same amount of power to be transmitted. Heavy steel towers have to be used to support large copper conductors, which is also a big consideration on a fifty to seventy-five mile long transmission line.

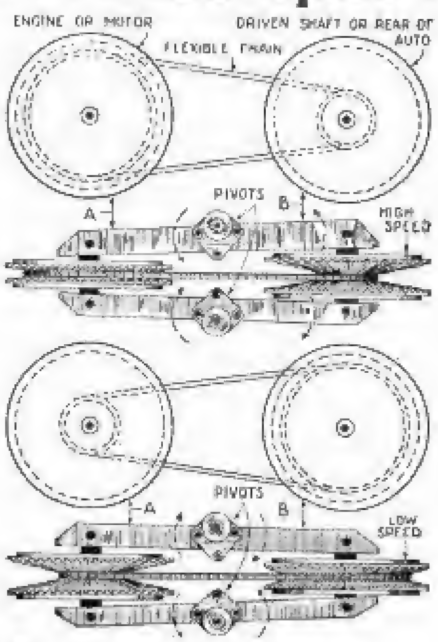


Here we see what happens when the voltage of a transmission line is increased to a certain degree. When the corona or stray electrical discharge exceeds a certain amount, the line losses become prohibitive.

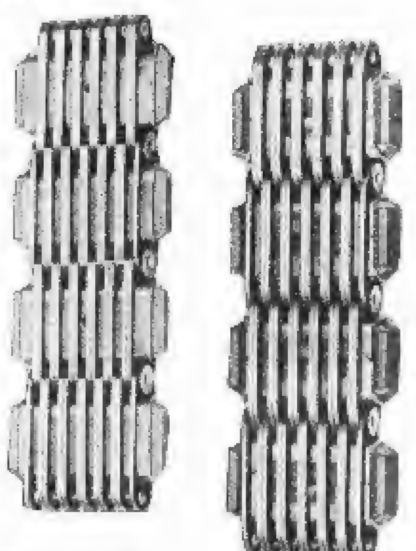
Gearless Variable Speed at Last



A positive drive, infinitely variable gear which has been sought for many years, was recently exhibited in England at a mechanical exhibition. This change speed transmission known as the P. I. V. device is capable of an almost infinite number of speed changes between the driver and driven shafts. It should mark a step forward for automobile purposes.



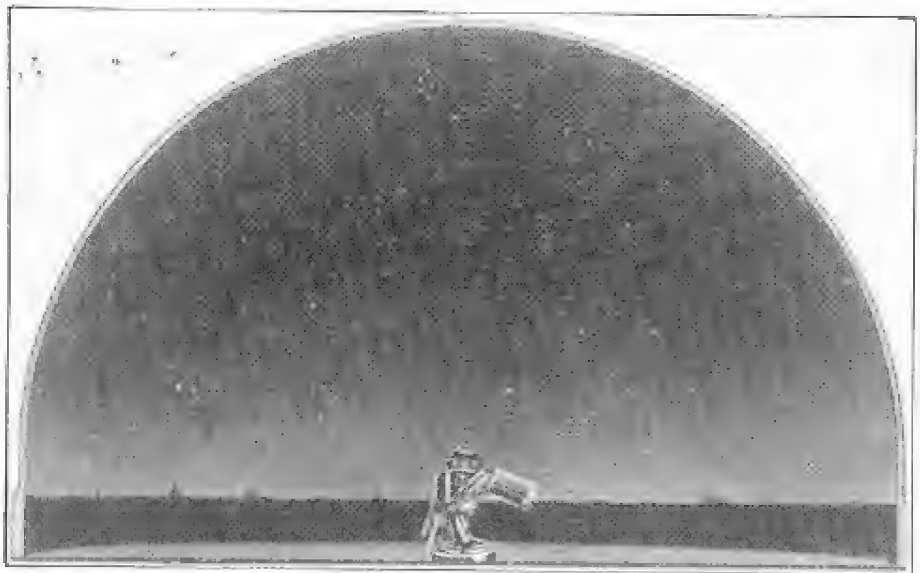
The two diagrams above show how levers open and close grooved cones and change speeds.



The two photos above show appearance of chain connecting the two sets of variable cone pulleys used in the P. I. V. gear box. With a single lever, innumerable speeds are at one's instant command. It should prove welcome in motor cars instead of the present awkward gear box.

Artificial Sky

The New Zeiss

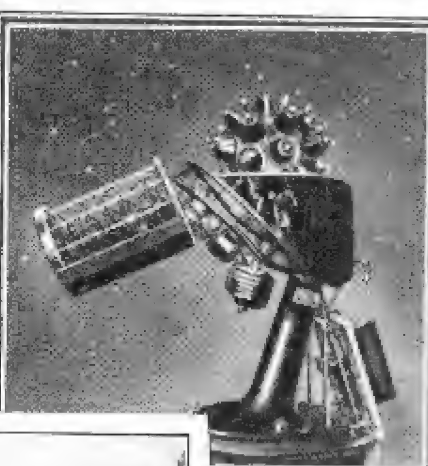


The Zeiss Planetarium with cupola nearly eighty feet in diameter, the inner surface of which is supposed to represent the vault of the heavens. This hemi-spherical surface is the screen on which the complicated projection apparatus in the center projects representations of the celestial bodies, stars, planets and moon, so that one feels as if they were out in the air under a brilliant night sky.

BEFORE the World War the director of the German museum in Munich, M. de Miller, asked the Zeiss firm at Jena to construct for the museum a planetarium, which would make possible the demonstration of the course of the planets before a large number of spectators at once. Its hitherto unattained perfection is due to the technician of the firm W. Bauersfeld. The idea of representing the celestial bodies by little spheres was abandoned and optical projections were substituted. How to get the motions by projection was an extremely complicated problem.

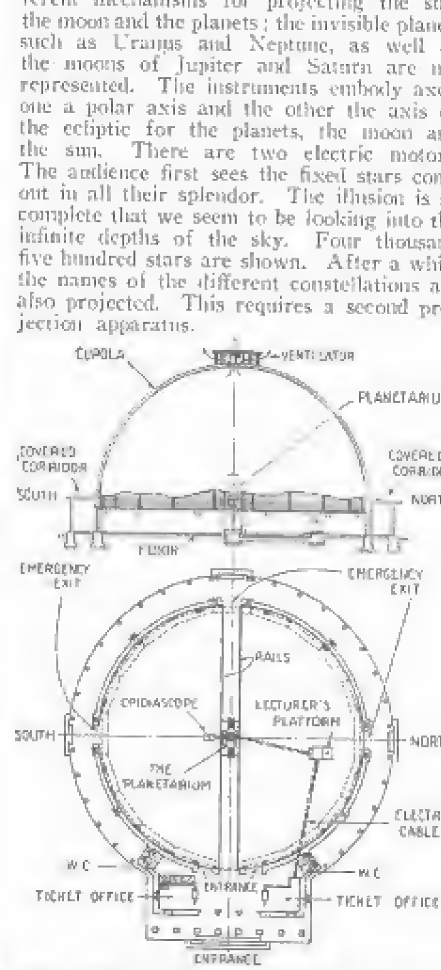
The Planetarium constructed by the Zeiss concern makes it possible to show astronomical phenomena of such diversity that to do it mechanically has hitherto appeared to be an absolute impossibility. The ingenious idea developed in this Planetarium is due to one of the technical engineers of this establishment, W. Bauersfeld; to him this progress in instructive mechanics is due. Mr. W. Bauersfeld completely puts aside the system of representing celestial bodies by little balls moved by any kind of mechanism. He, therefore, made the substitution alluded to, and this was productive of a high degree of simplicity. It centered all the apparatus in a small space, because, optical projection being used, it was simply a question of constructing and supporting and giving proper motion to a set of magic lanterns or stereopticons, as we may term them. But while on the face of it, this seems very simple, and while it does dispense with very clumsy mechanism of the old type, the construction of the apparatus presented an extremely complicated problem. Scientific knowledge and technical construction were intermingled in a way that only a house of the grade of Carl Zeiss at Jena could cope with.

The spectator goes into a cupola twenty-five meters or about eighty feet in diameter. The whole interior surface is white. The horizon of the place is traced upon the surface. Several rows of chairs surround the projection apparatus in the corner of the cupola. At first sight the projection apparatus resembles a pair of opera glasses, but looking at it more closely one sees that the objective or projection lens is replaced by thirty-one little projection apparatus of great precision, each of which projects a definite portion of the celestial sphere upon an area of the hemispherical wall. As a sort of counterpoise and covered by a glass shade, there is a cylinder containing the different mechanisms for projecting the sun, the moon and the planets; the invisible planets such as Uranus and Neptune, as well as the moons of Jupiter and Saturn are not represented. The instruments embody axes, one a polar axis and the other the axis of the ecliptic for the planets, the moon and the sun. There are two electric motors. The audience first sees the fixed stars come out in all their splendor. The illusion is so complete that we seem to be looking into the infinite depths of the sky. Four thousand five hundred stars are shown. After a while the names of the different constellations are also projected. This requires a second projection apparatus.



Above is shown a perspective view of the extremely complicated projection apparatus. It has to take care of the planets in their motion each with its own individual path and speed, of the stars all having the same motion, and not the motions of the moon and of its different phases.

This view gives an idea of the magnitude of the building. The impressive approach with an esplanade and flight of steps leading into a porch with a row of columns on the front and the beautiful hemisphere behind it makes it a most attractive piece of architecture.



The upper figure gives a section of the planetarium, while below is shown its plan. The great size of the installation can be appreciated when the entrance shown on the plan which is a large classic columnar porch, is contrasted with the great circular building behind it.

And now the celestial sphere begins to turn and the phenomena of a winter night appears, with the rising and setting of some of the constellations or the paths of others around the pole. Then comes daylight, but which, while showing the sun, does not obscure or put out of sight the planets. Then comes the moon, which pursues its path and shows all its phases from the crescent to the full moon. Last of all come the planets. Mercury, the nearest to the sun, follows its orbit rapidly; Venus appears moving more slowly; Mars moves still more slowly, but Saturn and its ring is yet slower. From five thousand years ago to five thousand years in the future the heavens can be shown for any given date. Three different speeds can be given to the apparatus, four and a half minutes, two minutes, or fifty seconds can represent a celestial day, or a whole year can be given in four and a half minutes down to a few seconds. The earth can be arrested on its axis, which holds the star stationary, while the moon and the planets continue to move. The relation of the rotation of the earth and the apparent motion of the stars is clearly brought out.

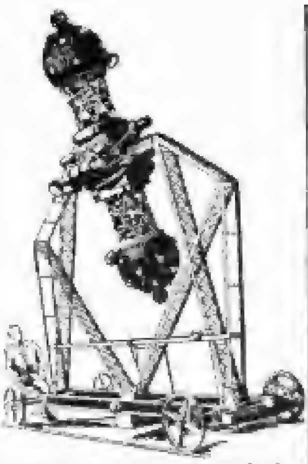
The apparatus comprises two similar parts, one above the other and below the horizontal axis. All the northern constellations are projected by the spherical portion of the upper division, while the cylindrical body, which carries the apparatus, projects

For Students

Planetarium in Jena

the moon and two planets, the lower part projects the meridional constellations and four planets. Besides this in A, is the apparatus projecting the names of the constellations, and in B are the projectors of the Milky Way. In C are contained not only the projection apparatus for planets of the solar system, but also the necessary apparatus for carrying out the movements of the sun, of the moon, and of the planets Mercury, Venus, Mars, Jupiter and Saturn. Finally in D are placed the apparatus for the projection of the representations of the great circles (equator, ecliptic and meridian) by luminous lines which are especially used when the Planetarium is employed for teaching. The whole thing is carried on a truck which moves on rails; the lighting is done by electricity.

The weight of the apparatus, including the frame and the car, is about four thousand pounds.



Installation of the great projection apparatus of the planetarium. The great frame has its dimensions made appreciable by the man seated near it. It is set and mounted so as to give the heavens the effect they would have if the sky was seen from the equator.

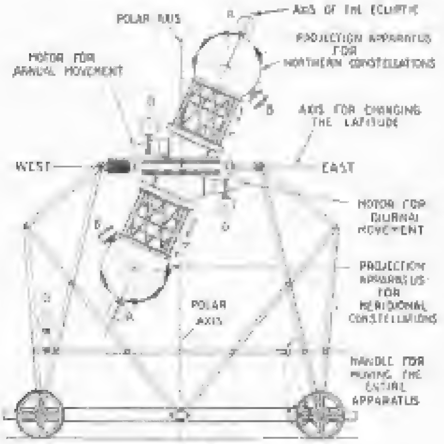
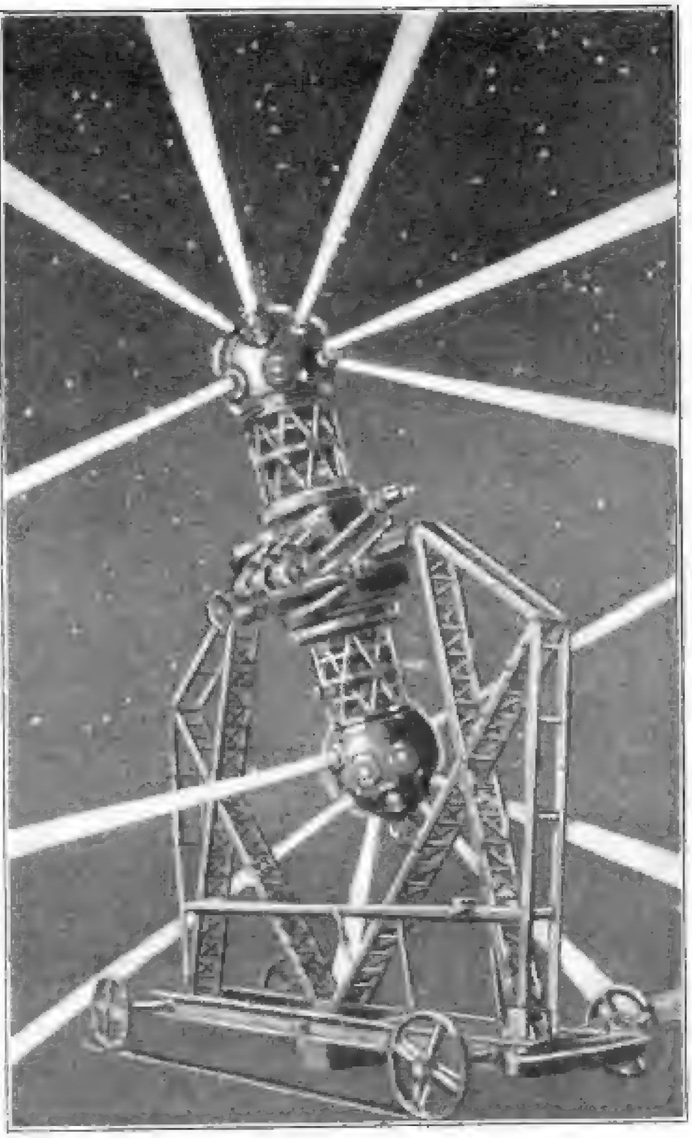


FIG. 1

Side view of the projection apparatus carried on its frame with its different parts named on the drawing. It is far more complicated than even this representation shows, as it has so many moving bodies to represent.

A better idea of the giant structure can be obtained from the photo given on the right. It would seem to be so bulky as to impair the illusion, but it must be remembered that it stands in the center of a giant dome.



Indian Fakir Lives On a Rope

NEXT after Egypt, India is the land which is celebrated for or rather plagued with the most beggars. A certain class of these do not reckon themselves among the beggars, but call themselves ascetics, hermits, monks, fakirs, or something else, which will have a more impressive effect upon the outer world. It is true that many of these are religious fanatics, who do penance upon themselves in various ways, partly for obtaining in their own conviction a holy state of existence; partly to win fame for themselves and attract the attention of tourists and by-passers and get alms from the same.

The man shown in the picture has for his specialty to lie stretched out upon a slack cord for days, for weeks or for years—yes, for all his life! This is an exhibition which in no other country than India could support a man's existence, but here it is a quite profitable way of obtaining a livelihood.

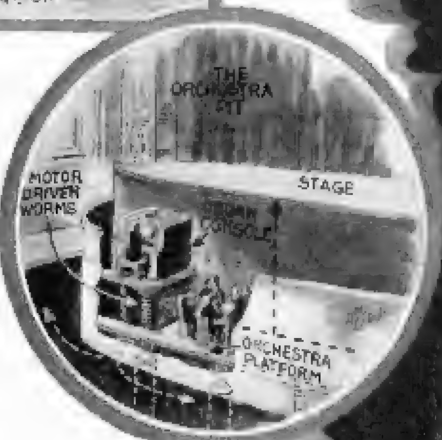
Regarded as a mere feat of balancing, it is certainly a very fine exhibition of the magician's art, which can excite our astonishment to the uttermost; but it is also a refined way of doing penance on yourself; a slight cord is certainly not a very comfortable bed, especially when one has to lie there for a long time. When the man is tired of lying on it, he suspends himself bodily as we see in the picture, that is to say, freely swaying with head and feet pressed against the bamboo poles.

Above is shown a Hindu fakir who spends much of his life on a single rope, an extraordinary feat of balancing. He seems to be contemplating a flower, perhaps a sacred lotus. A curious concession to which we may call modernity in the language of the theologians is the umbrella. The fakirs sometimes support themselves from the poles, and the insert gives the idea of how this can be done by straightening out the body and pressing in both directions with head and feet. Below is a cloth or rug with receptacles for coins thrown by spectators, for the fakirs like to make money.

World's Finest Theatre
Eighteen Million Dollar Movie

This magnificent theatre contains the largest orchestral organ in the world. The console contains four manuals, controlling two organs on either side of the proscenium arch. The photograph above shows the position of the organ loft to the left of the stage

A great glass globe representing the world is always lighted at night. Clock mechanism flashes at hourly intervals



The appearance of Times Square in New York City has been completely changed in the past sixth months by the erection of an office and theatre building on Broadway from Forty-third to Forty-fourth streets. The Famous Players-Lasky Corporation purchased the old Putnam Building site at Times Square and proceeded to break all construction records by completing a thirty-five story office building in twelve months from the time of breaking ground. The Paramount Theatre, which forms the nucleus of this immense structure, is called the world's finest theatre. It contains all the latest developments in theatre art and science. The orchestra platform and organ console are placed on electrical elevators, so that they may be raised and lowered individually, as shown in the circle at the right.

Opens in New York City

Theatre Seats Thirty-nine Hundred

THE large wash drawing covering the greater portion of this page shows the details of construction of the auditorium and lobby of the new theatre. The grand lobby is one of the most impressive features of the ensemble. It is said to compare favorably with any of the European masterpieces of theatrical architecture. The lobby is approximately 144 feet long, and is paved throughout with marble tiles. The first twenty feet of the side walls are composed of marble obtained from a mine in Italy, opened after many years of inactivity for the special purpose of decorating this beautiful building. An interesting innovation for the convenience of patrons is illustrated in the circle above. A very complete electrical indicating system is arranged, so that ushers in various parts of the house may indicate seat vacancies by a signal board near the stairway in the main lobby. The chief usher, by referring to this central board, may tell just how many vacancies there are and their exact location.

IMMEDIATELY under the music room, indicated in the drawing above, is a marble archway, opening into the "Hall of Nations." In a large panel at the far side of this hall are imbedded stones representative of a number of foreign nations. These stones were presented in many cases by high officials of the governments of their native countries. In the music room, which is in the form of a balcony above the archway shown in the insert, artists perform continuously for the entertainment of patrons standing in the lobby and seated in various portions of the lobby promenade. It is interesting to note that elevators are provided for service to all floors of this theatre, running all the way up to the rotunda promenade, which is at about the tenth floor.

THE HALL OF NATIONS

THE BROADWAY ENTRANCE

THE auditorium of the Paramount Theatre is treated in the French Renaissance spirit, and the color scheme is ivory, rose and turquoise. The ornamentation has been particularly studied for scale, so as to be proportionate to the size of the auditorium and, although the auditorium is over 10 floors in height, the architects have achieved an intimate effect. The result is that the theatre is truly one of the sights of New York. The height from the orchestra level to the dome of the rotunda is about 140 feet, quite sufficient to make it possible to place a 10-story office building within the space occupied by the auditorium. The theatre is completely equipped with the finest of stage and lighting mechanisms, and effects may be obtained which are beyond the ambitions of most theatres. The visitor may obtain a magnificent view of the interior of the theatre from the rotunda promenade, which surrounds the dome vault, 10 stories above the floor of the theatre. The cooling system is graphically represented in the drawing above, which also indicates many of the details of construction far too numerous to list in the text of this article.

May

BROADCAST WRNY STATION

25 Cents

Science and Invention

OVER 300 ILLUSTRATIONS

Posed by GILDA GRAY and TOM MOORE

40,000 GERMS IN EVERY KISS

See Page 14

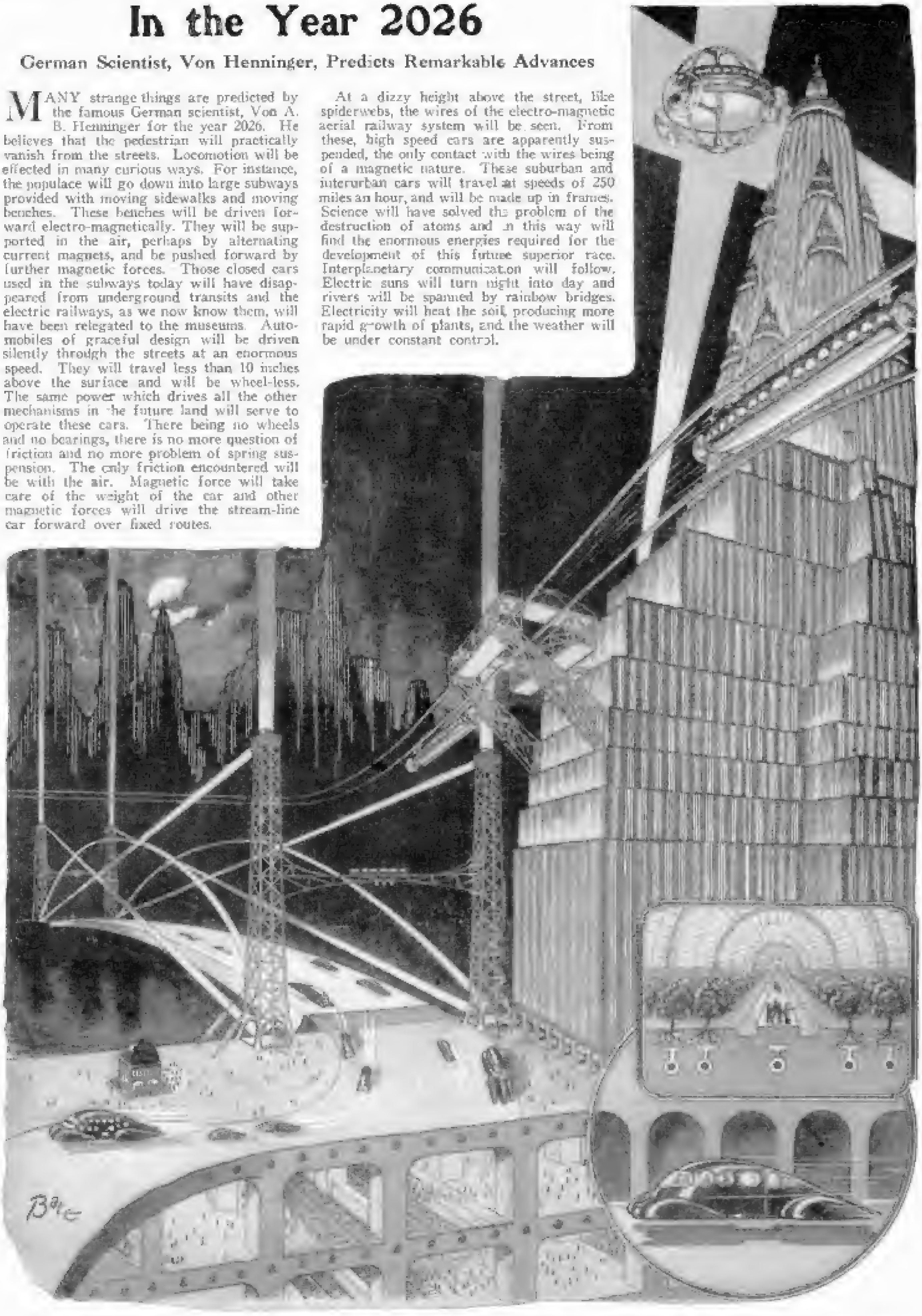
EXPERIMENTER PUBLISHING COMPANY, NEW YORK, PUBLISHERS OF
RADIO NEWS - SCIENCE & INVENTION - RADIO LISTENERS' GUIDE - AMAZING STORIES - MONEY MAKING - RADIO INTERNATIONAL

In the Year 2026

German Scientist, Von Henninger, Predicts Remarkable Advances

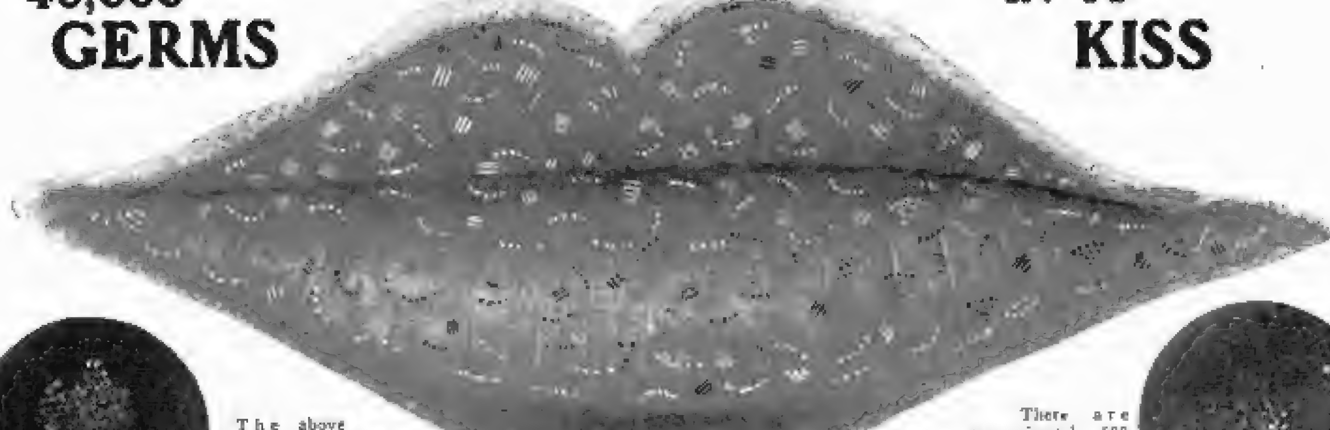
MANY strange things are predicted by the famous German scientist, Von A. B. Henninger for the year 2026. He believes that the pedestrian will practically vanish from the streets. Locomotion will be effected in many curious ways. For instance, the populace will go down into large subways provided with moving sidewalks and moving benches. These benches will be driven forward electro-magnetically. They will be supported in the air, perhaps by alternating current magnets, and be pushed forward by further magnetic forces. Those closed cars used in the subways today will have disappeared from underground transits and the electric railways, as we now know them, will have been relegated to the museums. Automobiles of graceful design will be driven silently through the streets at an enormous speed. They will travel less than 10 inches above the surface and will be wheel-less. The same power which drives all the other mechanisms in the future land will serve to operate these cars. There being no wheels and no bearings, there is no more question of friction and no more problem of spring suspension. The only friction encountered will be with the air. Magnetic force will take care of the weight of the car and other magnetic forces will drive the stream-line car forward over fixed routes.

At a dizzy height above the street, like spiderwebs, the wires of the electro-magnetic aerial railway system will be seen. From these, high speed cars are apparently suspended, the only contact with the wires being of a magnetic nature. These suburban and interurban cars will travel at speeds of 250 miles an hour, and will be made up in frames. Science will have solved the problem of the destruction of atoms and in this way will find the enormous energies required for the development of this future superior race. Interplanetary communication will follow. Electric suns will turn night into day and rivers will be spanned by rainbow bridges. Electricity will heat the soil, producing more rapid growth of plants, and the weather will be under constant control.



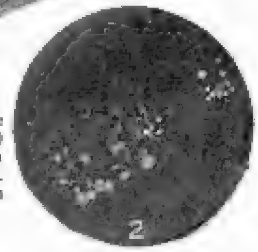
The above illustration shows what some of our future cities will look like, the cars are wheelless, supported and driven by magnetic forces. The railways are magnetically suspended 10 inches below the overhead tracks. Rainbows form the bridges and soil is electrically stimulated.

40,000 GERMS IN A KISS



The above photograph shows a pair of natural lips, unadulterated by lipstick. Left, germ culture from such lips.

There are approximately 500 germs on the lips in the photograph above. Right, another culture from unpainted lips



By JOSEPH H. KRAUS

THERE is in Paris an organization known as the Anti-Kissing League which is seeking to impose the decree, "Thou shalt not kiss." They argue that in every kiss no fewer than 40,000 disease germs are transferred. They say that if every person before kissing would pause for a moment and consider the possible consequences of a transfer of 40,000 germs the practice would die out.

Why is it, this league demands, that American or European motion films when edited for Japanese consumption show no kissing scenes? In Japan there is no inclination to learn the art of kissing.

In order to test the truth of the claims made by the Anti-Kissing League, this publication decided to actually breed germs. The results of the laboratory test showed that there were a surprising number of micro-organisms transferred during every kiss, but the number was nowhere near the amount claimed. But the experiments showed one very important and startling fact to which very little attention has been paid.

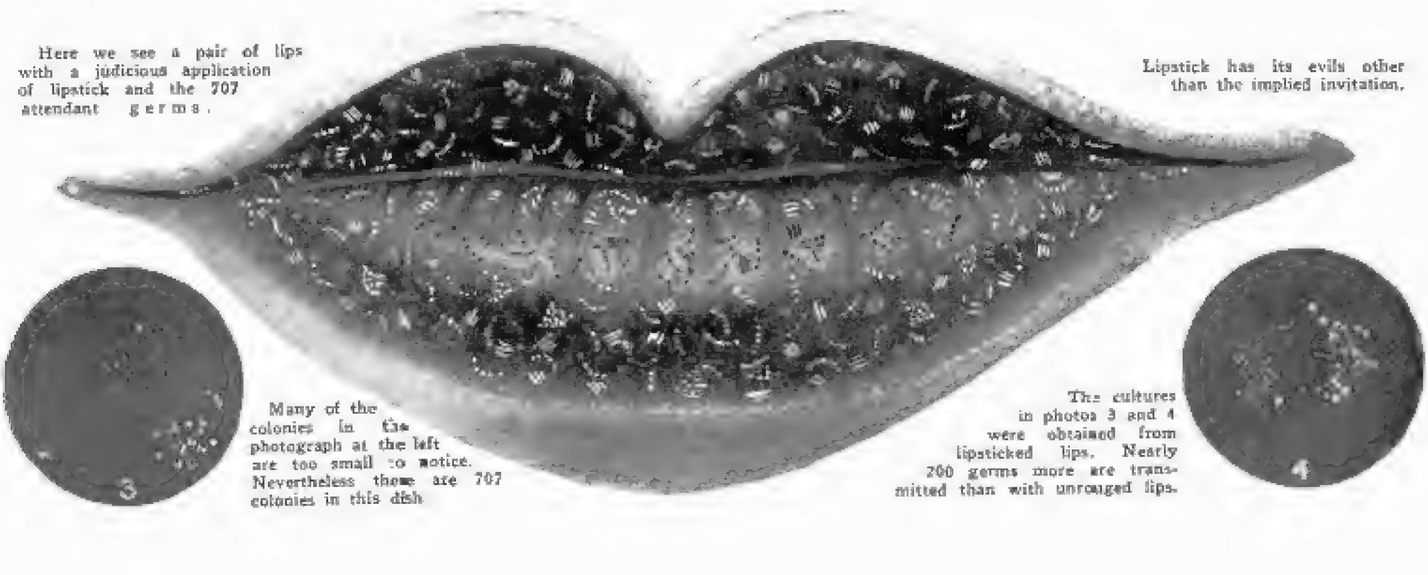
Gilda Gray and Tom Moore posed in this very entrancing manner expressly for SCIENCE AND INVENTION Magazine through the courtesy of Paramount Pictures. This same scene appears on the cover of this issue. Our own researches revealed that the scientist who claimed 40,000 germs were transmitted while kissing either grossly exaggerated or had particularly unhealthy subjects.

No longer need the boy friend be a conscientious objector to a kiss coming from his enamored, garnished with a plentiful application of lipstick. He now has a reason — a scientific reason for such refusal. The average number of germs transferred in a kiss from untainted lips; by that is meant lips that were not shaped with the red pencil, was 534. The average number of micro-organisms trans-

(*Cont. on page* 84)

Here we see a pair of lips with a judicious application of lipstick and the 707 attendant germs.

Lipstick has its evils other than the implied invitation.



Many of the colonies in the photograph at the left are too small to notice. Nevertheless there are 707 colonies in this dish

The cultures in photos 3 and 4 were obtained from lipsticked lips. Nearly 200 germs more are transmitted than with unrouged lips.

Mechanical Devices Animals Use

By DR. ERNEST BADE

ALTHOUGH the importance of the physical sciences is admitted, few realize through what difficulties and setbacks it had to pass before it became an exact science. Years passed and although the gain in knowledge was steady, it was slow. Even some of the principles were little understood and much time had to elapse before they could be employed. All this was in spite of the fact that numerous examples of the laws of physics were and still are being used by all kinds of animals under all sorts of conditions.

Nature is peculiar in this respect. Things most often seen are little noticed and seldom studied. Therefore, it is but natural that such simple machines as the lever, the inclined plane, and such devices as the pump, the valve, suction cups, springs and many others, were overlooked by the early men of science.

Take such a simple thing as the borer, represented in mechanics by the drill and auger. Nature made it long ago. An example is the stinger of various insects such as the wasp, while the borer of the thalessa, a thread-waisted wasp, is one of the longest and it bores right into solid wood to a depth of two and sometimes even three inches. The saw, too, is an instrument which some insects use, as, for instance, the gooseberry wasp.

Levers are some of the more common devices found almost everywhere under many various conditions. Often they are accompanied with springs, in the form of muscles. These are usually levers of the third class. Take the fore-arm of a man. The fulcrum is at the elbow joint, the biceps muscle, descending from the upper part of the arm and inserted near the elbow, operates as the power or tension spring. An object placed in the palm of the hand acts as the weight. Small weights can be held quite readily when the arm is extended, but when the weights are increased a much greater effort or muscle power must be exerted to compensate for the slight addition of weight and this is due to the fact that the muscles do not act perpendicularly to the bone, but at an oblique angle. This accounts for the difficulty of holding out a heavy weight at arm's length. In proportion as power is lost, quickness of motion is gained.

A lever of the first class is found on the foot. Here the power is exerted at the heel, the fulcrum is found at the ankle joint. The strong muscles at the calf exert such power that they are able to lift man every time he walks around.

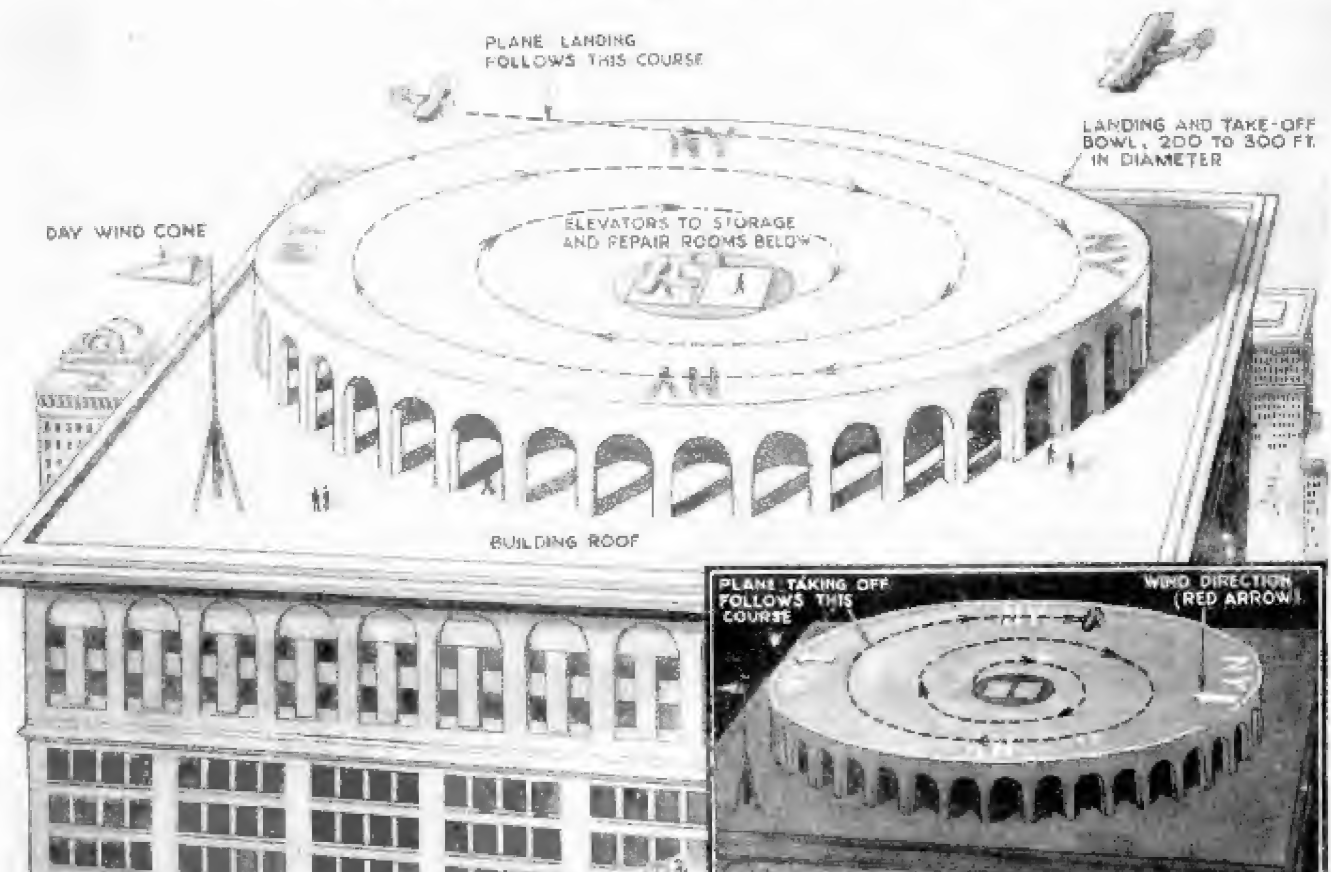
The speed of the snakes while gliding is astonishing, and their method of locomotion is peculiar. The scales with which they are covered, especially those on their abdomen, are provided with a set of muscles connecting to scale and rib and these, by means of contraction and expansion, move the scales backward and forward. Each individual scale is also connected to its neighbor by means of muscles which tilt the scales at an angle. When the scale is placed at an angle it catches some outside material such as a pebble and as the scales are brought parallel to the body, the creature moves forward. It is nature's example of a ratchet and pawl

The lightning-like speed with which the tongue of the chameleon is hurled from the mouth also necessitates certain mechanical arrangements of levers whereby a small original motion is converted into a rapid and extensive one. Since the tongue of the chameleon is almost as long as its body, some method must be arrived at to make it take its place in the mouth, and this is accomplished by making the extending tongue hollow and folding it. The tip of the tongue is provided with a clubbed thickening. At rest the tongue takes position 1-2-3, when suddenly extended, lever 2, which is at an acute angle to the tongue, is brought almost parallel with it and throws the tip 3 with considerable force outward, the folded part of the tongue at 1 then taking position "1."

The hinged joint requires only two muscles, a bender and a stretcher, and the resulting joint bends only in one plane like the blade of a pocket knife, the ball joint, on the other hand, usually demands more than four muscles. The latter are also very common. Besides being found in the more advanced orders of the animal kingdom, they are present in the jointed heads of many insects, such as the flies and darning needles.

(Continued on page 76)

Bowl-shaped Landing Place for Airplanes



The problem of finding sufficient space for landing fields in large cities meets a proposed solution in the suggestion of using a modified motordrome upon which the planes may land and from which they may take off without difficulty. It is known that a plane can spiral or turn in a one hundred foot circle while in the air, and therefore, theoretically one could land in a saucer of that size. To allow for more maneuverability, it was decided that a saucer two or three hundred feet in diameter should be used. After landing at the edge of this bowl, the plane would be able to taxi indefinitely, being protected from the side winds by the edge of the bowl.—Walter X. Brennan. Staff illustration drawn by Mr. Bate.

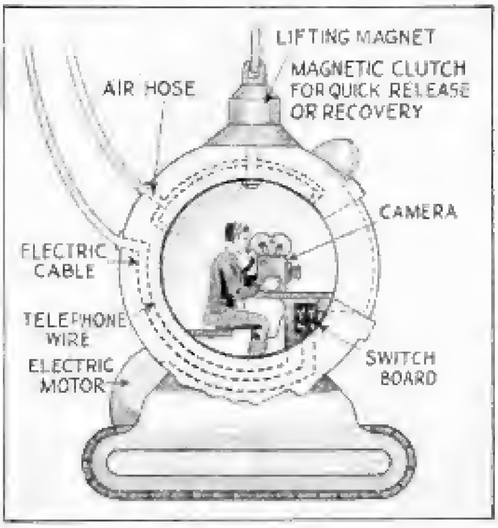
New Marine Tank

By F. O. BOYD

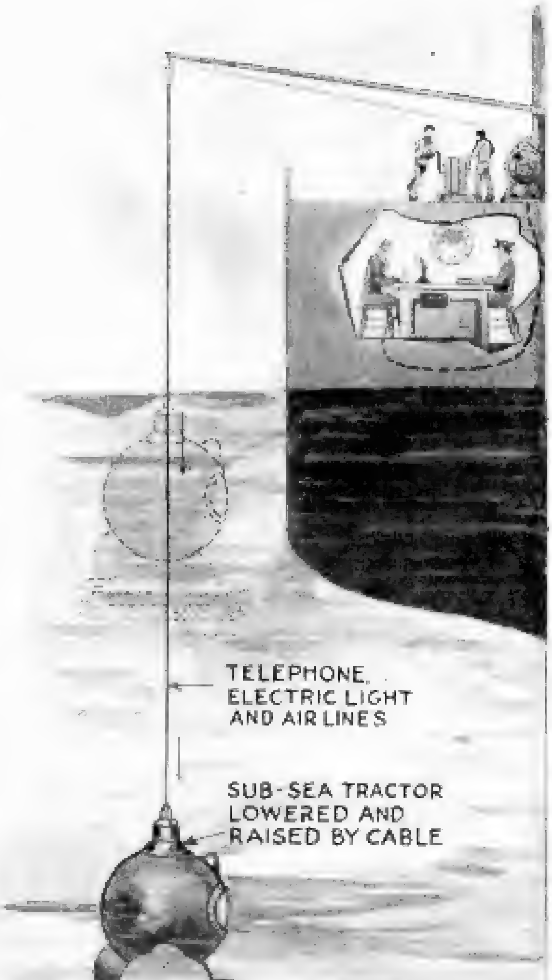
THE marine tank is a device here described in some detail by which it is possible for man to explore the depths of the seas. Essentially it is a globe of thick steel in which the observer sits. This globe is perforated by a window of thick glass as shown in the illustrations and it is mounted on a caterpillar tractor driven by electric motors. The power for locomotion is obtained from the mother-ship on the surface via a cable, or storage batteries, but the operator in the tank is able to control the direction of the tank by speeding up one tractor tread more than the other for steering the tank and can shut off the motors entirely. The tank is equipped with a powerful searchlight, a telephone and a motion picture camera.

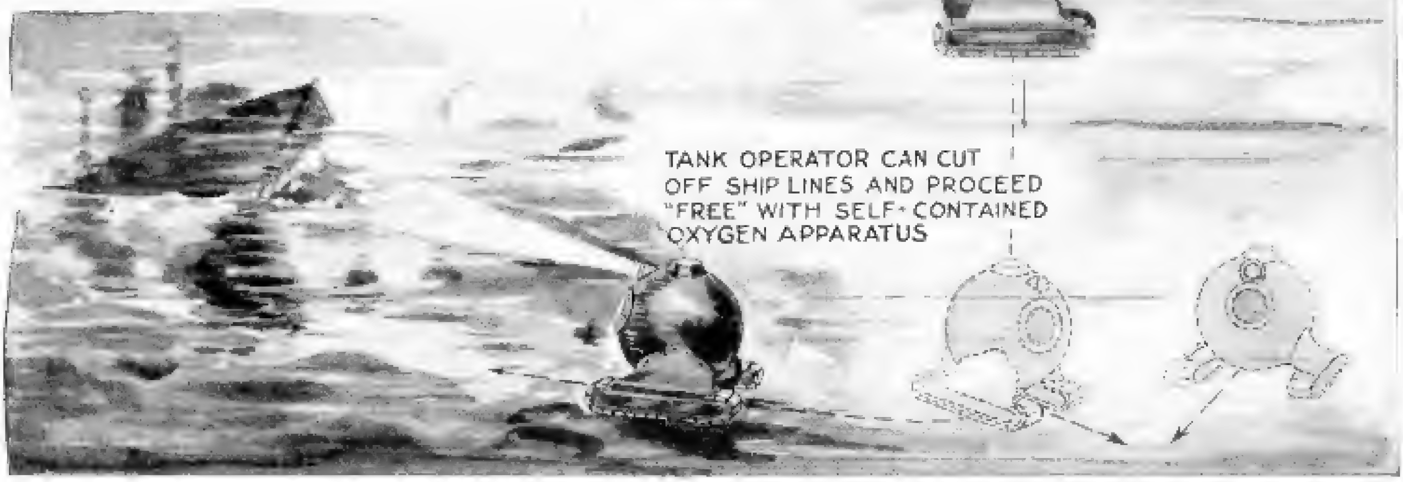
Inasmuch as the walls are quite heavy, capable of withstanding the pressure of the waters at the greatest depth in which such a tank would be used, it suffices to supply a continuous stream of fresh air at atmospheric pressure through a tube, the air entering through one and leaving through another. Entrance to the tank is obtained via the window. The tank is lowered from the ship by a steel cable and when the bottom is reached, the observer operates it from the switchboard inside it. A windlass with lifting magnet hoists the tank and tractor to the mother ship.

After the tractor has been lowered to the bottom, the tank operator may cast off the ship lines and proceed "free" with self-contained oxygen apparatus.



The tank for subaqueous work seen in cross-section. Note powerful construction.

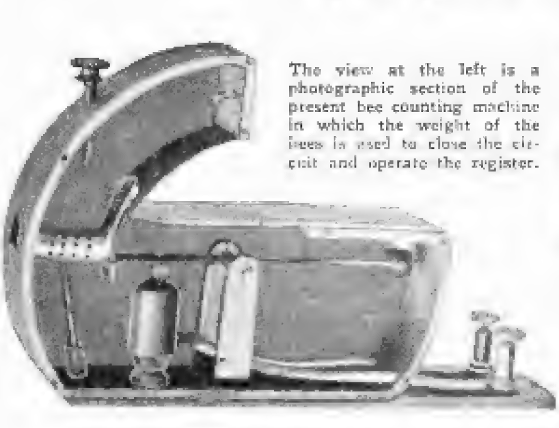




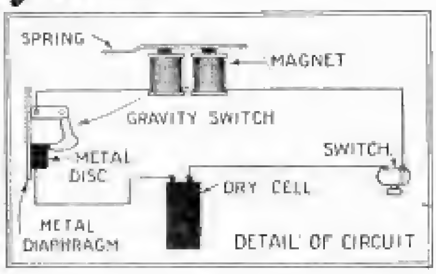
The above illustration shows the submarine tank in operation. It can either be connected to the mother ship at all times, receiving power and fuel supply or it may be cut free when desired. The illustration shows one tank being lowered into the water, and another at work.

Tuning Honey Bees

THE proposal to employ radio equipment in counting honey bees is quite spectacular. It is well known that the electric charge accumulated in a tuning condenser for a specified voltage and distance apart of the condenser plates depends upon the kind of dielectric material. When this dielectric constant is changed, as for instance, if a slab of paraffin is inserted between the plates an indication can be obtained on registering devices. It is questionable whether the method of having the bees serve as the change in dielectric and making them pass between two small plates is better than the method now employed and indicated on this page. —S. R. Winters.



The view at the left is a photographic section of the present bee counting machine in which the weight of the bees is used to close the circuit and operate the register.



It is importnt to know how many bees pass into and out of the hive and to determine the effects of weather conditions on the number of trips the bees take, consequently, counters are necessary. The above illustration shows how the mechanism at the left is operated. The mercury switch closes the circuit to the magnetically operated register.

The Canal-Geometers of Mars

By DONALD P. BEARD
OF THE U. S. WEATHER BUREAU, KANSAS CITY, MO.

WIDESPREAD shifting of certain major canals, "migration" through many miles of green vegetal areas and other similar phenomena have appeared of late upon the planet Mars.

Besides the enigmatic "canals"—a vast system of fine dark lines hundreds of miles in length enmeshing the planet from pole to pole—the disk of Mars presents an arrangement of dark green areas of similar geometric aspect. Apparently the shallow beds of ancient seas which ages ago evaporated, today they are filled with sparse vegetation cultivated in areas with artificially created boundaries.

It seems that the public never tires of hearing the latest news from our astronomical observatories as to the mysteries of Mars, and whether it is possibly inhabited or not. This photo from a drawing by Hamilton shows the Solis Lacus Region of Mars.

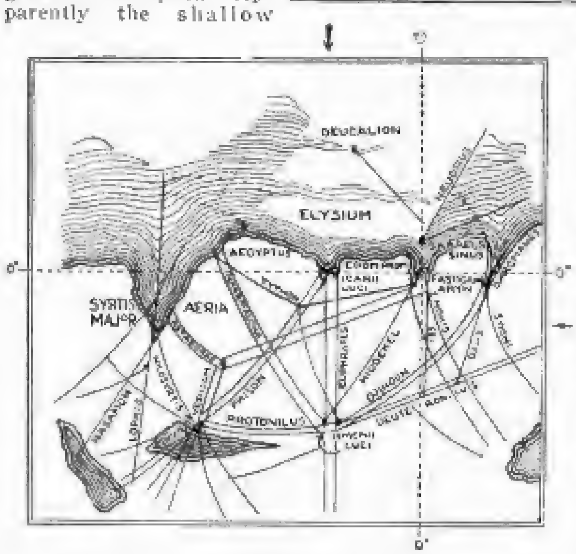
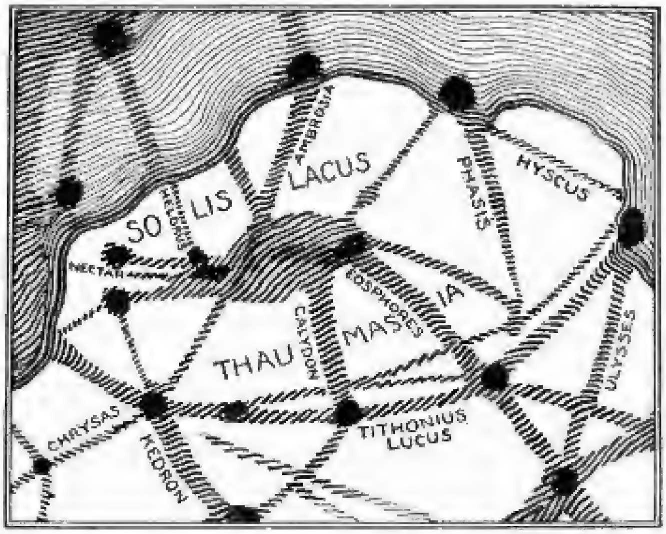


Fig. 2. Martian map reproduced at right shows a close-up study of the Solis Lacus Region of Mars.

Fig. 3. The Martian map at left shows that region known to astronomers as the "Star of Elysium." The marginal arrows converge on matrix of star.



The behavior of the canals is the most inexplicable of all the mysteries that brood over the red neighbor planet. In recent years Prof. W. H. Pickering has thrust the great Harvard telescope through the palms and banyan fronds about his observatory at Mandeville, Jamaica (B. W. I.) and observed startling changes that march across the yellow-marl disk which hangs like a signal lantern in that lucid tropical firmament.

Prof. Pickering has sketched the shifting of certain major canals like Phison and Tartarus and has discovered that nearly all the canals either shift their positions, vary in width, or otherwise change their appearance.

An instance of major change is furnished by the Hellas region of Mars. The "Cross of Hellas" first appeared to Schiaparelli in 1879 and at the next close appearance in 1892 was observed by Lowell, Thollon, Schiaparelli, Cellori and others. At the latter approach of Mars a regular pentagon figure with several radiating canals was seen from the Harvard station near Arequipa, Peru.

Several canals in this Hellas area have altered visibly their places and directions at recent Martian approaches. In 1909 M. Jarry-Desloges of Nice on September 26th drew the arrangement shown in Fig. 1, which is a quite significant figure, since large four-sided constructions are most unusual on Mars. The central meridional canal is Laestrigion; the two lower ones Tartarus and Cerberus.

At the opposition of 1924 Mars came to a close approach of 34 million miles and in that year an unusually large and complicated figure appeared. "Again it was pentagonal, apparently a favorite figure with the Martians, but in a different place."

The great "Solis Lacus" or *Lake of the Sun*, is the supreme enigma of Mars, its oval shape and location rendering it the dominant feature upon its hemisphere. Suggestive of a huge dark "eye" of some world-monster looking out calmly into space, it has defied rational explanation since its discovery in the pioneer days of Maedler and Schmidt's studies. It may possibly house some such Utopia on Mars as Hauptmann or Wells would describe in one of their fantasies!

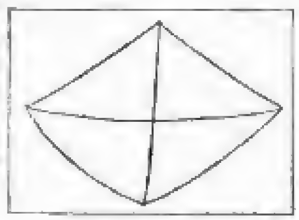
On the night of August 23rd, 1924, at the last close approach of Mars, this strange "eye" of the Martian planet looked directly down upon those regions on the earth from which our great observatories had focussed their telescopes upon it,—a rather significant fact, remarked G. D. Hamilton of the Harvard observatory at Mandeville.

On that particular night the Solis Lacus exhibited a most unusual shape, as shown in the accompanying sketch made by Dr. Hamilton at the British West Indies observatory. The canal Nectar, as shown in the key map, did not meet the Mare Erythraeum as usual, but was an extension of the Solis and ended in two of the four "oases" or lakes shown in the drawing, Fig. 2. A rift cut the Nectar transversely, close to these oases, and was itself crossed by a triple Nectar canal, the central member of which passed through the whole length of the Solis and continued on across the outer plain of Thaumasia—a structure of most amazing complexity!

Furthermore, a cross-shaped *white canal* appeared in the dark region of the Aurorae Sinus, with a continuation leading off to the small oases of Fons Juventae and Pseudo Fons. Perhaps the Martians have cultivated the borders of their vegetation into cross forms such as this and may occasionally illuminate them with powerful incandescent lights in efforts at signalling. Indeed, the arrangement of the great canals of Naarmalcha, Hiddekel, Phison and Euphrates into the cosmic symbol of the masonic square and compass is strikingly shown in Fig. 3

Concerning this "pentagon of Elysium" (out of which the Masonic symbol mentioned is formed) some startling discoveries were made by Pickering recently. The pentagon area measures 1600 miles in diameter, or twice that of Hellas. Moreover, it is not a true pentagon, although roughly of that shape, but a five-pointed star, more nearly. Conceivably it is a universal, cosmic symbol flashed to us across 40 million miles of space to reveal the presence of reasoning mind upon that distant planet.

Fig. 1. Arrangement of canals drawn at Nice. The central canal is Laestrigion; the two lower ones Tartarus and Cerberus.



Obviously so large a figure, formed out of the hedgerows of Martian vegetation, similar to the symmetrical box-elder hedges of our own gardens, and projected upon the globose surface of Mars, can only appear in its true character during a certain presentment of that region to the earth. That position was precisely assumed at the opposition in 1924, when the planet approached nearer than for the preceding century-and-a-half, and the centre of the disk was in Martian latitude 16°, and rotation had brought the central meridian to its zero point of longitude.

(*Continued on page 76*)

June

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See page 110

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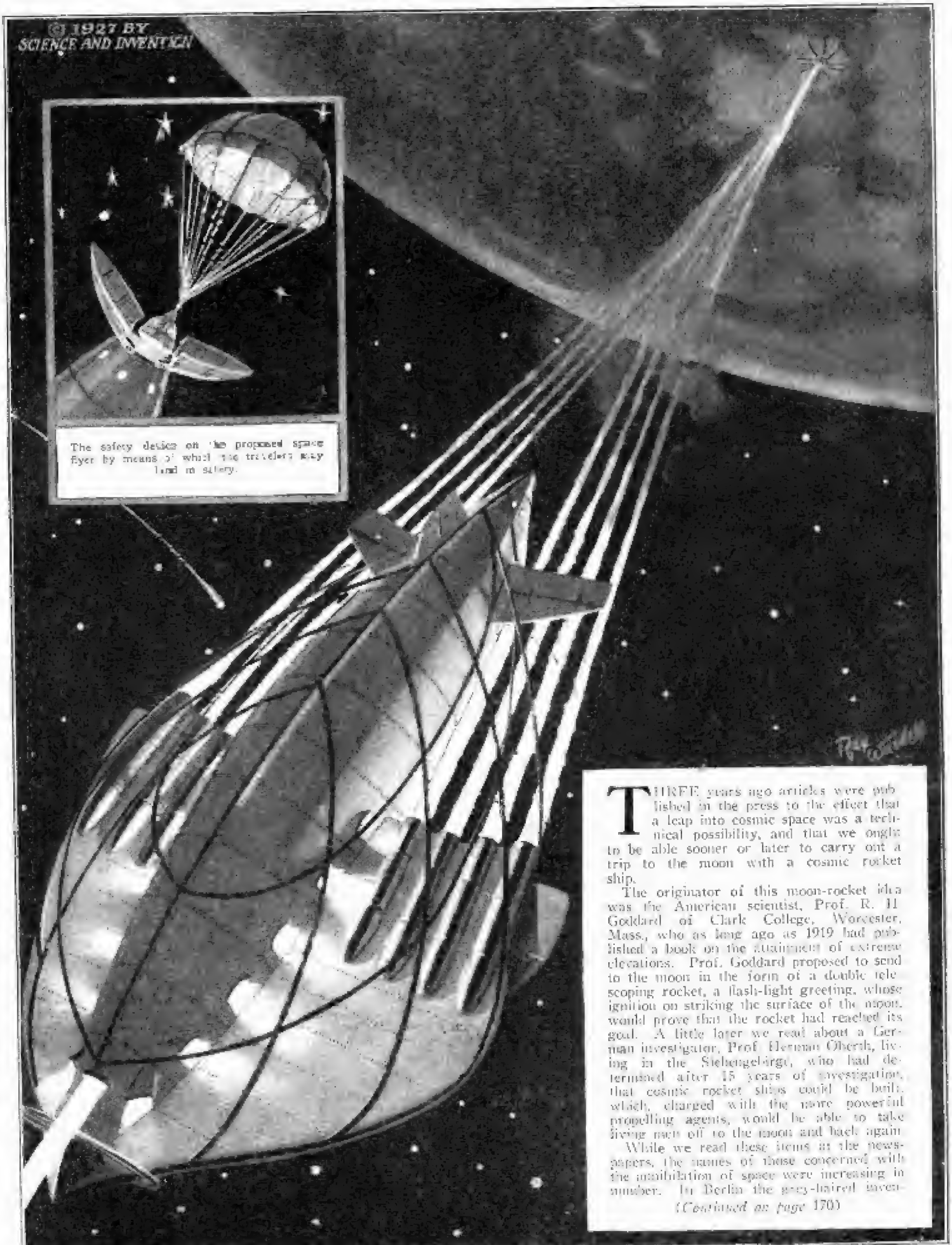
Can We Fly to the Planets?



The safety device on the proposed space flyer by means of which the travelers may land in safety.

THREE years ago articles were published in the press to the effect that a leap into cosmic space was a technical possibility, and that we ought to be able sooner or later to carry out a trip to the moon with a cosmic rocket ship.

The originator of this moon-rocket idea was the American scientist, Prof. R. H. Goddard of Clark College, Worcester, Mass., who as long ago as 1919 had published a book on the attainment of extreme elevations. Prof. Goddard proposed to send to the moon in the form of a double telescoping rocket, a flash-light greeting, whose ignition on striking the surface of the moon would prove that the rocket had reached its goal. A little later we read about a German investigator, Prof. Herman Oberth, living in the Siebengebirge, who had determined after 15 years of investigation, that cosmic rocket ships could be built which, charged with the more powerful propelling agents, would be able to take living men off to the moon and back again.

While we read these items in the newspapers, the names of those concerned with the annihilation of space were increasing in number. In Berlin the grey-haired inven-

(Continued on page 170)

Mars as Seen From Its Satellite "Phobos"

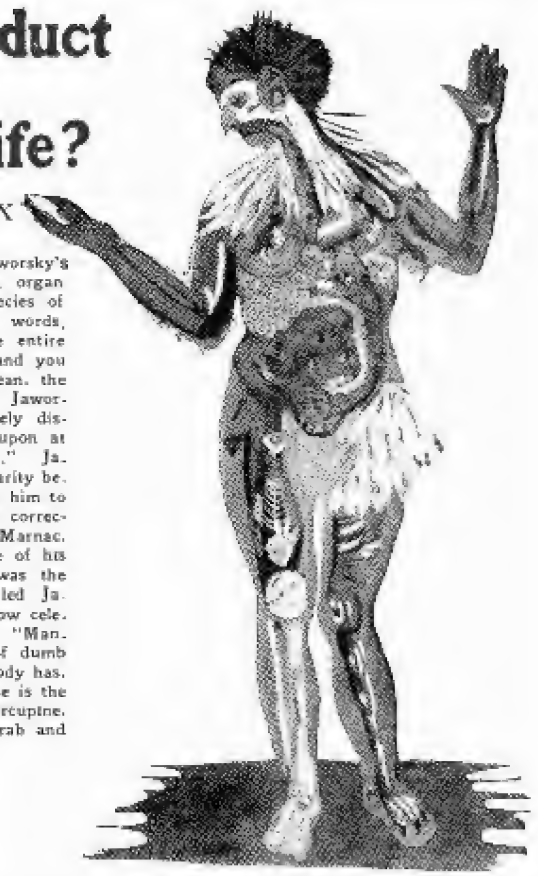
A view of the planet Mars as it would look from its nearest satellite, Phobos. Seen in this manner Mars is not red as when viewed from the earth with the naked eye. It is, as one observer aptly termed it, an opal, and it surely has some of the qualities of an opal in the diversity of aspect which it shows to the imaginary observer on Phobos. Phobos makes a complete circuit around Mars in seven and one-half hours.

Worthy of note is the constellation Orion, and other bright stars, which appear exactly as they do from our earth. The second satellite is just visible to the left of Mars, in the constellation, Taurus. Note also, that it is not yet "Full Mars," and that the disk of Mars far surpasses the constellation Orion in size. The canals on the Martian surface should also be observed. This illustration originally prepared by the famous astronomer Flammarion.

Is Man A Product of All Animal Life?

By UTHAI VINCENT WILCOX

The "Man-Menagerie" illustrates Dr. Jaworsky's revolutionizing discovery that each human organ is the equivalent in function to some species of animal life so that, in Jaworsky's own words, "man is a miniature reproduction of the entire history of evolution." Study the picture and you will see the hand representing the crustacean, the intestinal tract the reptile, et cetera. Dr. Jaworsky's biological researches have been widely discussed and these have also been written upon at unusual length in the "Courrier Medical." Jaworsky's recognition of the functional similarity between the bird and the human lung enabled him to actually make a serum from birds for the correction of respiratory troubles. Mme. Jane Marnac, the popular French actress, represents one of his most successful "bird-serum" cures. It was the principle of the "Man-Menagerie" that led Jaworsky to the discovery of the new, and now celebrated rejuvenation treatment. Jaworsky's "Man-Menagerie," as he calls it, is composed of dumb animals and insects. Each organ in the body has, he holds, its prototype in Nature. The nose is the beak of a bird, the hair the quills of a porcupine, the ear a shell, the hand the claw of a crab and the alimentary canal a serpent.



DR. HELAN JAWORSKY of Paris has been receiving high honors and accomplished remarkable results in his studies of mankind. The Academy of Science have recently recognized his theories. Dr. Jaworsky had constructed a biological tree in support of his claim that man's descent cannot be traced to apes, but instead to an original *life-cell*. He represents the evolution of the *same* cells that held the life-germ of all other animals. He further claims that not the ape alone, but all animals in type and more particularly in function, are represented in the human body.

Life, according to this eminent scientist, is a series of movements, varying only in length and quality. Thus the jerk of the kangaroo's jump is represented, functionally, in Man's breathing. The sinuous movements of the snake, again, are represented in many by the intestines. Bone formations, in his view, have kept their relationship with animals and lower forms of life as indicated by jointure and construction, and so even the fish has its counterpart in Man.

In the biological tree which Dr. Jaworsky has conceived as being fundamental truth, various species could be substituted for those which he has shown. The animals which he shows in his drawings are only those that indicate what he calls a biological principle.

One of his drawings relating to the functions of man to those of other forms of life—as, for example, one wherein he demonstrates that birds, like kangeroos, in their entire entity, function almost completely on the lines of the human lung. From this he argues that the kangaroo and the bird originally belonged to or grew from one species of *life-cell*, conditions being responsible for the division of the species. His investigations have led him to conclude that a further division took place when Man evolved, but that the cell-function was still reproduced in this new form of life, but, without changing its character, became only a highly specialized function amalgamated with other functioning cells, in a higher developed creature.

Sir Jagadis Bose, M.A., D.Sc., F.R.S., the great Indian scientist, from another angle has given most interesting scientific corroboration to the principle of the unity of life and the harmony of function, by his discoveries that all growing things in Nature have similar mechanisms to those of Man—that there is, for example, a nervous system in plants, a system of sap-circulation and actual nerve-impulses and responses to stimuli—as demonstrated by plants suffering from shock, or responding to tonic influences by increased vigor.

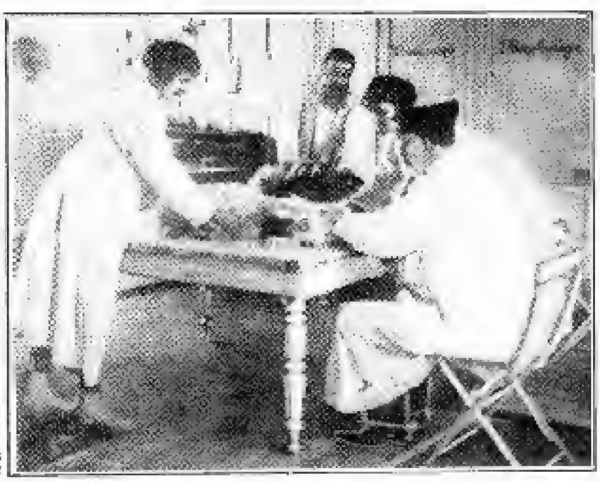
Dr. Jaworsky's drawings put into concrete form the evolutionary adaption of movement or functioning and show scientifically the development of functioning, bringing out the principle that no function has ever been lost but that it has been incorporated in the better developed type of living creature, Man.

"Biology," says Dr. Jaworsky in explanation of his principles, "brings to light the actions, more scientifically termed 'functions,' of every living thing. Study biology, understand it—and Man becomes nothing more, physically, than the problems of each species, but in the aggregate. It has long been known that serums can be made from the blood of various animals to react beneficially on human beings. I need seek no further for an instance than in the antitoxin used in the treatment of diphtheria. I go so far as to say that in time we shall find in each species of animal a cure for most ills.

"Through studying birds, I have found their functions duplicated in Man, or rather, to be exact, practically the entire functioning of a bird is concentrated simply into man's lung. I have demonstrated the usefulness of this knowledge by making from birds a serum which has cured numerous cases of pneumonia, asthma, bronchitis, hay fever and other respiratory ills.

"Our knowledge of the functions of animals, as yet, is very limited, I regret to say. There are many species of animal whose peculiar functions are so little understood by us that we cannot yet identify these with their prototypes in Man. But, that, after all, is a question of further research by enlightened scientists who even now, are investigating from every standpoint. The animal world and the vegetable kingdom too, can be described as a series of functions. Man is simply a completion and modification of these functions. Therefore Man—for the moment at least—may be the uppermost branch of the biological tree—is, indeed—but still he remains only a biological step in progress."

While Dr. Jaworsky's discovery seems to be gaining many friends, it does not necessarily follow that all his statements are correct. For instance, many of us would rather believe that the breathing of a kangaroo is similar functionally to man's breathing. We do not infer that the jerk of the kangaroo's jump is represented functionally in man's breathing. While we have given this theory of Dr. Jaworsky's space in this publication, it is not to be implied that the editors of SCIENCE & INVENTION *Magazine agree with all of Dr. Jaworsky's theories.*

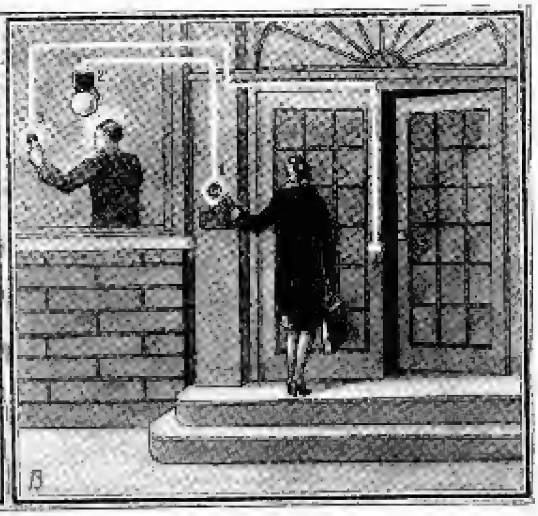


For years the scientist Jaworsky experimented in his laboratory with dumb animals in an effort to find a way to overcome "fatigue poison," and now he is acclaimed a rejuvenator of human beings.

What Is Relation of Sight and Speech?

THE WONDERS OF

A simple reflex. Striking the knee with the hammer at 1, sends the stimulus to 2, in the spinal cord, which acts on nerve cell at 3, and causes muscle, 4, to bring foot into dotted position.



The electrical analogy for the action depicted in the diagram at the left is indicated in B above. The push button, 1, sends the stimulus to 2, which corresponds with the spinal nerve cell. This causes button, 3, to be pressed and produces action at 4.

IF one steps from the investigation of the single elements to the contemplation of the complete nervous system, we come upon astonishing resemblances between arrangements of Nature and the electrical lay-outs of human technology. The human nervous system resembles the telephone network of a city. Like this system the nervous organs comprise a number of independent single apparatus, which by contact, are bonded to the general system, but in other ways have their own individual peculiarities. These independent parts are the nerve cells. Every nerve cell forms, with all of its connections, a biologic and functioning unity, which one designates as the nerve-unity, the neuron. The human system is a complex of neurons. The neurons do not grow together, but are in contact by means of the nerve system with the neighboring neurons. Many investigators believe that these contacts are analogous to the plug-contacts used in our telephones, as the end fibres of the nerves by stretching out make contact and then by drawing back, "when through speaking," again break off the contact. On account of the obvious difficulty of microscopically observing the living nervous system during its activity, it is difficult to demonstrate or refute its other functions just as in the case of other nerve hypotheses.

THE SIMPLE REFLEX ACTION

As the single connections in our telephone systems, so in our nervous systems, the individual neurons only in a few cases cover the entire system of "receivers," but usually only start as the result of the reception of a "transmitter" by the "central station," which is the spinal marrow of the brain and here gives its excitation to the connecting neurons. In contrast to the single neurons, the entire stretch which excitations pass through is designated as the transmission system, and in individual cases it may be designated as the transmission line for sensations as of pain, hearing, feeling, or when motion is involved, as the motor line. The simplest line of excitation between two neurons is the reflex line. If one crosses one leg over the other and allows the upper leg to hang down freely, and if one strikes with a hand or a little hammer right under the patella, against the stretched tendons of the knee muscles, the excitation will be carried from one sensation neuron back to the spinal marrow (1-2), and then through a multiple contact to a motor neuron (3-4), which carries the excitation from the spinal marrow to the substance of the excited muscle, and excites the muscle filaments to contraction.

As an answer to the excitation of the blow against the tendons, the muscles contract. The excitation travels from the epidermis to the spinal marrow, and hence, just like light from a looking glass, is reflected back and travels to the periphery. We call this progress of excitation a reflex and the reflex just described is a knee-tendon reflex. The nerve conductor system of the knee-tendon reflex represents in layout and transmission a single electric call and answer apparatus, such as we use, for example, in an automatic door opener (B). Outside the door, there is a push button (1). If we press the button we carry excitation to a bell (2). Here the excitation operates an automatic contact, or else a porter with a second line (motor neuron) going to the periphery (3), which by the current transmitted, opens the house door (4).

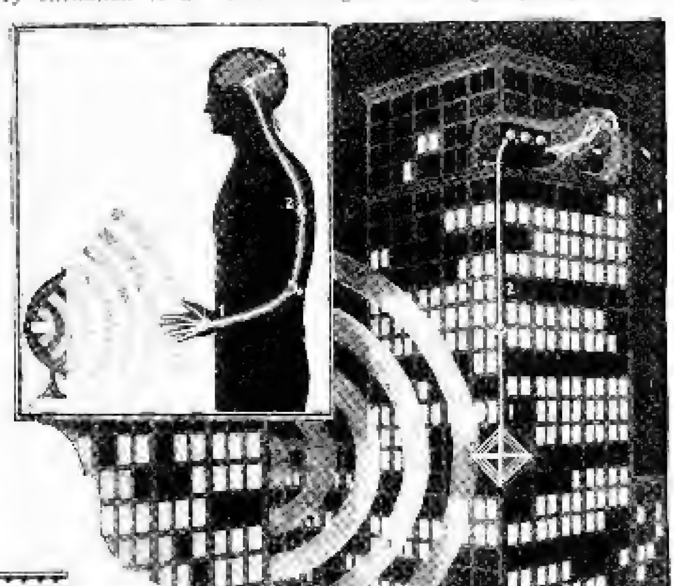
The system becomes more complicated when it is not limited to the line of skin-spinal marrow-muscle, or doorbell-porter-hall door, but goes on into the region of consciousness or into the room of the tenant.

THE PERCEPTION OF HEAT

We warm our hands a little at an electric heater; just what happens? Ether waves which we feel as heat stream out against our skin. Here they are received by the spreading filaments of the terminal sensitive nerves, just as radio waves are picked up by an antenna, just as the hammer blow on the knee tendon was carried by a sensory neuron from the periphery to the spinal marrow (1). Here the nerve excitation is communicated to a second neuron, whose function it is to carry the nerve current through the spinal marrow, up into the brain in contrast with the reflex action (carrying it back to the skin). Here the second neuron ends in the base of the brain. This central base of the human brain corresponds to the foundation of the brain acquired by the vertebrate animals and contains as the oldest portion of the brain, the primary center of perception, by which the lower members of the vertebrate feel the excitation of the outer world and register it.

Here the excitations are "qualified," that is to say, are registered individually as light, heat, feeling or hearing, but are not yet comprehended. The reception power of this central stem is of lower grade than the intelligence area, just as for us men, the presence of the ground during an exciting entertainment is not perceived. We feel at every step whether the surface is hard or soft, we automatically adapt our muscle tension thereto, and if we find ourselves first going over a soft foot path, and suddenly are on a paved street, we at once react to a perfect switching in "of the walking mechanism"—but the sensation does not come to our consciousness. So we are, for example, entirely filled with the discourse on the tragic fall of the kingdom of the Incas and our conscious thoughts and feelings are far back in the sixteenth century among the inhabitants of old-time tropical America.

For the dawning intelligence of animals, to rise to the clear human intelligence, this function must go from the lower part of the base of the brain into the cortex (3). Here the excitation is passed on to a fourth neuron, the superficial brain cell which represents the organ of intelligent perception (4).



Another analogy is indicated in the two illustrations here. In this case, feeling heat from an electric heater is likened to radio waves and a listener. It will be observed that the heat is felt in the hand, 1. The stimulus passes to the nerve cell in the spinal cord at 2, and is then transferred to the brain at 3, and registered at the brain center at 4. In B the radio waves are picked up by 1, which is similar to the hand, transferred via plug and cord, 2, to the set, 3, and registered by the person at 4.

OUR NERVOUS SYSTEM

If the reception of ether waves through the human nerve system is compared with the same reception by a radio set, we come across a striking analogy in construction. The first neuron, the sensitive neuron, which receives the ether waves of the outer world by its spreading filaments and carries it into the interior of the body is the antenna that receives the ether waves and takes it inside the house through its conductor (1). The second conducting neuron represents the connections which within the residence run from the end of the antenna to the radio set (2). The third neuron, the basic brain neuron, is a radio apparatus (3). Here the ether waves are distinguished, and changed back, as it were, into the quality of the excitation received and given back as the human voice, the tones of an organ, or the sound of a violin; but the radio apparatus itself feels nothing, only man listens to it. In man the operation of the radio apparatus converts knowledge into experience, we have the fourth neuron, the peripheral brain cell, the organ of intelligent perception (4).

The sensation of the skin here pictured is the type of the simplest central action. Most of them are so complicated that without preliminary study they cannot be followed.

Nervous System Like Telephone

In this diagram an analogy of how the brain works from the time the eye sees an object until the object is named, is given. Further explanation is found in the accompanying text.

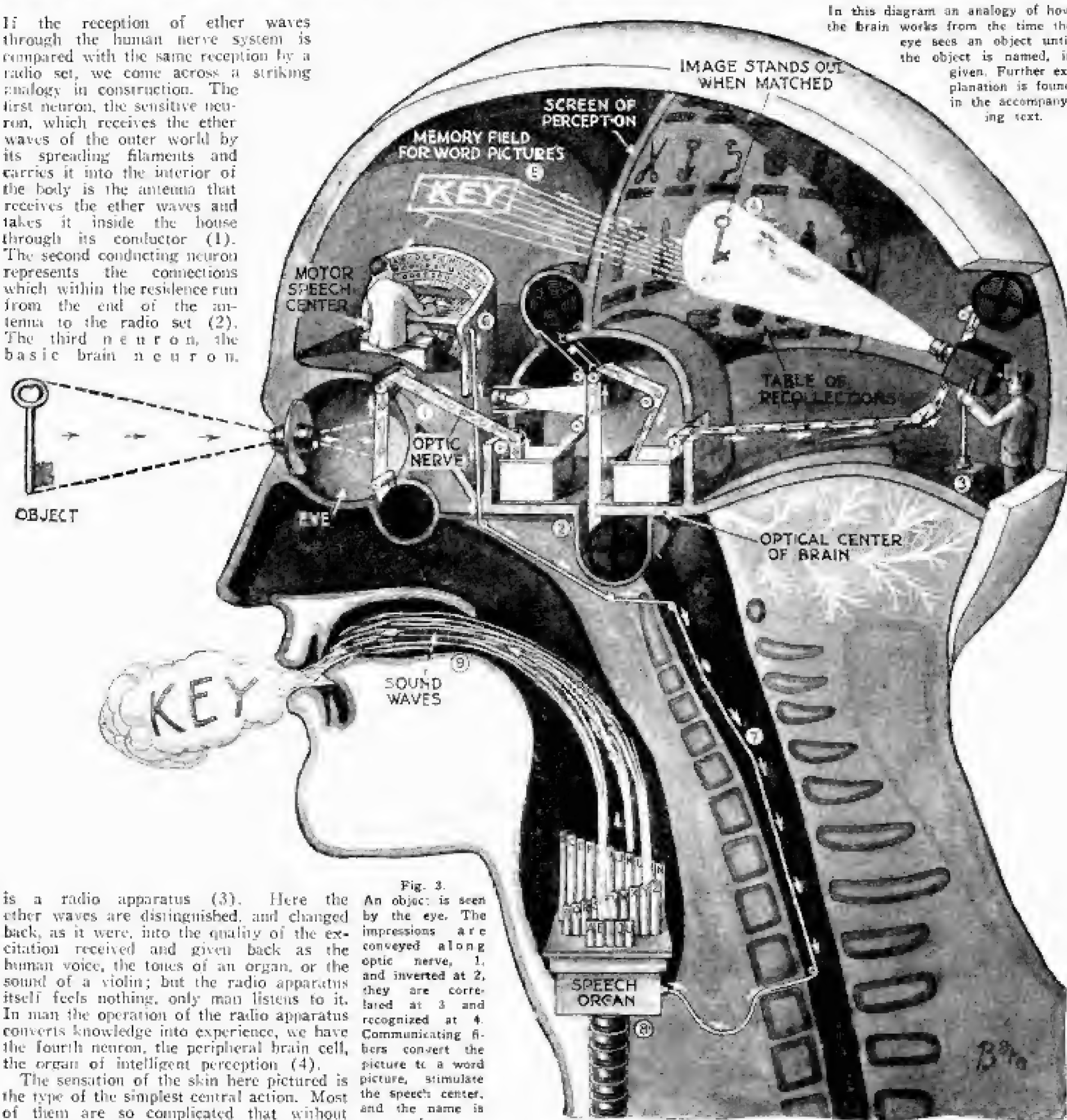


Fig. 3. An object is seen by the eye. The impressions are conveyed along optic nerve, 1, and inverted at 2, they are correlated at 3 and recognized at 4. Communicating fibers convert the picture to a word picture, stimulate the speech center, and the name is spoken.

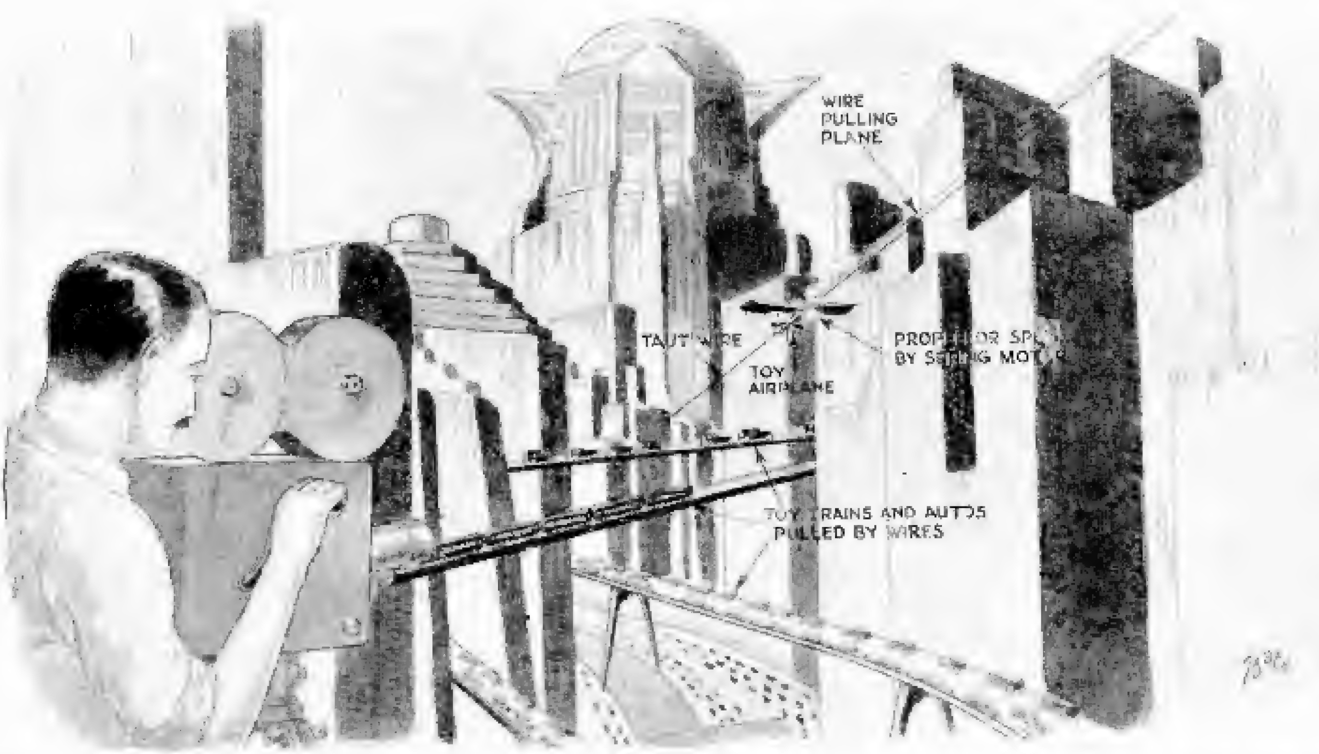
HOW "WORD PICTURES" ARE FORMED

One contact system which is still easy to understand, but involves over eight different neurons, is one of our intellectual actions which is most frequently used, where we give a name to an object which we see. In Fig. 3, the progress is shown in mechanical reproduction in the picture. We see a key and say: "key!" Now in this sixth of a second what has happened? First the image of the key reduced by the lens of our eye is thrown upon the camera obscura of our eyeball and here is thrown upon the light sensitive lining of the retina. Under the influence of light the retina is changed and apparently sets free various chemical combinations which act as excitants of the nerve cells here present. This excitation in some way unknown to us is changed, and is communicated to the first transmission neuron, a nerve cell whose sheath of nerves goes from the retina into the optical center at the base of the brain, which along with its nerve threads from other cells, forms a thick cable with some million of individual threads, the optic nerve (1). The image is transferred from the retina to the optical portion of the brain "telegraphically" through a cable.

It will be seen that in Fig. 3 the human reception of an image is maintained and the optic nerve is shown as a picture film, which in the back of the eye-ball is illuminated and then goes on to the optical center of the brain. In this center (2) the picture is developed and qualified: here it appears as a picture of a key. The picture now seen exactly as in the case of a skin sensation, is passed over to a neuron that carries it from the depths of perception and out to the cortex of the brain in the region of clear perception. Speaking as if it were a matter of photography, the negative is changed into a positive, is copied, and sent through the path of vision to the promulgation apparatus. Here the peripheral cells of the human brain (3) receive the picture as something experienced. The picture is thrown on the screen of perception (4) and there it appears as the picture of the key, which is in the outer world in front of us. The screen of perception is at the same time the table of recollections. It is not white and empty, but dark and carries the intaglios of all those pictures that have been impressed upon it in the past. The image of the key travels about over the surface; it seeks here and

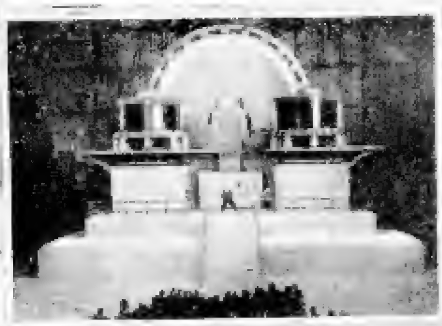
(*Continued on page 162*)

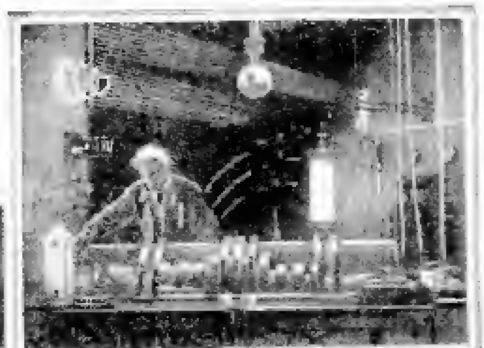
"METROPOLIS"—A MOVIE



The miniature set which was used in the filming of this remarkable motion picture. Toy trains and automobiles were pulled along the bridges by means of wires. The airplanes were suspended by a wire which was pulled by an operator outside of the set. At times full size lower stories were used, the image of the upper stories being reflected in a mirror to blend with them.

In "Metropolis," the city of the future, the lower classes are enslaved by the scientific and mechanical genius of the ruling group. Above is one of the laboratories in the "upper city." By invoking a diabolic discovery the ruler of the city was able to endow a manikin with human life and intelligence. This photoplay is reminiscent of our own "scientifiction" stories, which you all know.

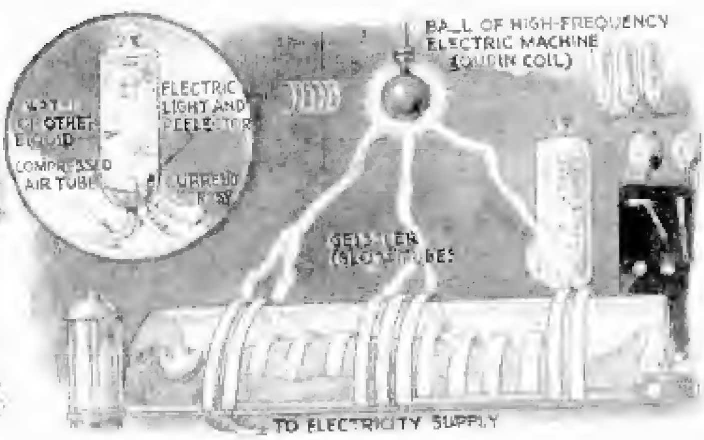




In the photo above, the ruler's scientist is transferring the vital spark from a girl of the lower city into his fiendish manikin, which he uses to spread disorder and destruction among the slaves. The sets used in this production are remarkable for their ingenuity and imaginativeness and the photography is unique.

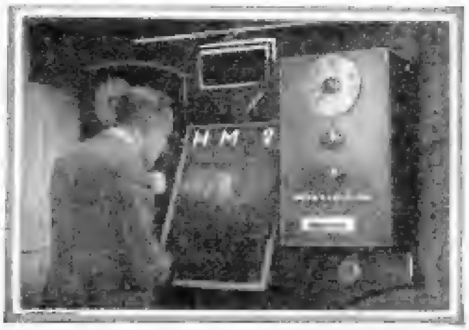
—*Photos courtesy Paramount Pictures.*

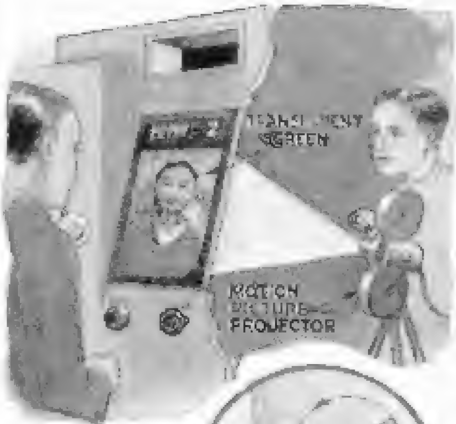
The effect of sparks jumping about the machines was produced by placing a small high frequency apparatus near the camera as shown above. In the finished picture the sparks seemed to jump from the two huge coils placed on either side of the mechanism.



The spectacular scene in the scientist's laboratory. A weird effect was obtained by forcing compressed air through a closed tube containing a liquid and illuminated by a lamp placed at the bottom. Center photo shows one of the huge papier maché machines in the "power plant."

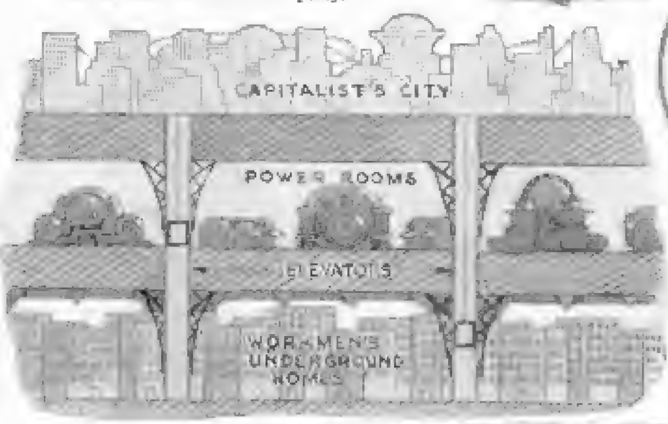
BASED ON SCIENCE

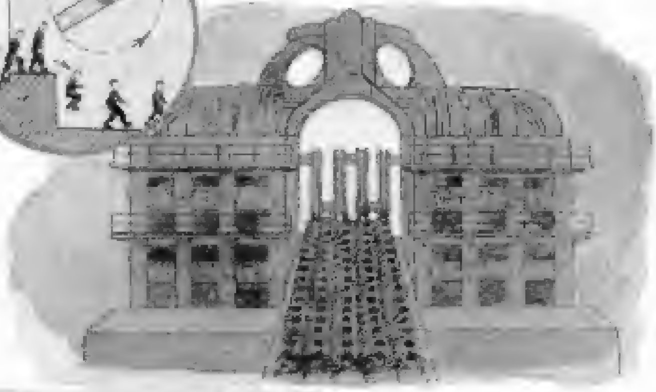




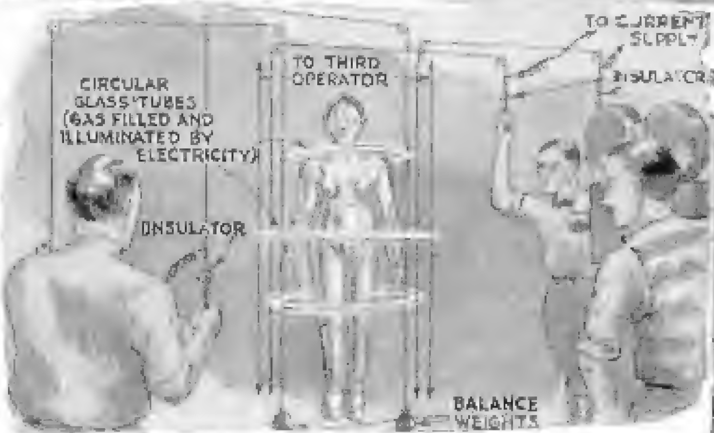
Of course the city of the future would have all the inventions of which we dream today. The recently perfected television apparatus, is in common use. By using it, those who converse may also at the same time see the other party.

The illustrations shown on this page are taken from the film "Metropolis," produced by UFA in Germany. The photoplay is now enthralling the American public.

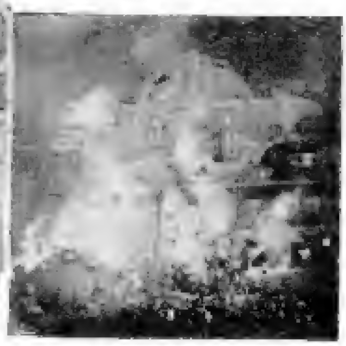




A sectional view of "Metropolis," the city of the future. Below may be seen mechanical woman possessing human life but no soul.

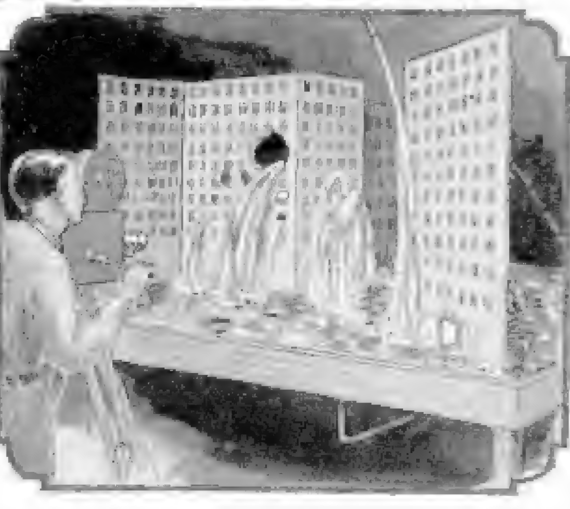


The maw of the huge machine which ruthlessly destroys body and soul. Below a picture of the huge machine at the time of its destruction.



The concentric rings of light which played about the machine were hand operated.

Below: The workman's underground city. Note the shadowed effect.



Right: Destruction of "Workman's City." A small set was used and water, forced through pipes, was directed through the sides of the buildings and down from above. Pipes placed at street level ejected water in a geyser-like effect.

The destruction of the "Workmen's City" at the time of the flood. Note the appearance produced by the outstretched arms of the small children. In the center may be seen the immense gong which was used to sound alarm. Full size set used here.

July

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A CATAPULT FOR DIVERS

See Page 206

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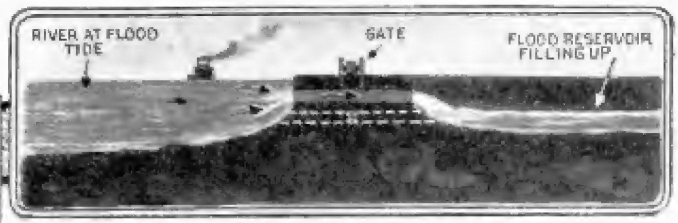
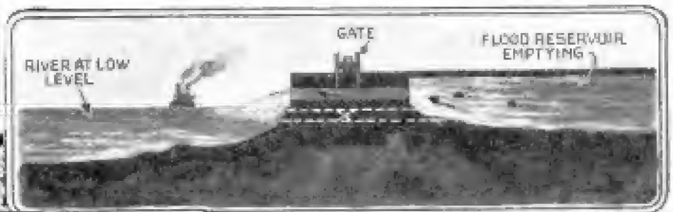
Mississippi Flood Prevention

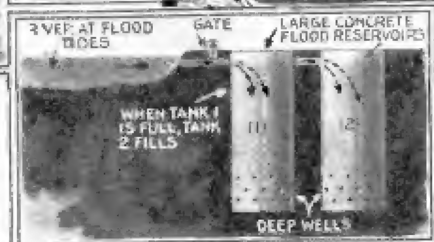
A Number of Schemes Having More or Less Merit Are Here Described

The above illustration shows the Mississippi River connected, by canals, to flood reservoirs. When the river is high the overflow runs into these reservoirs and thus is kept at the natural level. As soon as the river runs below the level the water again runs back from these reservoirs.

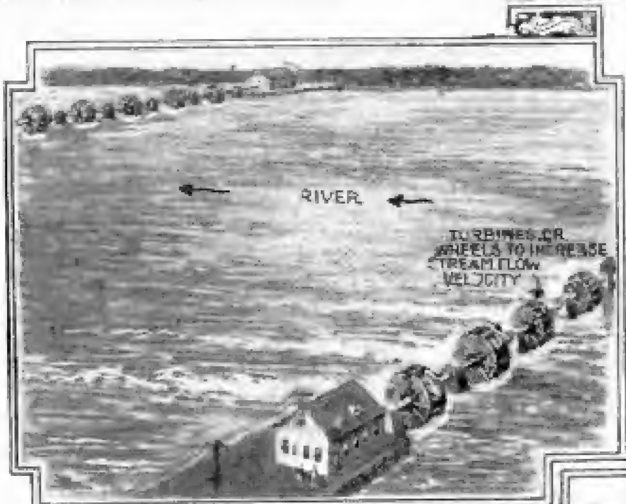


One of the methods suggested for the prevention of further floods is shown in the illustrations appearing above and below. A reservoir with a gate is provided so that the flood waters may run off and the reservoir again emptied when the river is low.





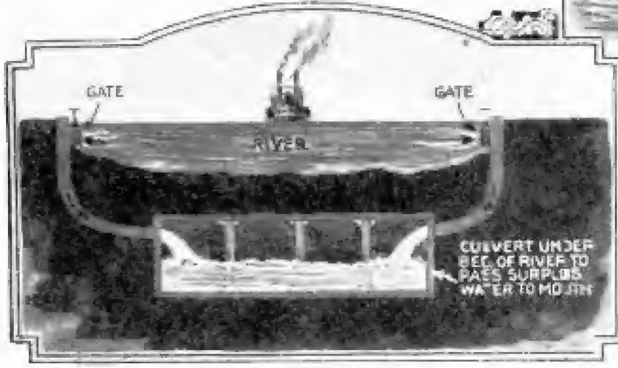
At the left we have two large concrete wells or tanks: these tanks serve the same purpose as do the reservoirs, but do not take up the area which would be required for them. The flood waters seep away or are pumped off.

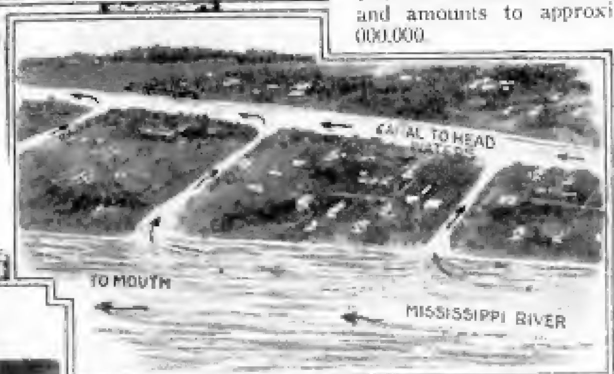


A French engineer, J. Archer, has suggested that the Mississippi flood might have been prevented by installing turbines or wheels to increase the velocity of the flow of the water. These wheels are to extend across the river. According to the inventor, the whole cost of installation would not equal the losses in one big flood.

A suggestion has also been advanced whereby concrete walls, 40 feet high and extending some 2,000 miles from the mouth of the Mississippi River, should be built as a means for controlling future floods. The cost of this construction would be entirely prohibitive and amounts to approximately $64,000,000,000.

Below we have an ingenious flood prevention method advanced by one of our "master minds." This consists of building a river under a river in emulation of our present-day subway system. The overflow is to run through this culvert and thus the surplus water is passed on to the mouth of the river.

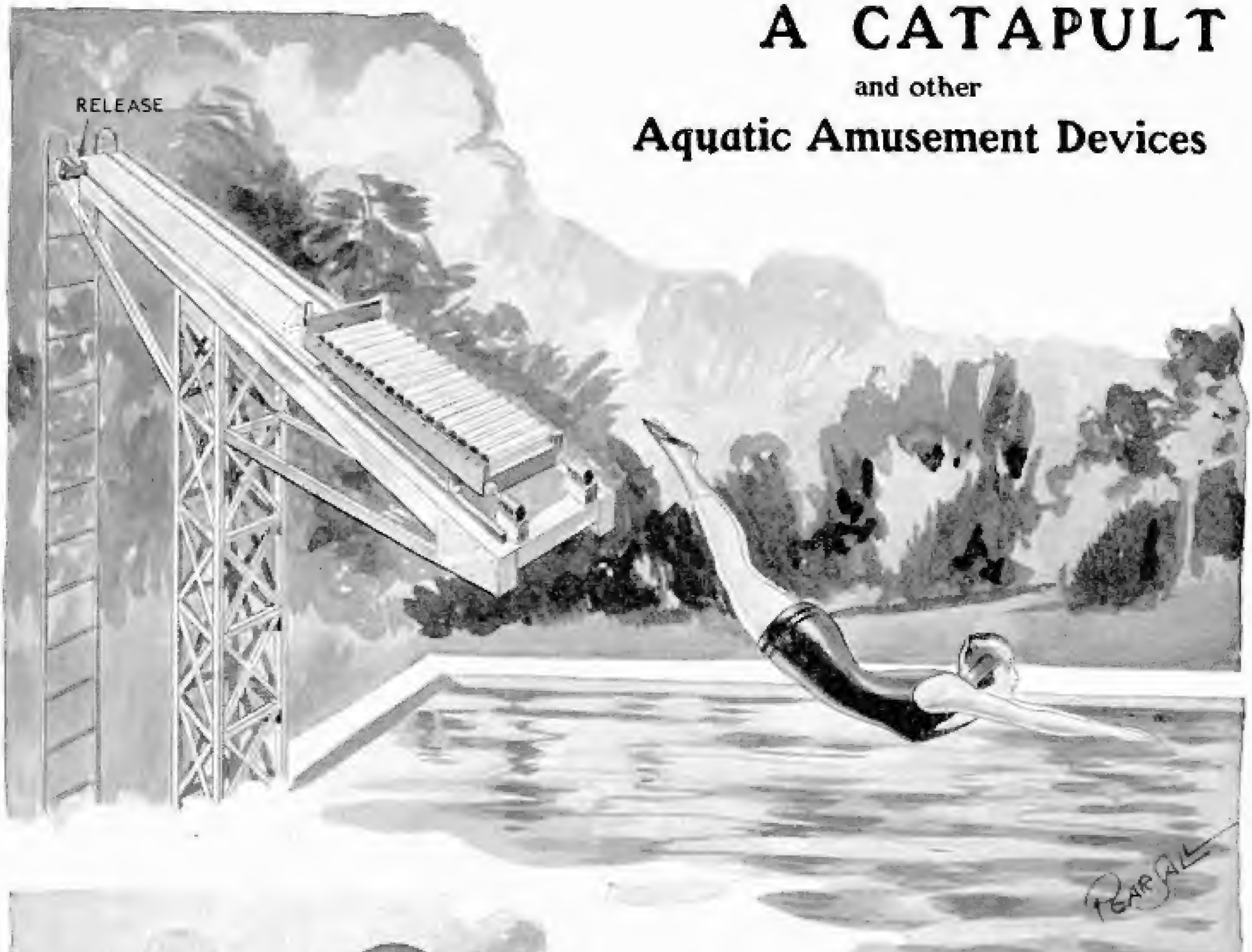


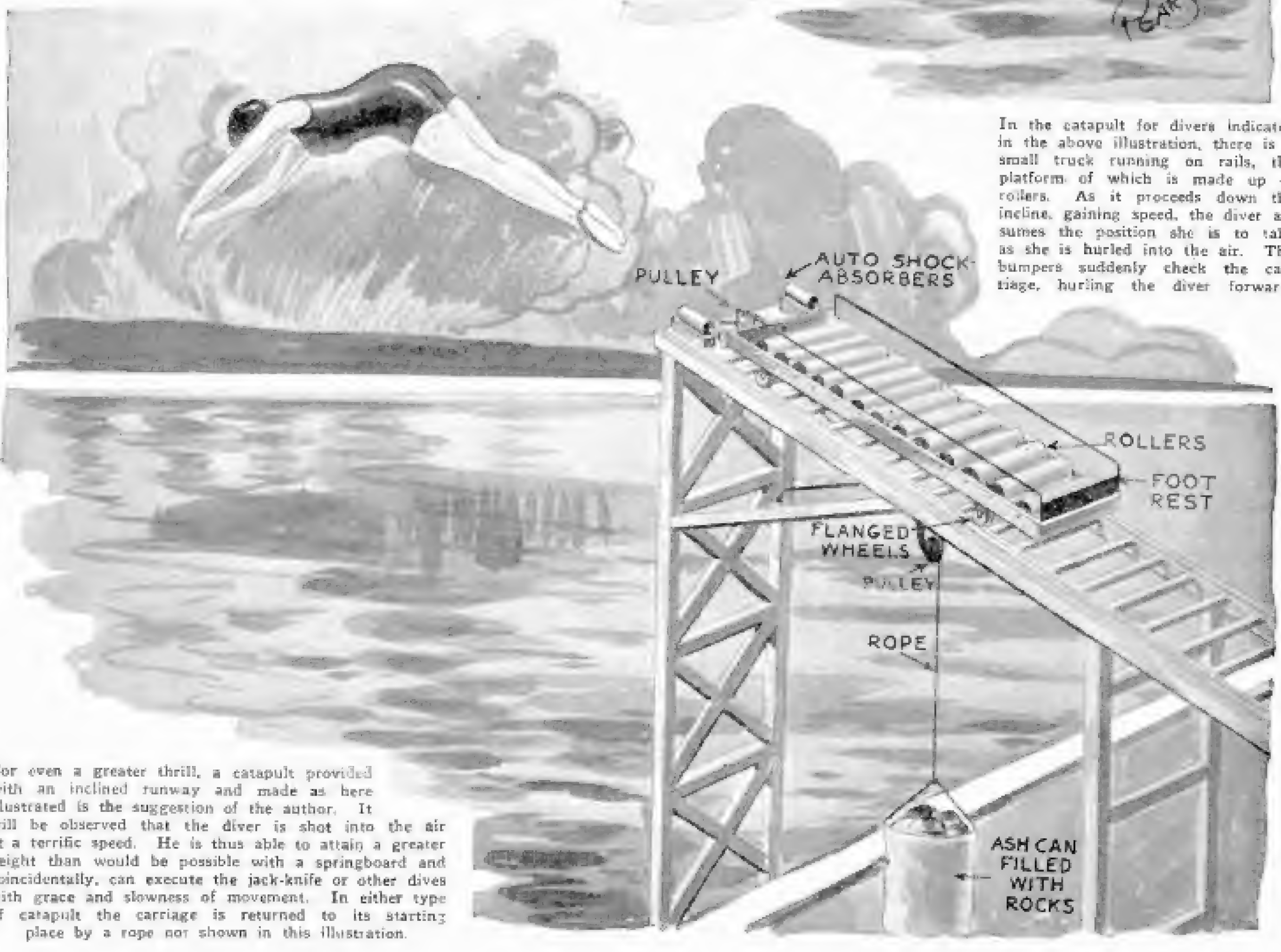


Probably the most fantastic and deceiving plan for preventing the flood is shown at the left. This consists of constructing a canal parallel to the Mississippi River, or, in other words, it amounts to the making of another Mississippi. The flood waters run through canal to the mouth.

THE Mississippi flood could have been prevented, according to the inventors who have advanced the various ideas appearing on this page. Probably the most feasible of these is to provide overflow tanks or reservoirs which will take care of the excess water in the time of flood. All of the ideas illustrated on this page would undoubtedly work, but are not practical, the main drawback being the excessive cost. It is certain that within a relatively short time a worth-while flood prevention method will be adopted. The cost of building and maintaining such a system would probably not cost more than the loss incurred during one large flood.

A CATAPULT
and other
Aquatic Amusement Devices





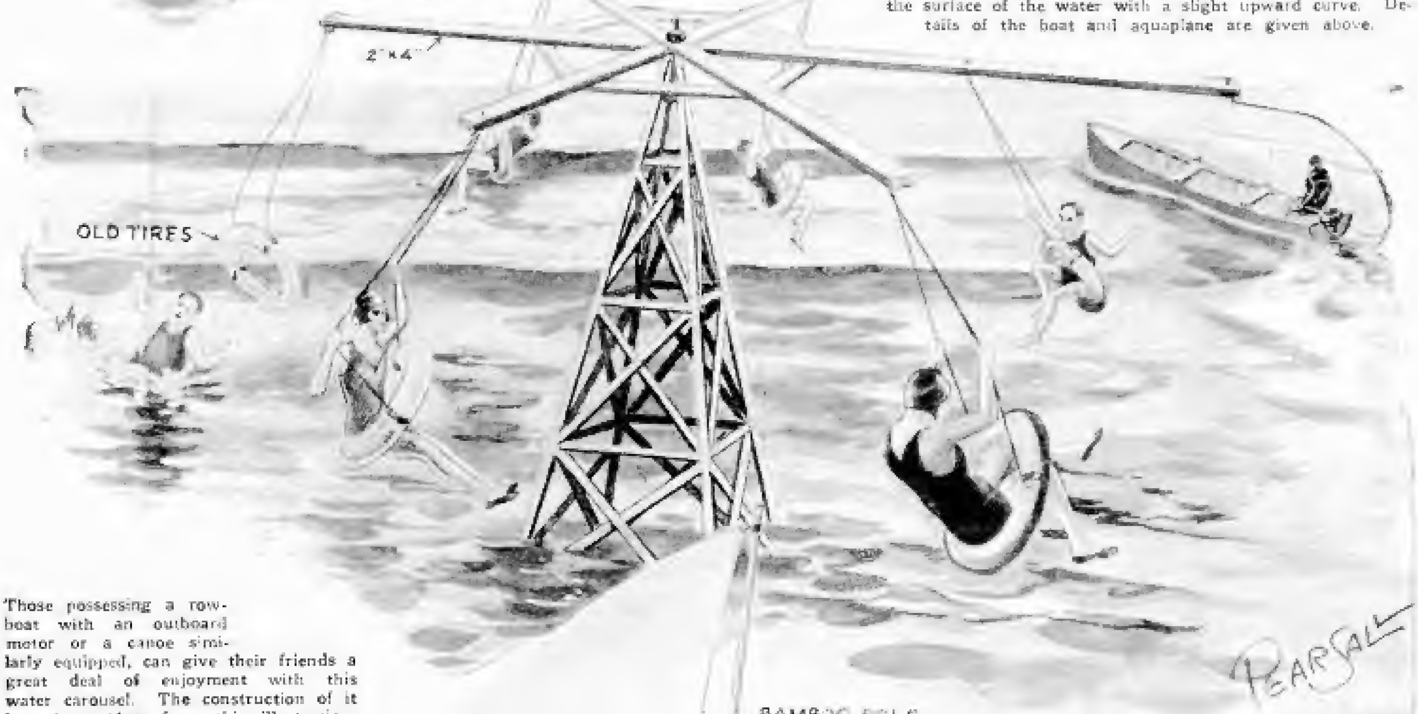
In the catapult for divers indicated in the above illustration, there is a small truck running on rails, the platform of which is made up of rollers. As it proceeds down the incline, gaining speed, the diver assumes the position she is to take as she is hurled into the air. The bumpers suddenly check the carriage, hurling the diver forward.

For even a greater thrill, a catapult provided with an inclined runway and made as here illustrated is the suggestion of the author. It will be observed that the diver is shot into the air at a terrific speed. He is thus able to attain a greater height than would be possible with a springboard and coincidentally, can execute the jack-knife or other dives with grace and slowness of movement. In either type of catapult the carriage is returned to its starting place by a rope not shown in this illustration.

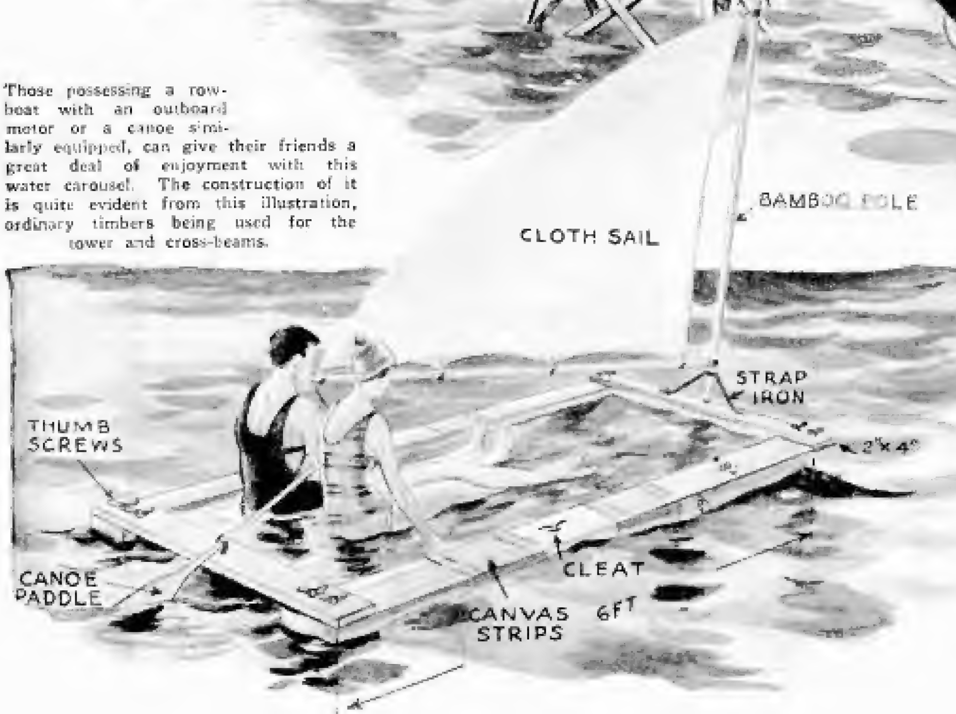
FOR DIVERS

By JOSEPH H. KRAUS

Those having access to a shore where there is a steep hill will find a great deal of amusement in this improvised chute. Several 2x6-in. beams are nailed to upright posts. At the bottom of the hill the track terminates just below the surface of the water with a slight upward curve. Details of the boat and aquaplane are given above.

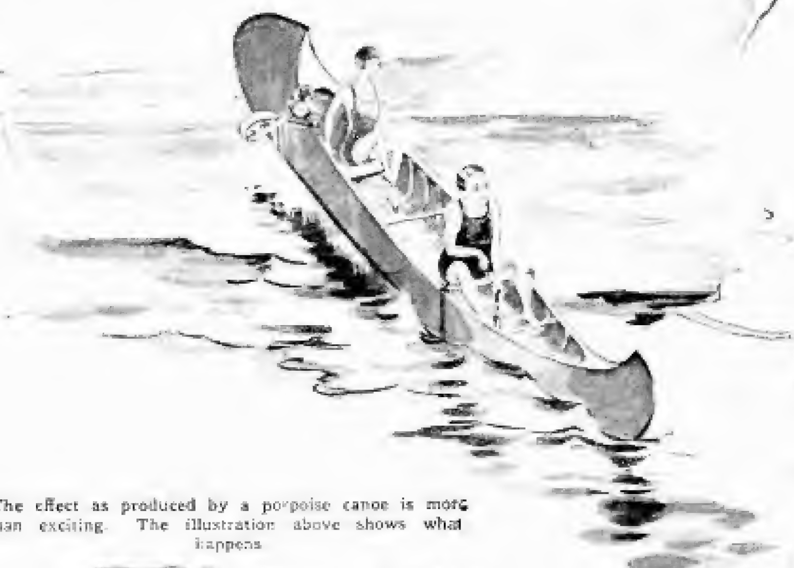


Those possessing a row-boat with an outboard motor or a canoe similarly equipped, can give their friends a great deal of enjoyment with this water carousel. The construction of it is quite evident from this illustration, ordinary timbers being used for the tower and cross-beams.

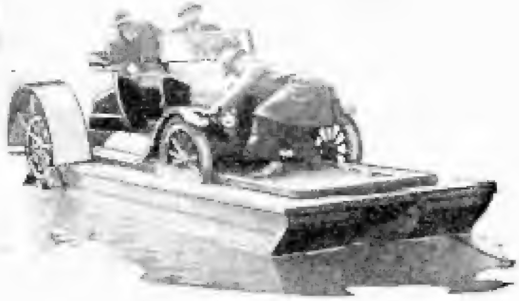


A swimmer's sail-boat is illustrated at the left. This is made so as to be entirely collapsible. When taken apart, it can be placed on the running board of a car or can be stored in a locker. The swimmers are seated on two canvas strips, running from beam to beam. The canvas strips help to bind the beams together when the vessel is figuratively rolled up. A slight upward curve at the forward end of the beam will speed up the vessel and if the bathers do not object to being immersed in the water further than the illustration indicates, the length of the vessel can be cut down.

Aquatic Amusement Devices



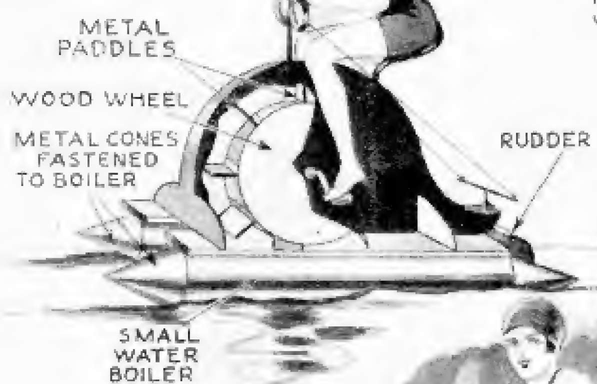
The effect as produced by a porpoise canoe is more than exciting. The illustration above shows what happens

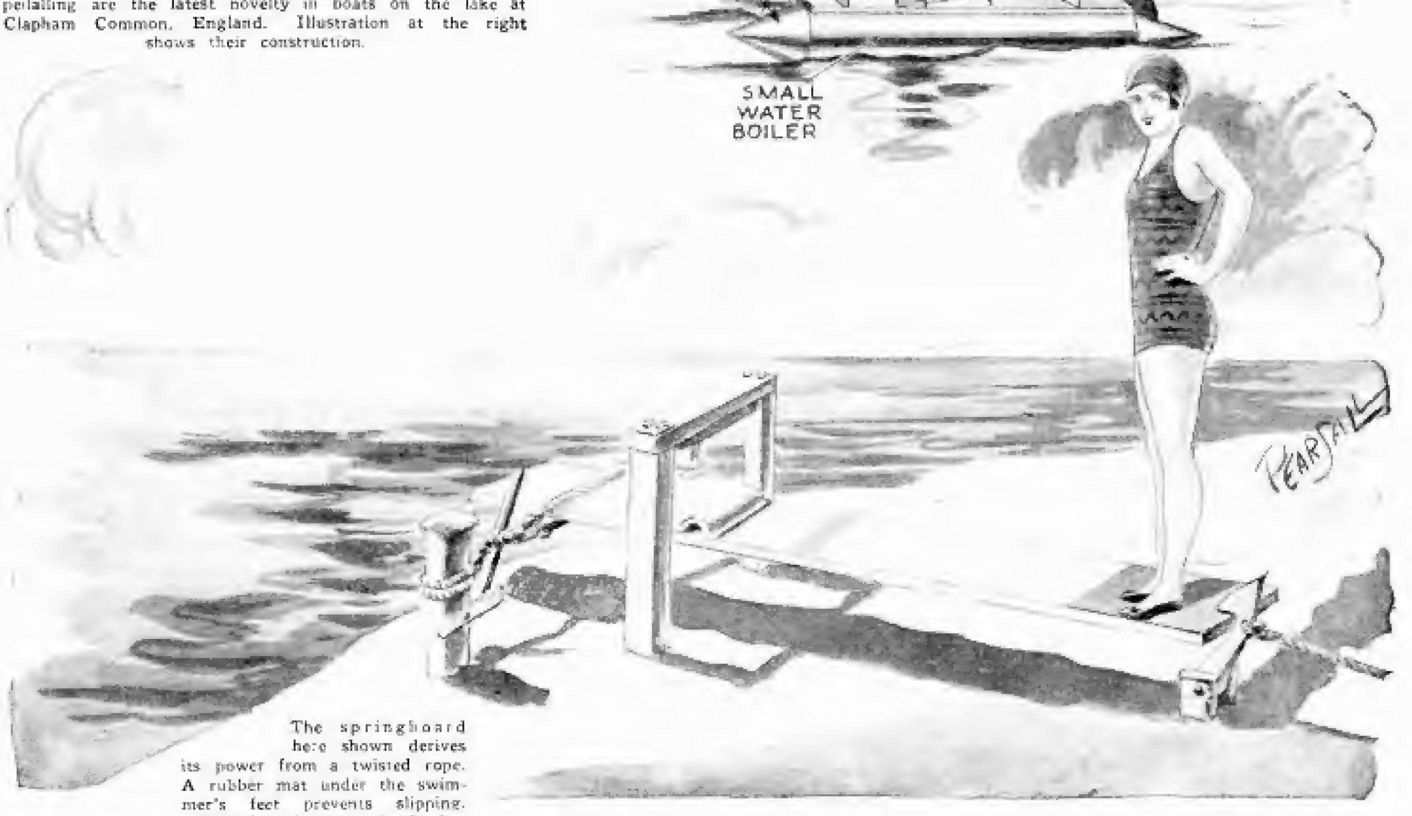


Attaching paddle wheels to the rear axle of a Ford enables Mr. Arthur H. Smith, of Winthrop, Mass., to send this heavy craft through the water at a speed of four miles per hour.

The porpoise canoe is operated by an outboard motor. At the forward end of the canoe there is a sheet of metal affixed immediately below the body on two pivots. A chain running through a pipe communicates with the flat metal sheet which, when lifted or lowered, causes the vessel to bounce along.

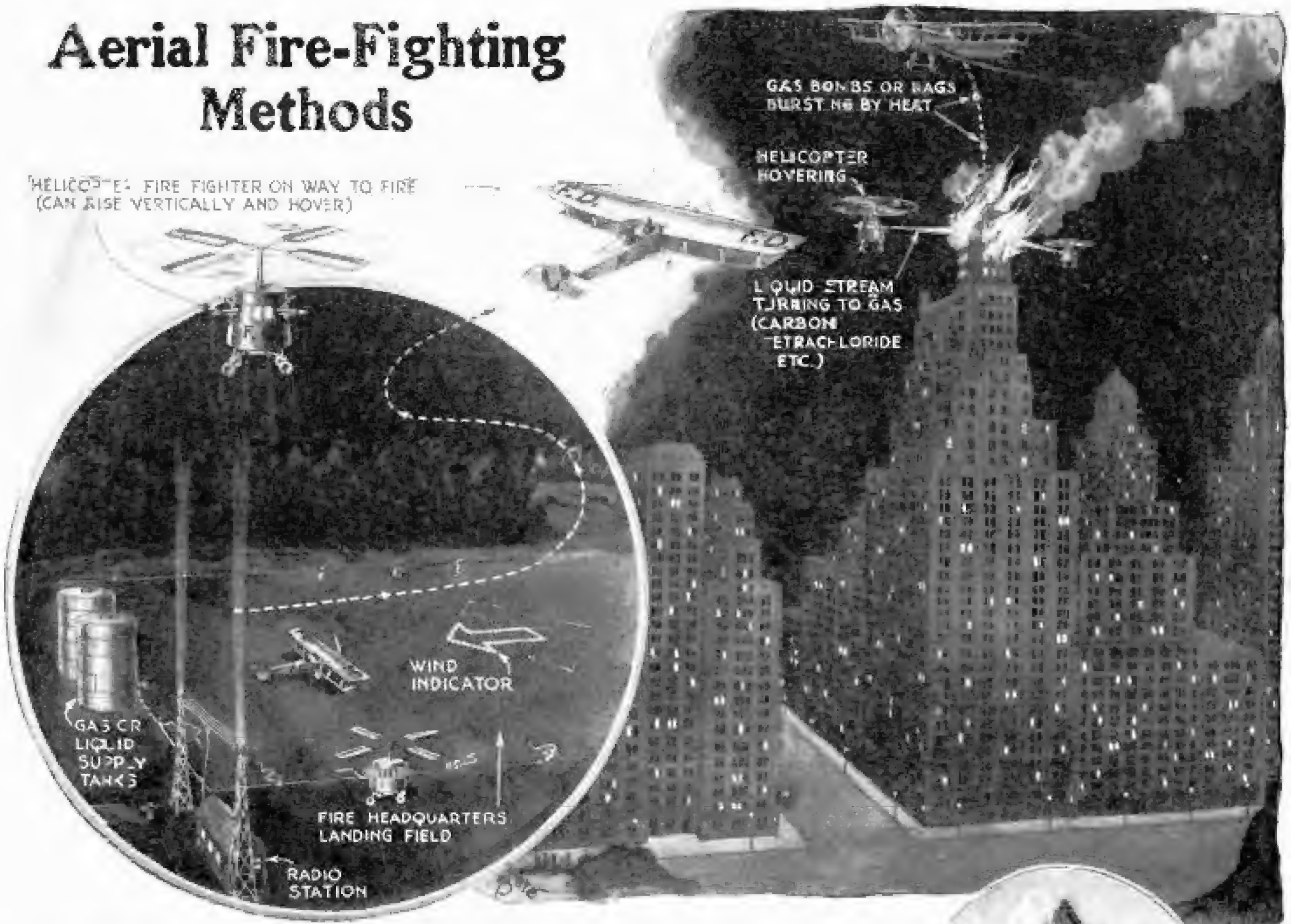
These strange craft in the form of fish and propelled by pedalling are the latest novelty in boats on the lake at Clapham Common, England. Illustration at the right shows their construction.





The springboard here shown derives its power from a twisted rope. A rubber mat under the swimmer's feet prevents slipping. The higher the stop, the further will it hurl the diver.

Aerial Fire-Fighting Methods



It is suggested that fires can be extinguished from the air by means of airplanes and helicopters. The airplanes would carry gas bombs or bags which burst from the heat of the flames. The helicopters could project a stream of fire extinguishing liquid upon the burning structure.

WITH the growth of our modern buildings, daily reaching higher and higher into the air the present day fire apparatus is rapidly becoming antiquated, and we have to cast about for some means of successfully coping with conflagrations in these huge structures. On this page are illustrated some of the methods which have been advanced. One of the most efficient ideas is pictured at the top of the page. In this case the fires are fought entirely from the air, by dropping bombs of fire-quenching materials upon the fire or by projecting upon it a stream of liquid which will turn to a gas upon hitting the flames. Carbon tetrachloride and liquids of similar nature are suggested. The fire alarm is received by a radio station located at the fire headquarters flying field, and at a moment's notice the fire-fighting planes are on their way. Storage tanks containing the fire-fighting gas or liquid are located on the field so that the supply may be replenished quickly.

At the left we have another fire-fighting device. The small V-shaped cars are held aloft by water motors driving propellers.

One of the worst conflagrations of the season was the fire which broke out in the new Sherry-Netherland Hotel in N. Y. City. The blazing beacon may be seen at the right.

A high pressure test was carried out on the Custom House tower in Boston by the fire department. The hose projected a stream of water 500 feet above the street level under a pressure of 280 pounds.

An extremely ingenious device for fire-fighting has been invented by Edward P. Conlin of Girard, Ohio. The pressure of the water is caused to operate two lifting propellers, the purpose of which is to carry the hose to great heights so that the water may be projected into the burning building with a much greater degree of accuracy than heretofore possible with the present day hose-towers. The fire-fighting structures are permitted to rise by their own power to a height greater than the floor level which the water is to reach. The stream of water or chemical can be further directed by the aid of a grip at the base. Even though the water may not pour out of the nozzle at a high pressure, it is evident that the floor space could be completely drenched.

Aug.

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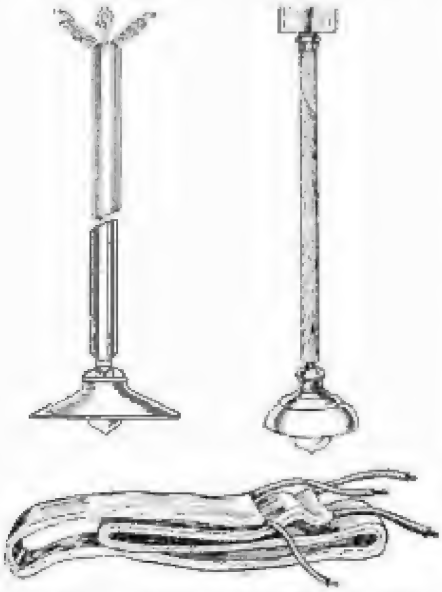
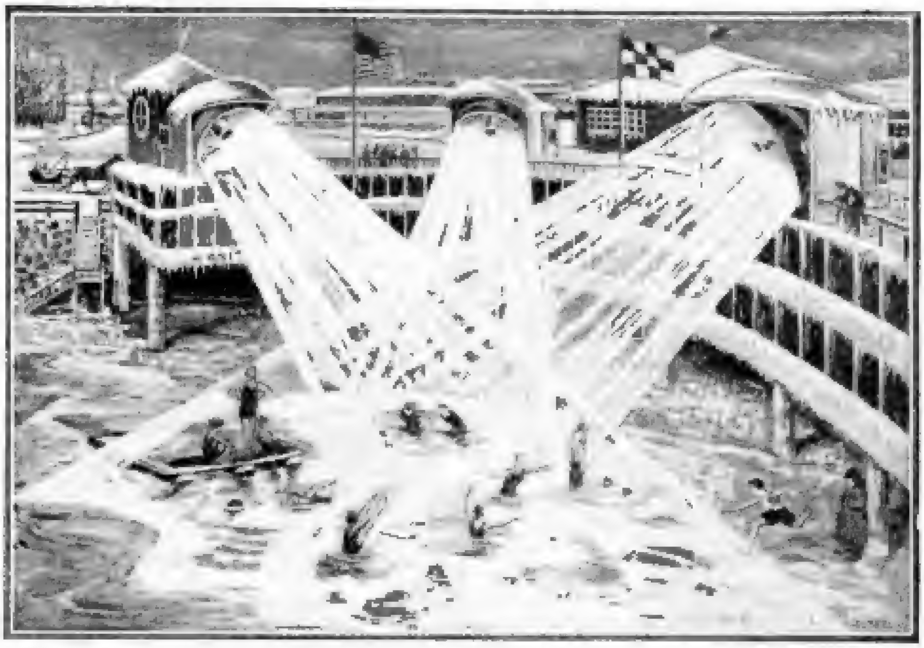
Antique Electric Lights

The illustrations below show the evolution process through which the present day drop-light passed. The lamp at the left was supported by small strips of molding and



came into use in Europe in 1883. The other drop-light was popular in this country at the same date. At the bottom of the drawing is an illustration showing the first flexible lamp cord which consisted of conductors sewed in the edges of a woven fabric. This suspender-like arrangement was used in the Edison home at Menlo Park in 1881.—*Edison Monthly.*

Summer Bathing in Winter Time



By using concentrated heat rays, it will soon be possible to enjoy your morning's dip in the ocean, despite the fact that it is mid-winter. Several large electric heaters are fitted with reflectors so that the heat rays may be concentrated and directed to any spot desired. These concentrated heat rays will melt the ice and snow and warm the water. The bathers will be able thus to enjoy a beneficial salt or fresh water swim in the heart of winter. This novel scheme was suggested by a German genius.

SECRETS OF THE FLOWER

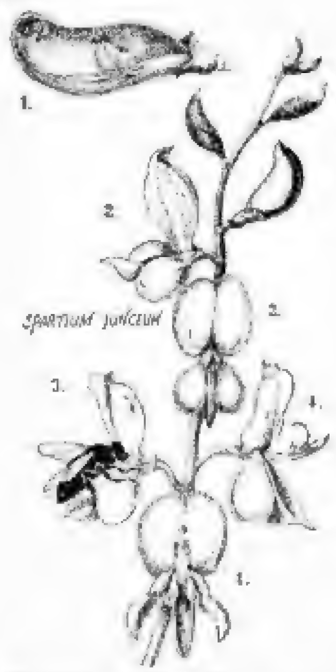
By DR. ERNEST BADE

(Concluded from July issue)

In another flower of the same species, the style or tube of the pistil has been lowered and when the bumble-bee visits this flower the style rubs on the back of the pollen laden insect and a number of pollen grains adhere to the gluey surface of the stygma whereby the flower is fertilized which may now proceed to seed formation thus insuring the continued existence of the species. The movable lever arm of the first flower returns to its normal position when the bumble-bee leaves the flower and is thus able to give another light shower bath of pollen to the next visitant.

A different method is employed by some of the *leguminosae* to provide the honey seeking bees with their pollen. A kind of a hurling device is used in the family of Spartium as well as among some others. Here the lower lip of the flower, which gives an easy method of entrance to the flower, is connected to the pistil and the anther and both are in tight tension, like the spring of a watch. When the bee arrives on the landing stage of the flower, its weight presses the floral leaves downward whereby the anther and pistil are revealed. The anther presses against the abdomen of the bee covering its hairy body with pollen by means of hurling the grains against it. The bumble-bee hardly notices this and continues its search for nectar. Such an opened flower is seldom visited again for the bumble bee has provided the pistil with pollen taken from previous visits to other flowers of this species.

The long flowers of *Aristolochia* are provided with downward pointing hairs in the early parts of life. This permits tiny insects to enter but not to pass out. And as these creatures seek a way of escape, they circle the inner part of the flower again and again, the anthers, in the mean time drip pollen grains and when the insects are covered with them, the hairs which prevented the escape of the insects, fall off and so permit the creatures to emerge from their trap. Then the tiny insects go to another flower and fertilize it with the pollen unwillingly taken from the first flower. When this has been accomplished the flower closes by means of a floral flap which originally was erect but now covers the entrance to the flower.



Spartium junceum flower front 2, side 2 closed and 4 opened. Flower opened by bee 3. Section through flower showing pistil and anthers 1.

The beautiful flower of *Yucca filamentosa* is entirely dependent upon the Yucca moth (*Pronuba yuccasella*) without whose aid it is incapable of producing seeds. But on the other hand the moth can not propagate its species without the plant. The female of this moth goes into this flower to seek pollen.

With this ball of pollen the moth leaves the flower and seeks another one. Here it looks for the pistil and places the ball of pollen on the stygma after depositing a few eggs in the style. The pollen fertilizes the flower and, after a few days, the eggs hatch and the tiny caterpillars feed on about twenty seeds.

Another peculiar method of propagation is found in the tape grass (*Vallisneria spiralis*) a water plant much cultivated in aquariums. The male flower is produced within two transparent leaves which have come together to form a bubble. They are found under the water near the bottom where they cluster together like the grapes. The female flower develops a long spiral thread, which lifts the flower slightly above the surface of the water. At the time of fertilization the male flowers loosen themselves from the plant and rise, one by one, to the surface of the water. Here the flower opens and three leaves fold back and expose the anthers. This entire device resembles three miniature boats held together at one point and it is from this central point that the anthers rise slantingly upward. The boats are carried hither and thither by the wind not capsizing nor shipping water. They float aimlessly about until they come to rest near some solid substance especially if it is slightly indented like the leaf of the female flower. If the two parts of the flower do come in contact then the pollen is given to the female flower thus fertilizing it. Then, in a little while the flower is again drawn under the surface of the water due to the twisting of the long stem carrying the female flowers. The windings of the cork-screw like thread gradually are brought closer together so that the seeds, when they are finally ripe, are very close to the bottom.

The Impossible

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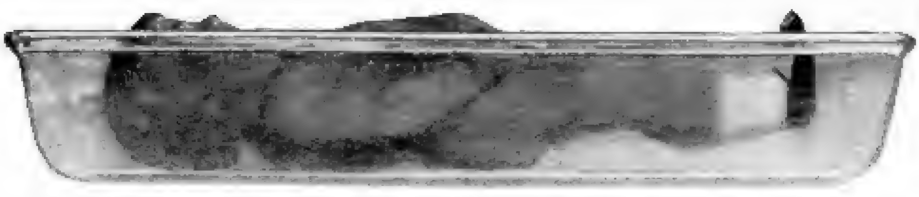
Member American



Here is a photograph of a doll weighted so that it will float in water to the same depth as a human being would float in the same medium. Compare with photo at right.

If you contemplate the front cover of this month's issue of SCIENCE AND INVENTION, you will be struck by what appears to be "an impossibility."

If you know anything about swimming at all, you will know that it would be quite impossible for the young lady to float on the water as depicted in our cover illustration.

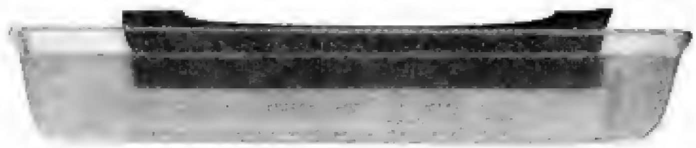
Furthermore, the ball which looks like the usual large medicine ball used so much at our sea resorts, could not possibly float in water as shown in the illustration. If the young lady were placed in water, as she appears to be, she certainly would, if at rest, sink so that practically her entire body would be submerged. Not all people, it may be said, float the same way. A thin and emaciated person will practically sink so that only the nose stays above the water. The reason is that the human body has about the same specific gravity as water, and would sink at once to the bottom of fresh water if the body did not contain a certain amount of air, principally in the lungs, and to a lesser degree in some of the other organs throughout the body.

Certain parts of the body are heavier than water, such as for instance, the skull and the bone structure. This, however, is counterbalanced by the fatty tissues which weigh less than water. Thus, a fat man or woman can float more readily in water and the body will rise out for a greater degree over the level of still water, than that of thin persons. So delicate is the balance, that a person will sink to the bottom if his lungs become filled with water, which is sufficient to make the body go to the bottom. If it were not for decomposition setting in, which gives rise to gases, the body would never come to the surface again. It is these gases principally which are responsible for a dead person coming to the surface again.

What has been said here, about the human body floating, holds good only for ordinary fresh water. In sea water, which latter has a higher specific gravity, the human body does not sink as deep. For instance, the water of the Dead Sea has a high specific gravity while that of the Great Salt Lake near Salt Lake City has a specific gravity of 1.66, which means in other words, that this salt water weighs about 60% more than fresh water, the specific gravity of which latter is 1.000.

Inasmuch as the specific gravity of the human body is about the same as that of clear water, it will be seen that it is impossible for a person to sink in either the Salt Lake, or in the Dead Sea, because even though the person be emaciated, over 60% of his body will rise above the water. From this we can form an idea of just what will happen if you submerge a human body in liquids that are denser, or in other words, as the scientists term it of a "higher specific gravity" than ordinary water.

If you submerge a human being into a liquid which has less weight than water, such as, for instance, oil—which floats on water and is therefore lighter,—even the fattest person will sink rapidly if thrown into a tank thereof. Any human being thrown into lighter liquids would have a great deal of trouble to keep afloat, and would have to expend more energy to keep above the surface.

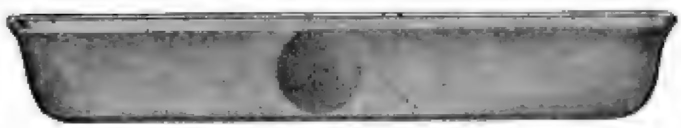


A photograph of a toy boat floating in water. Compare this photo with photo on opposite page.

One of the lightest liquids in existence, namely methenyl diphenylamine, would make it quite uncomfortable for the person who ventured into a tank filled with such a liquid. Even with the most strenuous exertion it would be impossible for the swimmer to keep his face above this liquid, which has a specific gravity of only 0.558, or about half that of water.

The iron weights used in our experiments which are ordinary platform scale weights, are here seen floating in mercury. The weight at the right is double and consists of a two and a one pound iron disk.

Furthermore, it is a well-known physical principle that a floating body sinks and keeps on sinking until it displaces its own weight in the liquid in which it floats. You will remember, the well known anecdote, about Archimedes and his famous bath; when he found that his body displaced enough water to make his bath tub overflow, he ran out into the street, oblivious to the fact that he wore no clothes at all, shouting "Eureka" (I have found it.) What he found was the law of specific gravity mentioned above, that is, a floating body displaces the same weight of water that is equal to its volume.



An ordinary golf ball sinks in water and comes to rest at the bottom of the vessel. Many golf enthusiasts know this.

Going back to the Salt Lake experiment where we noted that it is impossible for a human body to sink, we can now imagine liquids still heavier, where the body will submerge even less.

This is the idea behind the cover of this issue of SCIENCE AND INVENTION.

What then is the answer? *Mercury*, popularly called Quicksilver.

Mercury is the only metal that is liquid, and the reasons why this should be so are still only understood rather vaguely by our scientists. Mercury by no means is the heaviest element, although it is popularly thought so. The specific gravity of this metal is 13.595 at 4° Centigrade.

There are, however, some metals heavier than mercury. They have a specific gravity as follows: Gold—19.32 at 17.5° C.; Iridium—22.42 at 17° C.; Osmium—22.48 at Atmospheric temperature; Platinum—22.35 A; Tantalum — 16.6A; Tungsten — 18.7A; Uranium—18.68A.

Let us now imagine a lake of mercury. Here the appearance of a human body floating will be exactly as that shown on our cover illustration. The lake of mercury, which looks like calm water, is supposed to be about 22 inches deep, with the young lady resting exactly as pictured. Only one-thirteenth of the human body can be submerged while floating in mercury, while twelve-thirteenths is out of the mercury. In other words, only an exceedingly small portion of the body can be submerged while at rest, when floating on a lake of mercury.

The young man shown in the illustration would find some difficulty to stand in 22 inches of mercury, as he would have trouble to maintain his balance. The tremendous specific gravity of mercury as compared with that of the human being, tends to push everything lighter in an upward direction. Therefore the young man as pictured would only stand in this position a second or less after which he would fall over, and splash on top of the mercuric pool.

The heavy medicine ball which in water would be practically submerged, would float exactly as shown, only 1 or 2 inches being submerged below the surface of the liquid.

To show what effect mercury has on various different everyday articles, we performed a number of experiments in SCIENCE AND INVENTION Laboratories, and the photographs reproduced herewith show some of the results.

We first took a celluloid doll, and loaded it with buckshot, in such a way that when floating in water it would duplicate exactly the condition found if a human being were floating. This condition is shown in the illustration where the doll floats exactly as would a human being in water. Then the same doll weighing exactly the same amount,

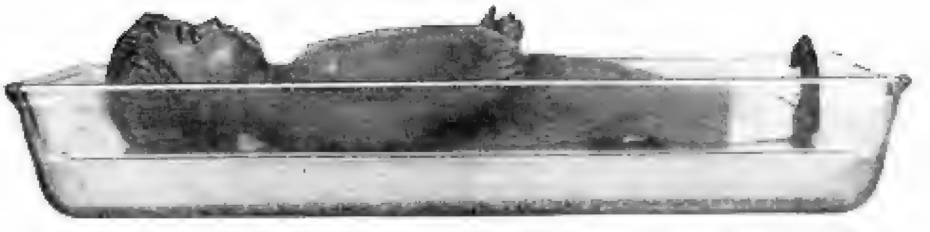
In water, a tennis ball sinks to one-half its height as indicated in the photograph here.

Is Possible

A SERIES

GERNSBACK

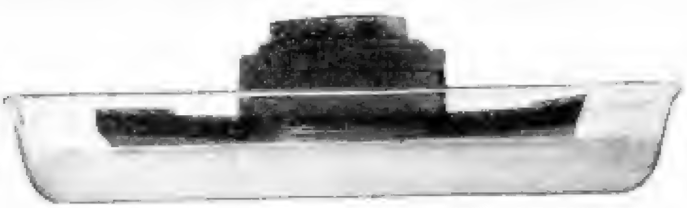
Physical Society



This is the same doll as in the photograph on the opposite page. It is here floating in mercury. Note that daylight can be observed beneath the neck and knee.

was placed upon mercury with the result as shown.

We might state that we would have liked to make the experiment with a full grown human being, by using a bath tub full of mercury, but unfortunately, this would have taken nearly 31 tons of mercury, which at the present value of mercury, $2.00 a pound, would represent $121.632!! We thought we had better not attempt this experiment, because in the first place, we probably would not have been able to find that much mercury even in New York City, and secondly, if



The wooden boat made to sink in mercury to a depth identical with the same vessel in water required an additional weight of 3¼ pounds.

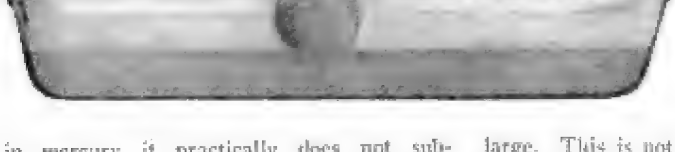
we had poured the mercury into a standard cast iron bath tub, it might even have burst into pieces, sending the quicksilver in all directions due to tremendous weight of this liquid.

In some of our illustrations, we have shown how even iron weights float easily on top of mercury.

A toy boat is also shown floating in water, and in order to make it sink to the same depth in mercury, it was necessary to place iron weights on it weighing 3½ pounds. This, not withstanding the fact that the little boat only measured 9¼ inches long, 2¼ inches wide and one inch deep.

A most interesting photograph shows a heavy solid glass inkstand floating on top of the mercury, as well as a small "B" battery. Although heavy and solid you can see how nicely both float, just as a cork would float on water. A pair of pliers is seen floating between the "B" battery and the glass ink well.

A surprising photograph is the one that shows the golf ball, which, of course, sinks to the bottom in water, and even sinks much further in the mercury than one would at first suspect. For instance, a tennis ball in water sinks almost all the way down,



How golf enthusiasts would appreciate a lake of mercury instead of water. Observe how the ball floats.

in mercury it practically does not submerge at all. The reason here, of course, is that the specific gravity of the golf ball is quite high. In other words, it is rather heavy, and that is the reason why it sinks a little further in the mercury than does the tennis ball.

An interesting problem comes up here, which has not been solved entirely. In South America there is a small lizard which can actually run over a solid sheet of water without sinking into it. Now, the little lizard weighs more than the water, consequently he should sink through the surface of the water and go below it. The point, however, is that he runs so fast and his motion along the water is so rapid that he

Mercury supplied through the courtesy of Chas. Cooper and Son, New York City.

does not sink in at all. By heating the surface of the water rapidly enough he can thus run on top. This can be likened to the skipping stone, with which we are all familiar. Of course, surface tension has something to do with the phenomenon. A problem now comes up: Suppose we had our imaginary lake of mercury. How fast would an average man have to run without sinking into the mercury? And is it possible for a man to run on the surface at all? Theoretically, of course, it is possible, if he runs fast enough. From a practical standpoint it is hardly possible for a human being to run fast enough, without sinking into the surface of the mercury. Then, too, if he sank into the mercury at all, his motion would necessarily be retarded, because the mercury itself, in closing in over the foot, would very likely retard his motion.

On the other hand, referring back to the lizard, the surface of the lizard's feet, as compared to the rest of his body, is quite large. This is not true of the human foot, where the surface is rather small. Furthermore, if the human being had four feet he would not have to run as fast on the surface of the mercury as with the two he has. Moreover it is questionable whether he could do the trick at all, due to his high center of gravity, which would tend to upset him, while the lizard's center of gravity is not much higher than the feet, and consequently he has no trouble maintaining his equilibrium. You might say, therefore, that for practical purposes it would be impossible for a man to run along the surface of liquid mercury, even if he could run fast enough.

It is interesting to conjecture at this point as to just how difficult it would be to remain afloat in liquids as light as ether or even gasoline. The questions naturally arising are: Can our best swimmers remain afloat in either of these two liquids? Can any of the present swimming animals remain on the surface in these liquids? The feat would seem quite impossible in liquids having a specific gravity of approximately one-half that of water, one of which was mentioned in a previous paragraph of this article, unless the swimmer himself very vigorously moved his hands and feet, thus keeping his head above the surface of the liquid.

One might even attempt to calculate the speed of swimming in a body such as mercury, the friction of which is slight but the buoyancy of which is very pronounced. Would the hands of the swimmer slip through the mercury more so than they do in water; or would the swimmer be capable

A glass ink well full of ink, a pair of cutting pliers and a "B" battery float in mercury. Observe how the "B" battery tips at an angle. Its construction makes it heavier on one side than on the other.

of phenomenal speeds; are interesting questions to cogitate upon.

Another very interesting problem is the reason why the B battery tips over at an angle in the mercury. These batteries, as we all know, are made quite expertly, and the weight of each individual cell should practically correspond to that of the adjacent cells. What then makes the battery tip? Does this illustration not prove that objects floating on mercury are not necessarily level?

What does all this prove?

In the first place, never trust your senses too much. What appears impossible at a glance, may not be so impossible after all. At the same time, we have gone to this length to show these experiments, because there is no telling that someone will not put the experiments to some practical use in some way of which we do not even dream. Mercury is used a great deal in the arts as well as in the industries, and we believe there are many other additional uses which are not in common practice, simply for the reason that many people do not realize the importance of mercury.

A tennis ball seemingly rests upon the very surface of the heavy, silvery, metallic fluid.

Sept.

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Gravity Nullified

Quartz Crystals Charged by High Frequency Currents Lose Their Weight

Fig. 1. The gravitation nullifier is shown in this illustration. The quartz crystal may be seen supporting a 55-pound weight. Dr. Kowsky is shown in a top coat because of the temperature at which the experiments were performed.

ALTHOUGH some remarkable achievements have been made with short-wave low power transmitters, radio experts and amateurs have recently decided that short-wave transmission had reached its ultimate and that no vital improvement would be made in this line. A short time ago, however, two young European experimenters working with ultra short-waves, have made a discovery that promises to be of primary importance to the scientific world.

The discovery was made about six weeks ago in a newly established central laboratory of the Nessartsaddin-Werke in Darredein, Poland, by Dr. Kowsky and Engineer Frost. While experimenting with the constants of very short waves, carried on by means of quartz resonators, a piece of quartz which was used, suddenly showed a clearly altered appearance. It was easily seen that in the center of the crystal, especially when a constant temperature not exceeding ten degrees C. (50 degrees Fahrenheit) was maintained, milky cloudiness appeared which gradually developed to complete opacity. The experiments of Dr. Meissner, of the Telefunken Co., along similar lines, according to which quartz crystals, subjected to high frequency currents clearly showed air currents which led to the construction of a little motor based on this principle. A week of eager experimenting finally led Dr. Kowsky and Engineer Frost to the explanation of the phenomenon, and further experiments showed the unexpected possibilities for technical uses of the discovery.

Some statements must precede the explanation. It is known at least in part, that quartz and some other crystals of similar atomic nature, have the property when exposed to potential excitation in a definite direction, of stretching and contracting; and if one uses rapidly changing potentials, the crystals will change the electric waves into mechanical oscillations. This *piezo electric* effect, shown in Rochelle salt crystals by which they may be made into sound-producing devices such as loud speakers, or reversely into microphones, also shows the results in this direction. This effect was clearly explained in August, 1925 *Radio News* and December, 1919 *Electrical Experimenter*. These oscillations are extremely small, but have nevertheless their technical use in a quartz crystal wave-meter and in maintaining a constant wavelength in radio transmitters. By a special arrangement of the excitation of the crystal in various directions, it may be made to stretch or increase in length and will not return to its original size. It seems as if a dispersal of electrons from a molecule resulted, which, as it is irreversible, changes the entire structure of the crystal, so that it cannot be restored to its former condition.

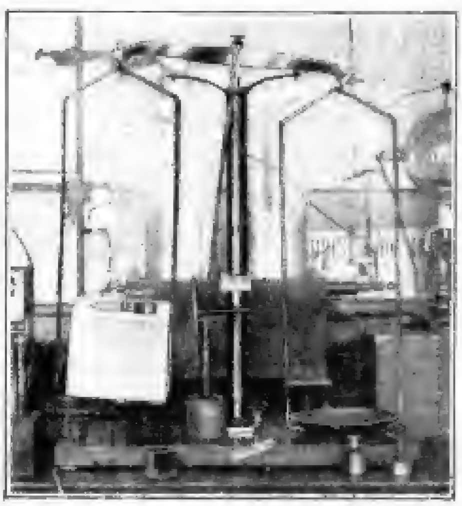


Fig. 3. This shows how the quartz crystal lost weight when subjected to the high frequency current. The original crystal was balanced on the scale.

The stretching out, as we may term this strange property of the crystal, explains the impairment of its transparency. At the same time a change takes place in its specific gravity. Testing it on the balance showed that after connecting the crystal to the high tension current, the arm of the balance on which the crystal with the electrical connections rests, rose into the air. The illustration, Fig. 3, shows this experiment.

This pointed the way for further investigation and the determination of how far the reduction of the specific gravity could be carried out. By the use of greater power, finally to the extent of several kilowatts and longer exposure to the action, it was found eventually that from a little crystal, 5 by 2 by 1.5 millimeters, a non-transparent white body measuring about ten centimeters on the side resulted, or increased about 20 times in length on any side (see Fig. 4.) The transformed crystal was so light that it carried the whole apparatus with itself upwards, along with the weight of twenty-five kilograms (55 lbs.) suspended from it and floating free in the air. On exact measurement and calculation, which on account of the excellent apparatus in the Darredein laboratory could be readily carried out, it was found that the specific gravity was reduced to a greater amount than the change in volume would indicate. Its weight had become practically negative.

There can be no doubt that a beginning has been made toward overcoming gravitation. It is to be noted, however, that the law of conservation of energy is absolutely unchanged. The energy employed in treating the crystal, appears as the counter effect of gravitation. Thus the riddle of gravitation is not fully solved as yet, and the progress of experiments will be followed further. It is, however, the first time that experimentation with gravitation, which hitherto has been beyond the pale of all such research, has become possible, and it seems as if there were a way discovered at last to explain the inter-relations of gravity with electric and magnetic forces, which connection, long sought for, has never been demonstrated. This report appears in a reliable German journal, "Radio Umschau."

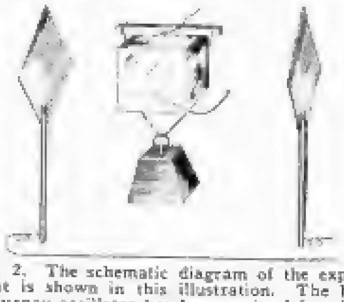


Fig. 2. The schematic diagram of the experiment is shown in this illustration. The high frequency oscillator has been omitted for clearness.

Fig. 4. This illustration shows the relative sizes of the crystal before and after the experiment. It is approximately twenty times its original length on any side.

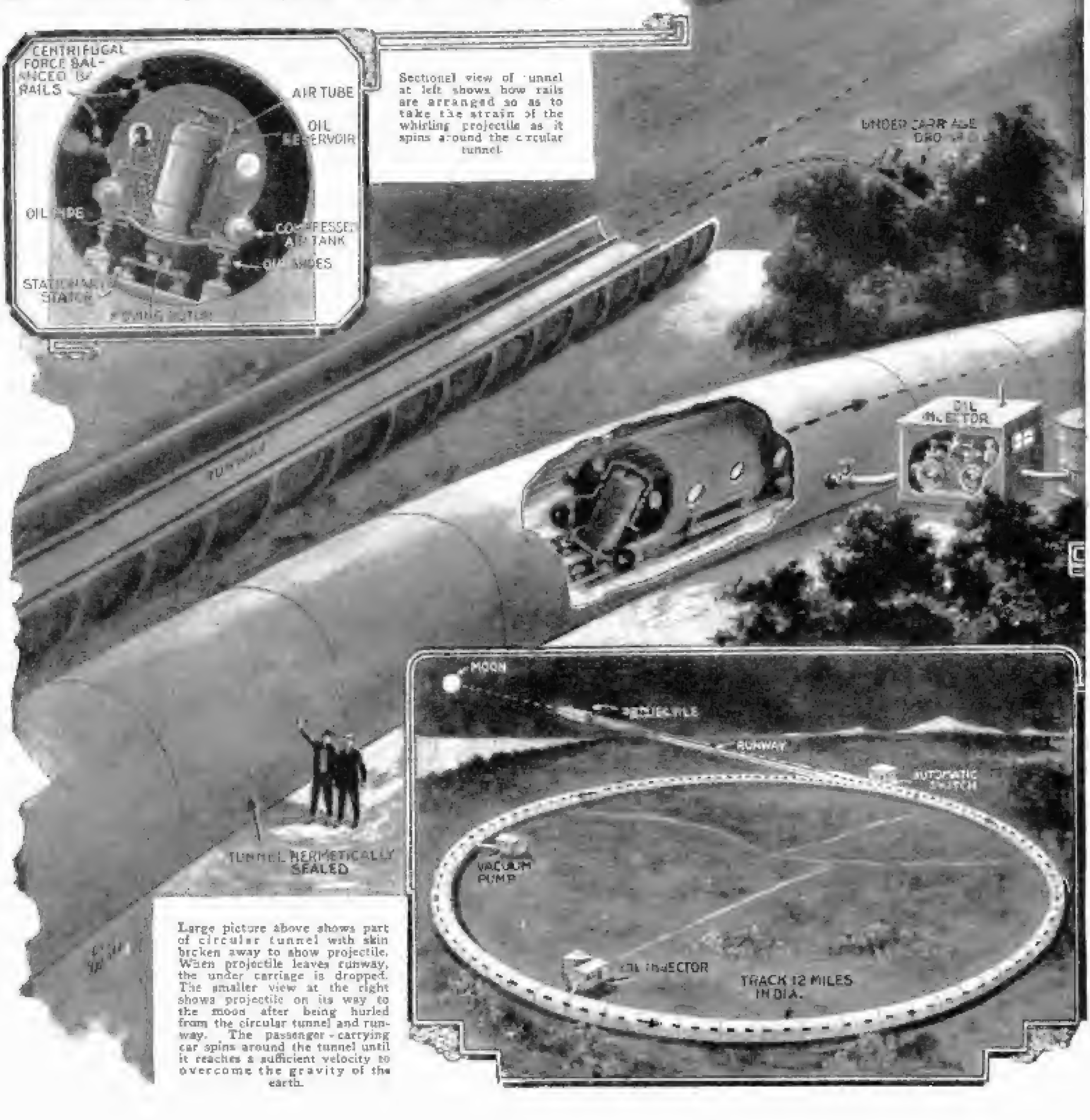
Don't fail to see our next issue regarding this marvelous invention.

TO THE MOON VIA TUNNEL

Passenger-carrying Projectile is Propelled Around Tunnel to Gain Sufficient Velocity to Leave the Earth

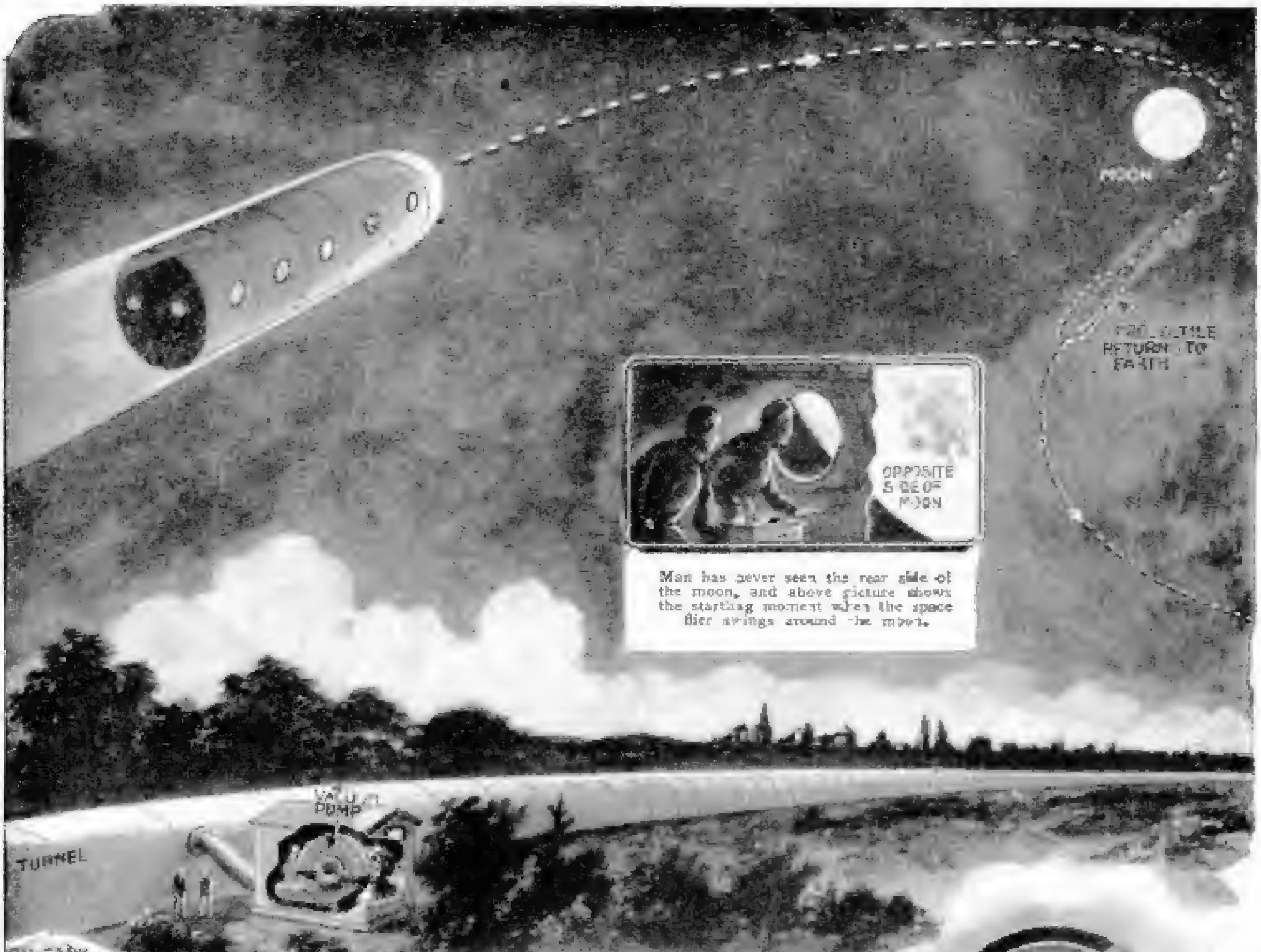
IF there is an idea which always has excited the adventurous spirit of numerous investigators it is certainly that of the exploration of the worlds gravitating along with our earth around the sun, and in the first place, the investigation of the moon, the satellite of our planet. This is the body nearest to us in space, its mean distance being only 243,000 miles, which a cannon ball going at the rate of 500 yards a second would reach in about eight days.

The proof of this preoccupation is given by the considerable number of stories written on this subject from Lucien de Samosate down to Miral and Viger, not forgetting Goodwin, Cyrano de Bergerac, Edgar Alen Poe, Jules Verne and H. G. Wells. But it is to be noted that none of these writers in their imaginary voyages have used the means, we will not say possible ones, but one which is even plausible, of effecting the crossing of the intervening space. None of the ways suggested could ever be carried out. One proposes balloons, others the propulsive force of powder in an enormous cannon the eruption of a volcano, finally the employment of a material opaque to gravitation, which of course is not in existence, and radium rockets which also do not exist.

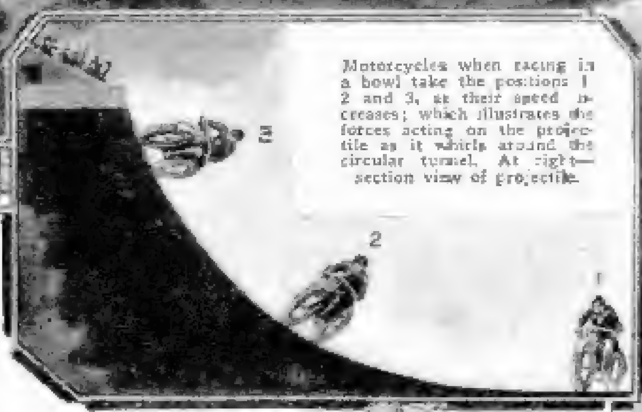


Sectional view of tunnel at left shows how rails are arranged so as to take the strain of the whirling projectile as it spins around the circular tunnel.

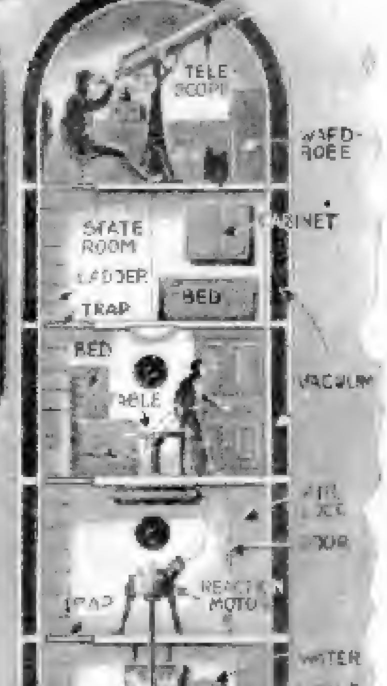
Large picture above shows part of circular tunnel with skin broken away to show projectile. When projectile leaves runway, the under carriage is dropped. The smaller view at the right shows projectile on its way to the moon after being hurled from the circular tunnel and runway. The passenger-carrying car spins around the tunnel until it reaches a sufficient velocity to overcome the gravity of the earth.



Man has never seen the rear side of the moon, and above picture shows the startling moment when the space flier swings around the moon.



Motorcycles when racing in a bowl take the positions 1 2 and 3, as their speed increases; which illustrates the forces acting on the projectile as it whirls around the circular tunnel. At right—section view of projectile.



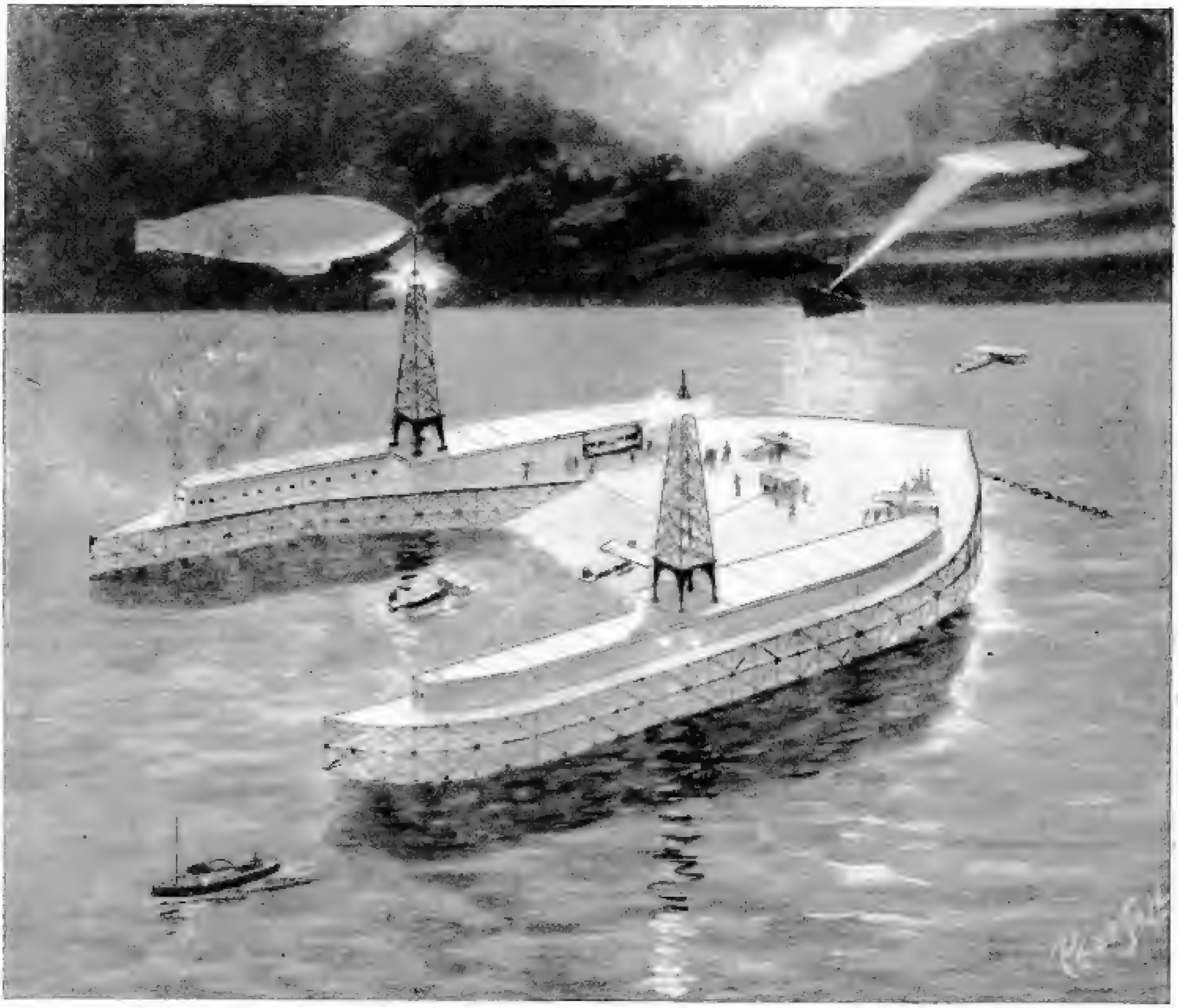
A QUESTION OF SPEED

BUT because a practical or reasonable idea has not yet been emitted by our romancers, does it follow that the problem is insoluble and above the possibilities of modern science? Students of the subject, scientists of high reputation hold different ideas. Today, now that our planet is entirely conquered that, so to say, there is nothing from the equator to the pole in the way of a single point of its surface unexplored, when we possess efficient processes of locomotion through the element so long rebellious, the ocean of air, man wishes to continue to extend his domination. Our globe seems too small for his ambition. He wishes to increase his domain, taking in the neighboring worlds, especially this near province the moon, the half of which only is known from the long range view through the telescope, and which ought to hold within its mass, rich mineral treasures which can be exploited. Is it then foolish to try to reach it?

To rise towards the heavens, to pass out of the immediate zone of the attraction of the earth, and to look for other worlds across the gulf of space, this dream is still in force, as the calculations of eminent astronomers have proved that the desired speed can be imparted to a moving body leaving the surface of the earth. It is sufficient that a body be projected from our globe with a velocity of about 15,000 yards as it leaves the atmosphere, to be able to reach the zone of attraction of another world wherever it may be. The moving body will never fall back upon the earth. But to reach the moon, this limited speed is not necessary. To reach its sphere of attraction, situated at some 78,000 leagues from the surface of our planet, the initial velocity should be about 13,000 yards per second.

Is the attaining of such a velocity, above the possibility of realization by actual mechanical means? We are not the only ones to believe it is possible; as long ago as 1913 two French engineers described the process capable of giving us this propulsion. Very properly these engineers MM. Mas and Drouet divide the problem into two parts

(Continued on page 462)



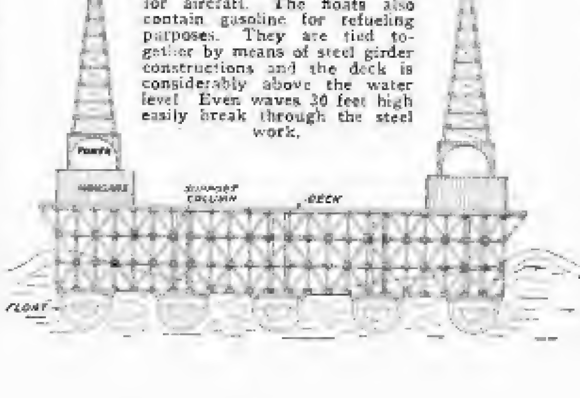
Above is a pictorial view of a landing station for use along the great circle route to Europe from New York. This type of a vessel is floated by immense double pontoons, the inner compartments of which contain the gasoline, while the outer is the buoyant body. Note the artificially constructed basin protected from the winds by the vessel itself. Hangars for planes, quarters for crew and airmen and mooring towers for dirigibles are found. The ocean island has its own meteorological department and its own radio station. Both are a distinct aid to aviators.

Ocean Islands for Aircraft

Transoceanic Aircraft Flights Will Be Greatly Stimulated by the Building of Three or Four of These Refueling Depots

By E. ZELONI

THE epochal flights of Lindbergh, Chamberlin and Byrd have demonstrated the ability of aircraft to span the waters separating the old and new continents. While these flights were certainly remarkable as far as stimulating the future of aviation and also demonstrating the worthiness of aircraft for intercontinental travel, the airplane is not yet developed to such an extent that daily trips could be taken, nor can modern planes carry a large amount of cargo and sufficient fuel to insure safety. Col. Lindbergh, along with many others, has advocated the use of landing stations anchored in mid-ocean so that transoceanic fliers would always have a haven of safety in severe storms or in the case of engine trouble. Along with other ideas for such ocean islands, we find one patented by Giuseppe Pino. This plan is indicated in our illustration. It consists of a large vessel probably a thousand feet long, built so as to withstand the terrific pounding of the most violent waves. Not only should the structure hold up under this incessant barrage, but it must be so constructed that the deck will not rise and fall with the waves, enabling the aviator to be sure of his landing field and not level out for landing as the field drops away 30 feet beneath him. The structure mounted on large floats is quite capable of doing this and even severe storms produce no undulating motion of the island the inventor claims.



Here is a diagram of the proposed ocean landing station for aircraft. The floats also contain gasoline for refueling purposes. They are tied together by means of steel girder constructions and the deck is considerably above the water level. Even waves 30 feet high easily break through the steel work.

A Ship that Swallows Whales

Latest Whaling Vessel Has Apparatus for Obtaining Every Bit of Oil

By C. McKNIGHT SMITH

The whaling ship "C. A. Larsen" of Sandefjord, Norway, represents the very latest scientific development in a complete floating whaling depot and factory combined. This huge ship of some 17,000 tons dead weight "swallows" the dead bodies of whales which are brought in by the smaller "killer" boats.

The two inset photos show front view of the ship's mouth opened and carcass of whale about to be drawn up runway; also a view of the runway taken from the deck, with body of a whale being drawn up to the deck. Steam boilers are carried for the purpose of removing the oil from the blubber

SCIENCE and invention, simple words in themselves, yet fully descriptive of the whaling depot and floating factory combined in the steamship "C. A. Larsen" of Sandefjord, Norway, formerly the oil tanker "San Gregorio" of 17,200 dead weight tons.

In 1923, C. A. Larsen, a Norwegian made the first of these efficient whaling expeditions in the steamer "Sir James Clark Ross" and took his commercial ships farther south than any other commercial vessels had gone. The 1924 voyage was marked by Mr. Larsen's death but financially this voyage and the one in 1925 were so successful that under the leadership of Mr. Magnus Konow who succeeded Mr. Larsen as president of the whaling company, the oil tanker "San Gregorio" was bought and reconstructed into the "C. A. Larsen" the pivot of our story.

Requirements of the whaling industry for which the ship was modernized resulted in a transformation that left but little of the vessels's former appearance.

The sides of the ship, and midship superstructure were raised and open decks fore and aft of this superstructure were built to facilitate the work of modern whaling for which the vessel was to be used.

From the forward end of the forward deck an iron-sheathed inclined slideway about twenty feet wide was built, the lower and outboard end terminating in a tunnel mouth; capped with a hinged hatch or lid, as shown in our illustrations: the first of its kind to be installed in any vessel for the purpose it was invented.

The hatch or lid has an arm or lever bar which swings on a shaft near the extreme bow of the ship and by hauling on the heavy wire cables which are attached to the end the lid itself is raised and the tunnel opening exposed.

The entire outboard end of this novel feature is so shaped that the cap or lid proper when closed is all but watertight and is so reenforced as to be almost solid. Shaped somewhat like the share of a plow the whole structure offers but little resistance in the speed of the ship and acts as a buffer or ice breaker when driving through the ice fields.

HOW WHALES ARE "SWALLOWED"

It is through this tunnel that the carcasses of the dead whales are hauled to the open stripping deck above, where the blubber is stripped off and cut into pieces, which are dropped through hatchways in the deck directly over the rows of steam boilers on the deck below. As fast as these boilers are filled they are capped and the blubber oil is separated from the tissue by steam boiling.

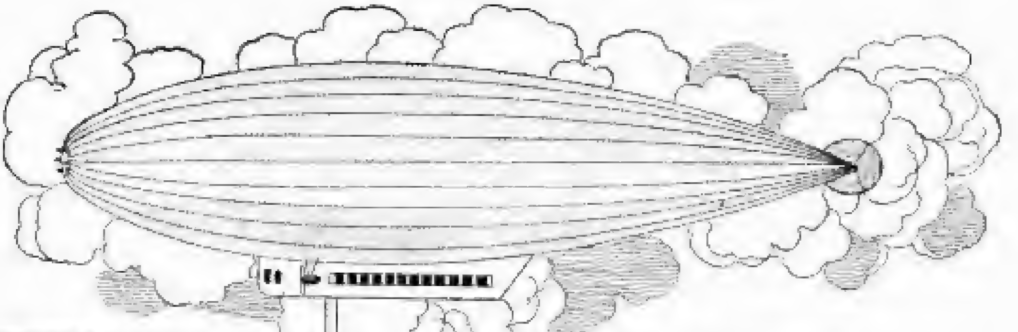
After the blubber has been stripped, the carcass is hauled to the after deck where all the bone and cartilage is separated from the fleshy part, ground, and whatever oil there is in the bone meal is pressed out and the products thus obtained from these two operations are subjected to various separating and refining processes and placed in the storage tanks until the vessel reaches port where the cargo is transferred to tank cars for distribution and delivery to the consumers, the principal ones being the manufacturers of fine soaps.

These operations are carried on night and

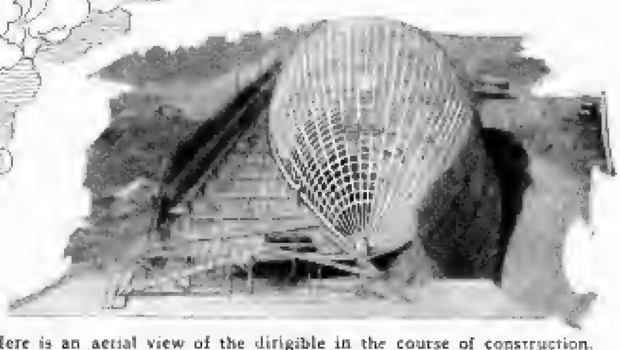
(*Continued on page 466*)

All-Metal Air Liner

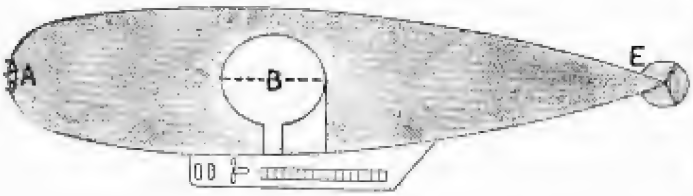
By EDWIN SCHALLERT



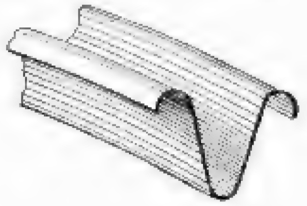
The above photo shows the all-metal liner in the process of construction. The girder work is first built up and then the liner is gradually developed but it will not become sturdy until the entire body is completely built, after which it becomes as rigid as an egg shell.



Here is an aerial view of the dirigible in the course of construction. The double balloonet at B, diagonally to the left is partially filled with gaseous fuel and partly with air. Its purpose is to equalize the pressure in the metallic hull.

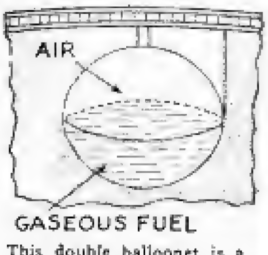


Here is a view through the air liner showing the air propeller at A, the gaseous fuel container at B and the rudder at E.

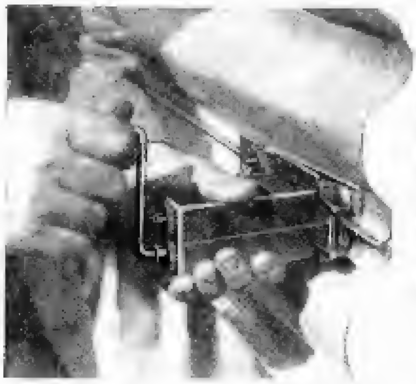


The finished air liner has sides of metal which are held together by U shaped metallic strips. The seams are caulked with a viscous liquid. Corrugations are .011 inch thick and are duraluminum. The airship is 200 feet long.

A photograph of the blower, A, is shown diagonally to the right. There are two auxiliary propellers on the body.

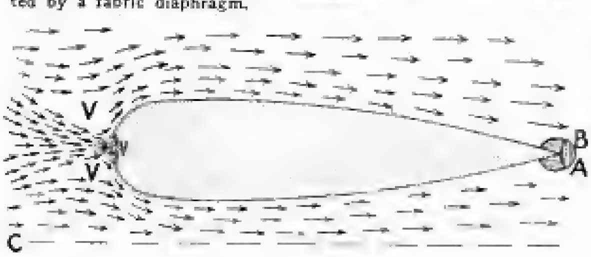


This double balloonet is a very important feature of the construction. There are two compartments separated by a fabric diaphragm.



The tool which crimps the corrugated sides together.

Thomas Slate with a working model of the all-metal dirigible.



This indicates how the radial blower produces a partial vacuum at the points marked V, and then, due to the increase of air pressure around the stream line hull, a squeezing effect is produced which drives the hull forward.

An air craft capable of transporting passengers speedily and landing them with reasonable safety in the midst of a humming metropolis has long been the goal of those interested in aeronautics. And the possibility of such a fulfillment is forecast in an invention now in process of development at Glendale, Calif., for which Thomas W. Slate is sponsor. He is constructing an all-metal dirigible there, which embodies novel features of propulsion and general design which are illustrated here.

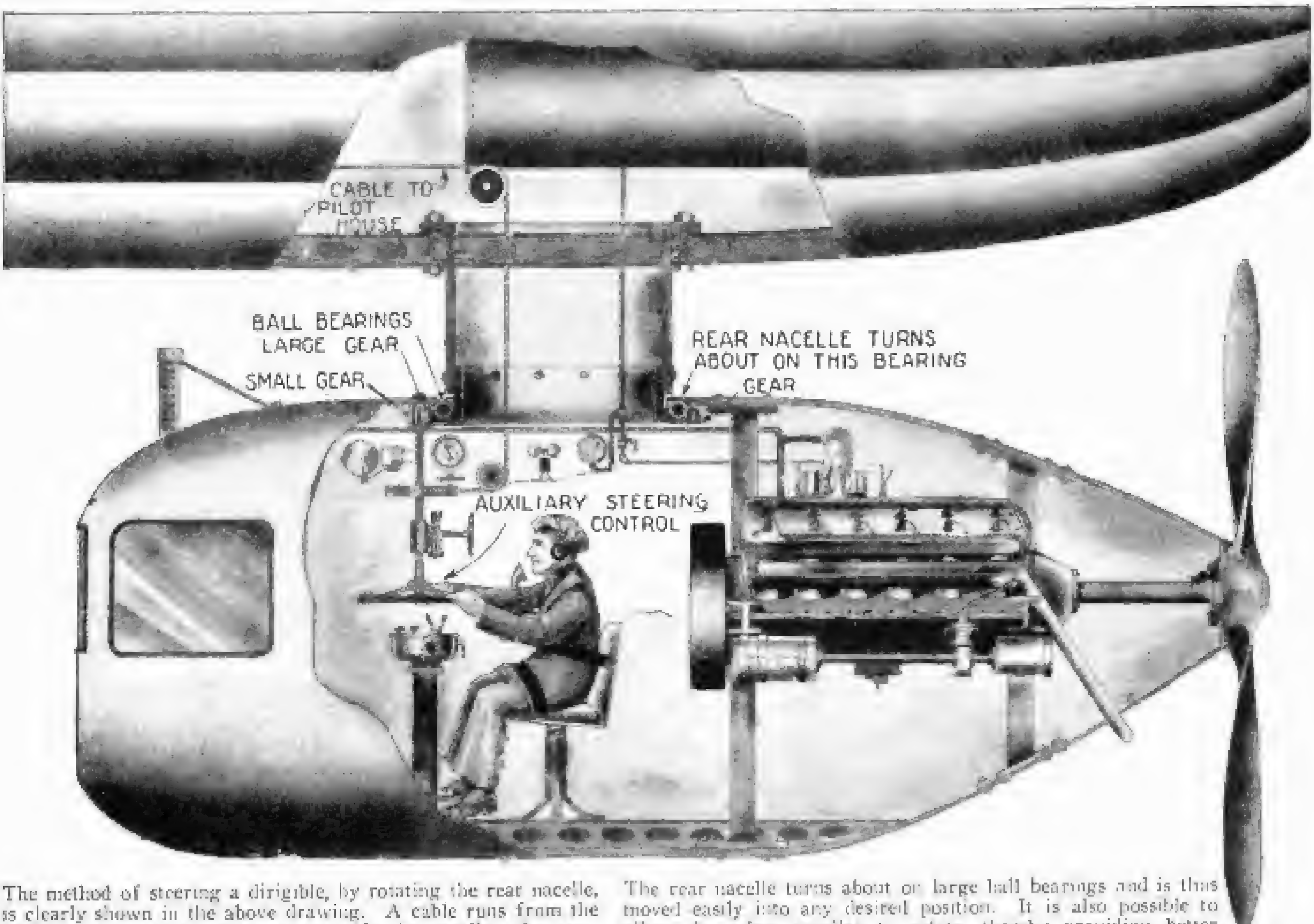
It is asserted among other things that the new craft will make possible thirty-six hour Pullman passenger service between New York and Los Angeles, and thirty-four hour service between New York and London. This new air liner will be capable of attaining a speed in excess of 108 miles an hour, and will have an elevator landing device. It will be steam driven.

The photos show the ship in process of construction. It is built on the egg-shell principle. Longitudinal beams are eliminated. The frame is made up of circular ribs, to which are attached corrugated strips of metal running the entire length of the ship. These corrugated strips are brought together in air-tight seams.

One of the diagrams shows the ship complete. The radial blower with turbine is located at point marked "A." The car for passengers and the power generating plant are suspended from the metal balloon while the rudders are at the stern "E." A cross section of the metallic covering for the balloon is shown in another diagram, while a photograph shows the form of ribs.

It is proposed that the all metal air liner will at no time decend to the ground, except for serious repairs. The illustration above shows a plan view of a city with a dirigible anchored. Along this anchor line an elevator car is to slide, to permit passengers to depart from the vessel, and likewise to take on new passengers and fuel. The ship will be maintained at an altitude of approximately 1000 feet and safety devices are provided so that in event the dirigible bobs up and down in the air, no perceptible effect will be noted on either the anchoring cable or the elevator.

Dirigible Steering Device



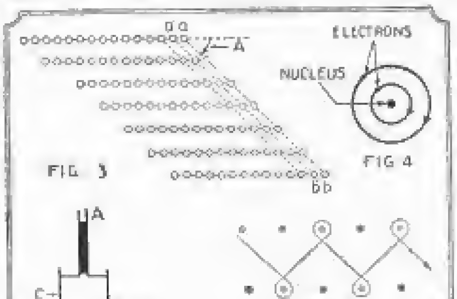
The method of steering a dirigible, by rotating the rear nacelle, is clearly shown in the above drawing. A cable runs from the pilot house to the steering apparatus in the nacelle. An auxiliary steering control is also provided. The rear nacelle turns about on large ball bearings and is thus moved easily into any desired position. It is also possible to allow the other nacelles to rotate, thereby providing better control.—*Contributor please send name and address.*

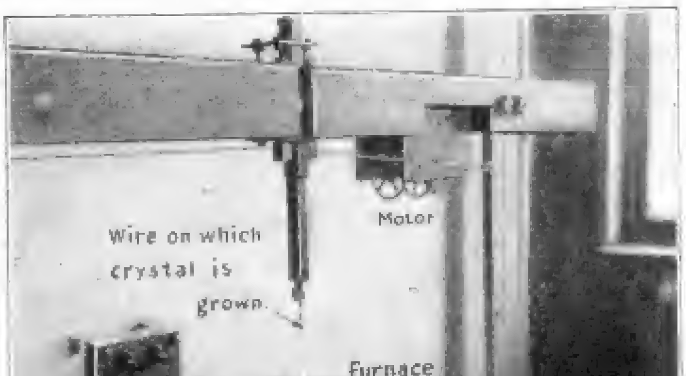
Making Single Metal Crystals

By ERNEST G. LINDER
Dept. of Physics, State University of Iowa

RECENTLY some unusual investigation has been carried out on what are called single metal crystals. It is common knowledge that sugar and quartz, for example, are crystalline, but it is not so commonly known that metals also are. The fact is, that all metals are crystalline, and that even iron nails, gold rings, and steel I-beams are but conglomerations of minute crystals, which, if they could be isolated and magnified, would be seen to have all the beautiful symmetry and geometric regularity of the finest specimen of crystalline quartz or calcite. The modern scientist, with his patient search for better methods for discovering the truth, has perfected an instrument with which he can produce extraordinarily large crystals of metal.

Fig. 1 shows the furnace retort. Fig. 3 the molecular lattice of crystals. Fig. 4 shows the normal path of electrons about the nucleus, while 5 shows them in an electrical field.





The photograph at the left shows the apparatus used by the author in producing metallic crystals of the type described. Single metal crystals from one to two feet long and about ¼ inch in diameter may be easily produced by this process. Czochralski, a German physicist, is credited with its discovery.

THE essentials of this interesting process are illustrated in the photograph. A melt of metal from which crystals are to be made is contained in a crucible and kept just a few degrees above the melting point by electric heating coils. By a suitable mechanism a wire is dipped into the melted metal and slowly withdrawn at the rate of 10 mm. or .4 of an inch per minute. A thick thread is drawn up, which rapidly solidifies, forming a single crystal. Investigation proves that the thread thus obtained is composed of one single crystal of the metal from which the thread was drawn.


Oct.
BROADCAST WRNY STATION
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NEW AIRPLANE CATAPULT
See Page 494
40 NON-TECHNICAL RADIO ARTICLES
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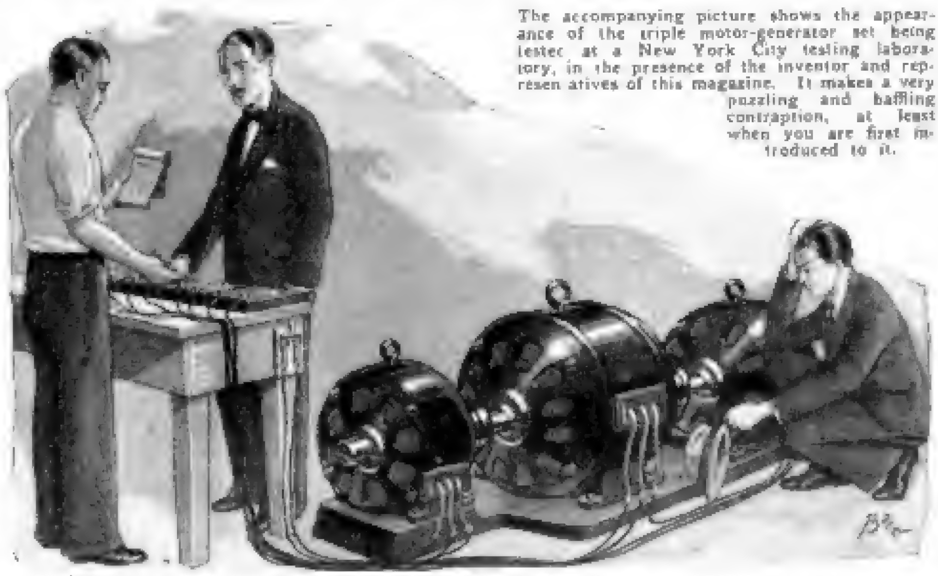
RADIO NEWS - RADIO LISTENERS' GUIDE - SPARE-TIME MONEY MAKING - FRENCH HUMOR - AMAZING STORIES

A Perpetual Motion Hoax

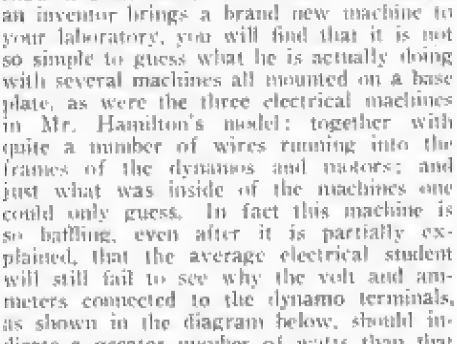
The Strange Tale of a Baffling Electrical Machine Demonstrated to the Editors and Which the Inventor Claimed Entitled Him to the $5,000.00 Offered by This Magazine for a Demonstration of a Perpetual Motion Machine.

THIS is indeed a strange tale, mates, and it all started on a warm summer's day, August 16th, 1926, to be exact. On that memorable day the editors had the extreme pleasure of meeting one Mr. John S. Hamilton, of Kansas City, Missouri, the state where they say, "show me." We were also willing to be shown, and as the editor's letter dated August 16th, 1926, reproduced herewith, shows, we were willing to pay $5,000.00, once we had been shown. "Shown what?" you will ask—simply this: A demonstration of a perpetual motion machine, in other words a machine which gave a greater output of mechanical or electrical energy, than the amount of energy put into it. After an electrical expert has read this article, he will of course say, no doubt, that it should have been easy to see what the whole show was all about at the start. But when an inventor brings a brand new machine to your laboratory, you will find that it is not so simple to guess what he is actually doing with several machines all mounted on a base plate, as were the three electrical machines in Mr. Hamilton's model: together with quite a number of wires running into the frames of the dynamos and motors; and just what was inside of the machines one could only guess. In fact this machine is so baffling, even after it is partially explained, that the average electrical student will still fail to see why the volt and ammeters connected to the dynamo terminals, as shown in the diagram below, should indicate a greater number of watts than that given by the volt and ammeters connected to the input of the No. 1 motor at the left of the machine. Just try it on your electrical student friends.



The accompanying picture shows the appearance of the triple motor-generator set being tested at a New York City testing laboratory, in the presence of the inventor and representatives of this magazine. It makes a very puzzling and baffling contraption, at least when you are first introduced to it.

Mr. Hamilton visited our offices, as aforementioned, on August 16th, 1926, and asked if we would pay the $5,000.00 challenge to him for simply demonstrating to our satisfaction, a perpetual motion machine or a machine that had a greater output than input, and as you will see we said "yes" in writing. Mr. Hamilton at that time stated to the editors that he had read our perpetual motion challenge, as published in this magazine, and the editors did not of course doubt that he fully comprehended what it was all about.



This diagram shows the actual connections of the volt and ammeters connected in the dynamo and motor circuits in the test of Mr. Hamilton's paradoxical machine, which he claimed "had a greater electrical output than input."

In order that the reader may gain a clear idea as to what the present argument is all about, it should be pointed out that ever since Mr. Hamilton's first visit on August 16th, 1926, until he again got in touch with us, just prior to June 24th, 1927, he has very shrewdly and carefully worded all of his letters and verbal statements in such a way, that it would seem we were understood to offer $5,000.00, simply to look at a machine under test and which machine seemingly developed a greater amount of actually measured power on the output side than that put into it. Mr. Hamilton knew all the time that we of course considered that he was going to show us a machine which actually developed a greater amount of true energy output than the amount of energy required to operate the machine. In other words, it should duplicate the requirements of a perpetual motion machine.

But what was our surprise when we finally discovered that he expected us to pay $5,000.00 for what really amounts to a perpetual motion hoax. Repeatedly in his arguments, both written and verbal, Mr. Hamilton says, "look at the meters, they don't lie, and they show a greater output than input." Again Mr. Hamilton has stated repeatedly to the editors, "do you consider that the second set of volt and ammeters were connected in the output side of the dynamo?" The second set of volt and ammeters are connected to the "output" terminals of the dynamo, but what Mr. Hamilton fails to take any cognizance of, is the fact that approximately *seventy per cent of the electrical energy passing into and through these meters into the third machine, which is acting as a motor, is returned in the form of mechanical power through the motor shaft to the dynamo* (center machine), all of which is carefully and fully explained in Mr. Secor's letter reproduced herewith. This arrangement of dynamo-electrical machinery is known to engineers as the "Hopkinson test," for measuring losses in such machinery. It is also called the "pumping back" test. The figures given in Mr. Secor's letter have been checked by several experts, among others the well-known electrical expert, Prof. F. F. Austin, Professor of Electrical Engineering at Dartmouth College. The phenomena taking place has been explained and confirmed as corresponding to the well-known Hopkinson test or pumping back method of testing dynamo-electric machinery, by Mr. Paul Findley, well-known scientist and engineer, connected with the famous Bell Telephone Laboratories of New York City, and Prof. Hehre, Department of Electrical Engineering of Columbia University.

Mr. Hamilton in his letters, as you will note, mentions a joke or two concerning America's greatest showman and trickster, P. T. Barnum. As Barnum once put it—the public likes to be humbugged—and Mr. Hamilton apparently thought to paraphrase this by coining a new slogan—the editors like to be humbugged. It would pay everyone to study this article very carefully and remember the explanation of the effect taking place in this paradoxical electrical phenomenon, for it may save them from investing a lot of hard-earned money in some crank inventor's "perpetual motion" invention which, as usual, *he is too poor to place on the market alone.*

Here are the letters written by Mr. Hamilton and also our letters written to the inventor before and after witnessing the test.

MR. HAMILTON INTRODUCED

August 16th, 1926.

Mr. John S. Hamilton,
5806 Locust St.,
Kansas City, Mo.

My dear Mr. Hamilton:

This is to certify that Science and Invention Magazine will pay the sum of $5,000.00 to you on condition that your electric machine will develop a greater amount of actually measured power on the output side than is put into it. The total input is to be actually measured under a continuous time test, over a period of not less than two hours; this is to be measured against the total output of the machine over the same period of time in horse-power hours. The total input is likewise to be measured in horse-power hours.

This test is to be made by The New York Electrical Testing Laboratories at your expense. Our Committee is to be present when tests are made and we will abide by the verdict of the Laboratory if the test comes under the above rules.

Science and Invention Magazine must be assured of exclusive publication rights for 60 days after test. Results are not to be published by any other paper or magazine before their publication in Science and Invention Magazine.

Cordially yours,
Science and Invention,
(Signed) H. Gernsback,
Editor.

OUR LETTER TO MR. HAMILTON, AFTER WITNESSING TEST

June 24th, 1927.

Re: Your Machine Having Greater Apparent Electrical Output Than Input.

Mr. John S. Hamilton,
5806 Locust St.,
Kansas City, Mo.

My dear Mr. Hamilton:

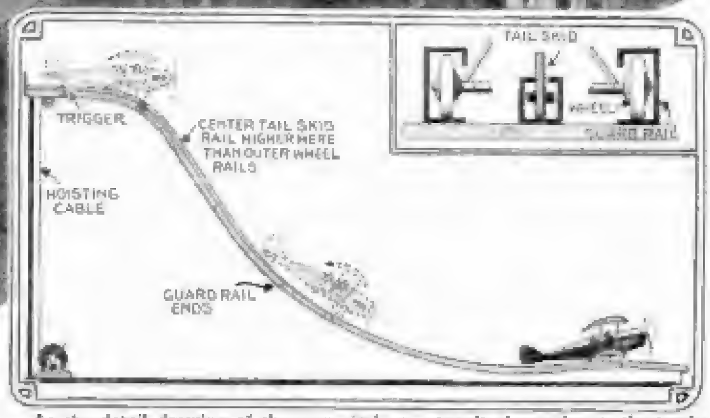
After witnessing the demonstration of your electrical machine, comprising two motors and a generator all rigidly connected on the same shaft, at the Electrical Testing Laboratories' plant yesterday afternoon, we have come to the conclusion that this machine does not, as you claim, have a greater electrical output than the electrical input.

(Continued on page 572)

NEW AIRPLANE CATAPULT

The Jenkins Catapult Permits Airplanes to Fly Off Building Roofs: His Reversible Propeller Stops Plane on Small Roof.

C. Francis Jenkins, the famous Washington, D. C. inventor, whose name has been linked with the first motion picture machine and television inventions, here proposes a new form of rotatable catapult for hurling airplanes from building roofs.



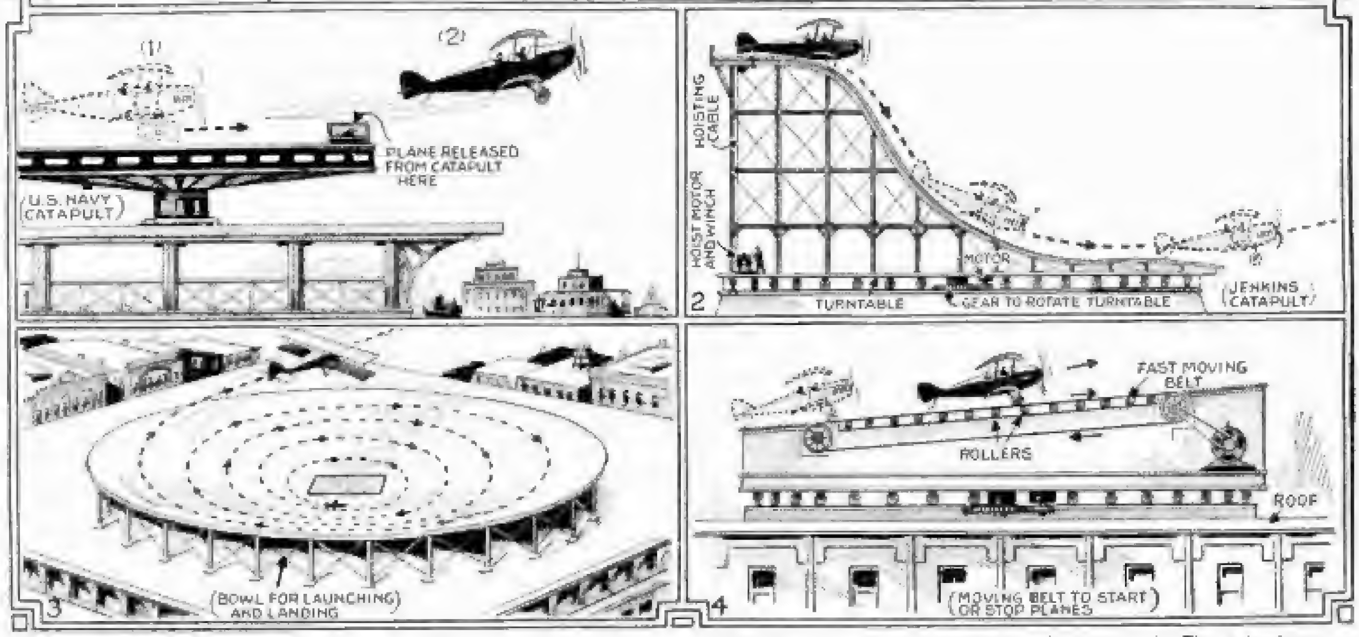
The front cover illustration shows vividly the new Jenkins rotatable catapult for launching aircraft from building roofs, while the illustration and diagram above show further details of Mr. Jenkins' invention. In the first place, this new design of airplane catapult can be rotated by electric motors so as to permit the airplane to be launched into the wind. The turntable proper has a central shaft and the outer edge of the platform revolves on a series of wheels running on a track. Thanks to the new Jenkins reversible propeller, it is possible for airplanes to stop in a very short distance, thus rendering an average size building roof available for airplane launching and landing purposes. The airplane is pulled up the catapult track by means of a cable, which is wound up on a motor-driven winch, this winch being visible underneath the framework of the catapult.

As the detail drawing of the new airplane catapult above shows, the tracks down which the plane dashes, may be covered with guards for about two-thirds of the run, to preclude the possibility of the plane jumping off the track sideways. An important feature of this invention is the arrangement of the center track along which the tail skid runs. By suitably designing the curvature of this tail skid or center track, the position of the wings, or rather their angle at a given instant, is automatically cared for, so that the plane takes off into the air with the tail and wings at the proper angle. This is important as the plane will have a very high velocity.

The U. S. Government Post Office Department has done a great deal for aviation in this country through the development of the air mail service. The picture above shows the design for the new Chicago post office, which, as will be seen, is provided with a large flat roof of ample size for the launching and landing of mail planes. The government engineers are considering similar ideas for other cities.

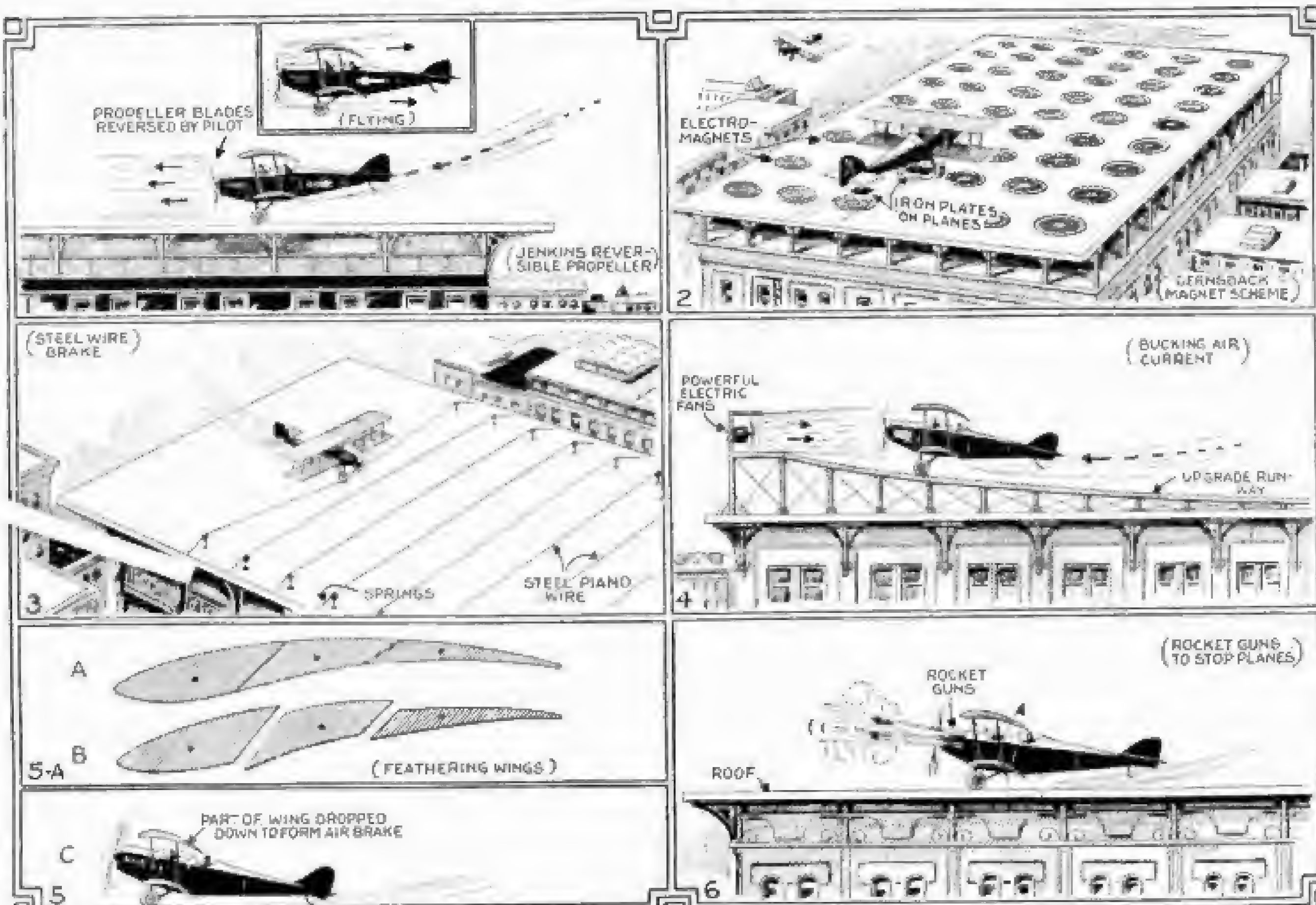
"ROOF STATIONS" FOR AIRPLANES

Various Schemes For Launching Airplanes From Building Roofs

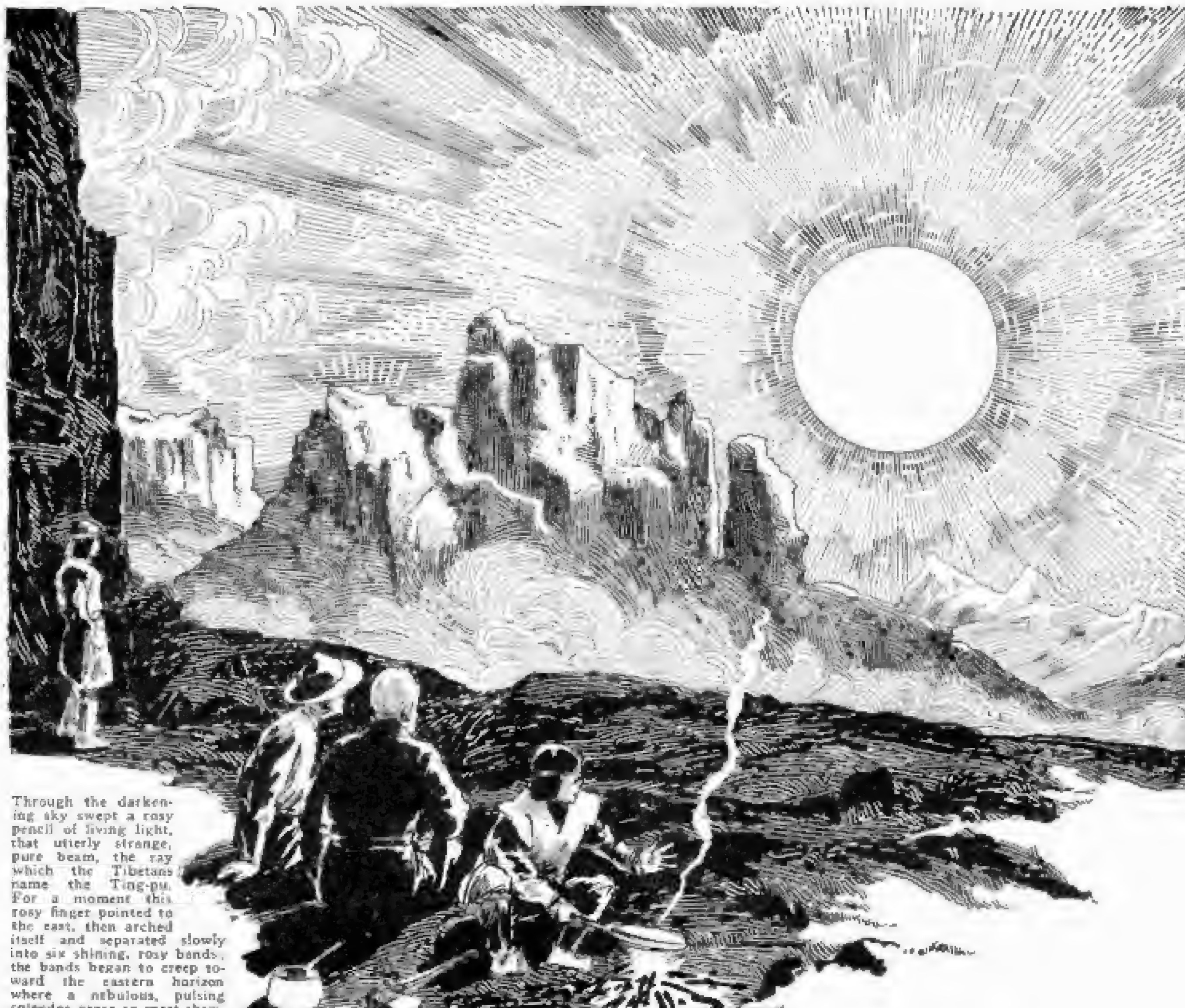


The device for launching airplanes shown at Fig. 1, has been used by the U. S. Navy on board vessels for several years. At Fig. 2 we see the catapult idea described on the opposite page. At Fig. 3 there is shown a bowl scheme for the launching and landing of aircraft. This scheme seems to have considerable merit. At Fig. 4 is shown a moving platform idea which may be used either for launching or stopping aircraft. When used for stopping airplanes, the belt is made to move in the opposite direction to that of the planes.

Practical Ways For Stopping An Airplane in a Short Distance



At Fig. 1 we see two pictures illustrating how the Jenkins' reversible propeller operates; when the propeller blades are reversed by the pilot, through an inter-locking safety mechanism, the reaction from the air stream, as shown, causes the plane to slow up and stop in a short distance. The propeller blades cannot be reversed while in flight, due to the inter-locking mechanism mentioned. Fig. 2 shows a scheme proposed by Hugo Gernsback about twelve years ago, utilizing a series of electro-magnets and iron plates secured to the bottom of the plane. Fig 3 shows piano wires under tension of springs or weights; this scheme has been used successfully. Fig. 4 shows bucking air current developed by powerful fans. Fig. 5 shows idea of feathering wings. In Fig. 6 rockets are fired to stop plane by reaction.



Through the darkening sky swept a rosy pencil of living light, that utterly strange, pure beam, the ray which the Tibetans name the Ting-pu. For a moment this rosy finger pointed to the east, then arched itself and separated slowly into six shining, rosy bands, the bands began to creep toward the eastern horizon where a nebulous, pulsing splendor arose to meet them. . . . The six beams began to sway; they moved with ever swifter motion from side to side in ever-widening sweep

The Metal Emperor

By A. Merritt

Author of "The Moon Pool," "The Face in the Abyss," etc.

CHAPTER I

I DECIDE TO REVISIT TIBET

THE valley in which I had encamped was of a singular beauty; so beautiful that the first glimpse of it caught my throat and set an ache within my heart; and then that beauty had reached out and drawn me to it and had cradled me with peace.

Sleet of a late December storm had whipped my windows in New York one night when, turning over the pages of what is perhaps the most sensational of my books, "The Poppies and Primulas of Little Tibet," I had been seized by a great desire to revisit that quiet, forbidden land. I wanted to sink myself within its high solitudes; cut myself off as though in another world from the rush and clamor of Western civilization. That desire grew not with the days but with the minutes; it became irresistible.

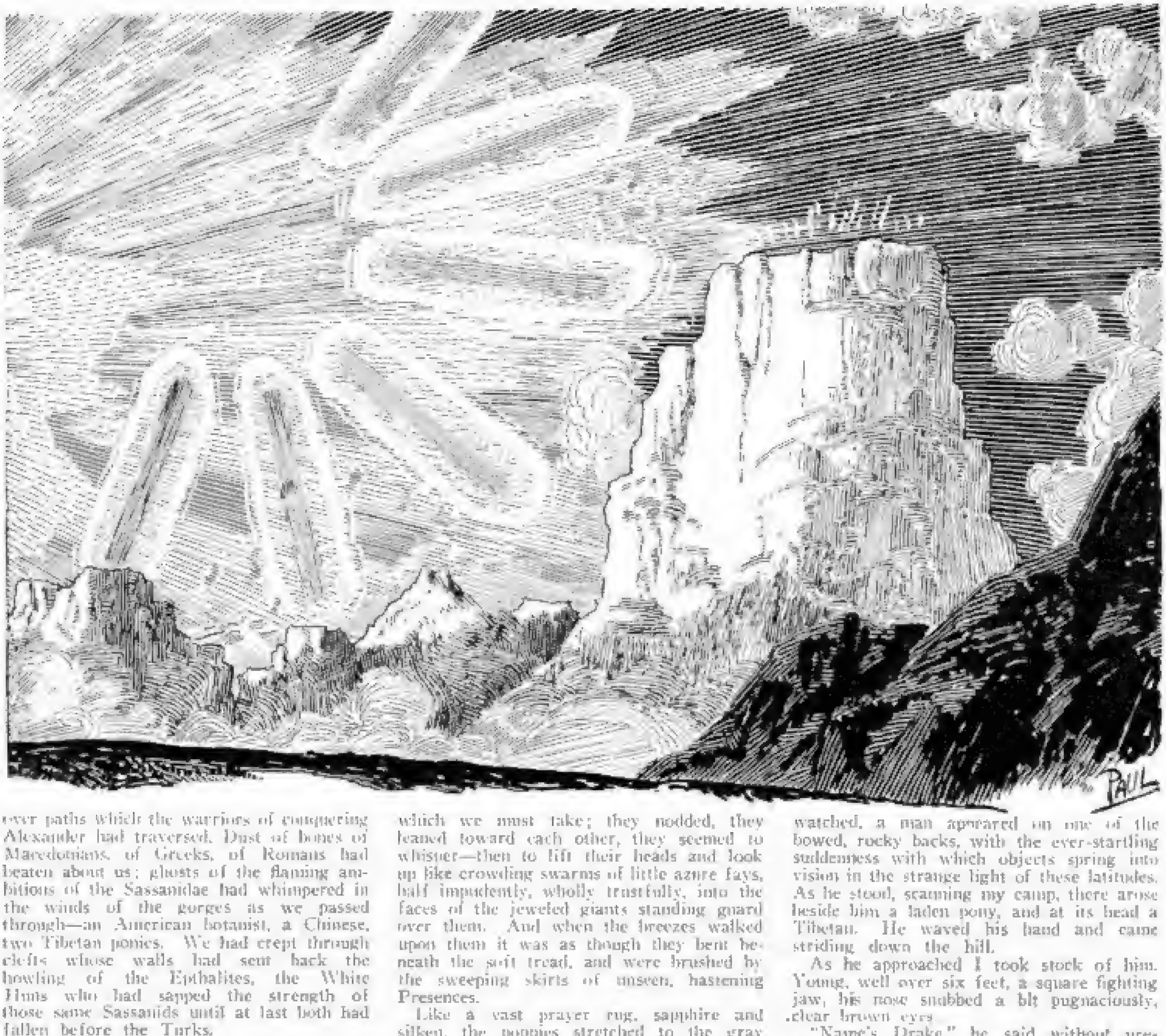
Nor was there any reason why I should resist it. A bachelor, none had claim on me. Fortunately free to go as I pleased and when I pleased, without leaving any anxious ones behind me, I was equally fortunate in possessing the means to go where I pleased.

Since early March I had been wandering among the hills. It was now mid-July.

In Teheran I had picked up a most unusual servant. He was a Chinese, his name Chiu-Ming. He was about fifty, and twenty of his years had been spent in the ancient Lamasery of Palkhor-Choinde at Gyangtse, west of Lhasa. Why he had gone from there, how he had come to Teheran, I never learned. I was most fortunate that he had gone and that I had found him. He recommended himself to me as the best cook within three thousand miles of Pekin. He spoke the truth.

For almost three months we had journeyed together, Chiu-Ming and I and the two ponies that carried my impediments. We had traversed mountain roads that had echoed to the marching feet of the hosts of Darius, to the myriads of the Satraps, the highways of the Achaemenids, and the same roads that before them had trembled to the tramplings of the godlike Dravidian.

We had slipped over hoary Iranian trails



over paths which the warriors of conquering Alexander had traversed. Dust of bones of Macedonians, of Greeks, of Romans had beaten about us; ghosts of the flaming ambitions of the Sassanidae had whimpered in the winds of the gorges as we passed through—an American botanist, a Chinese, two Tibetan ponies. We had crept through clefts whose walls had sent back the howling of the Epthalites, the White Huns who had sapped the strength of those same Sassanids until at last both had fallen before the Turks.

Over the highways and byways of Persia's glory, Persia's shame and Persia's death we had gone. For a month we had met no human soul, had seen no sign of human habitation.

A VALLEY OF ENCHANTED BEAUTY

That morning we had come out of a ragged defile into this valley of enchanted beauty; and here, although it had been so early, I had pitched our tents determining to go no further till the morrow. It was a Phocian vale; a gigantic cup filled with the very essence of peace. A spirit brooded over it, serene, majestic, immutable; like the untroubled calm which rests, the Burmese believe, over every place which has guarded the Buddha, sleeping.

At its eastern end towered the colossal scarp of an unnamed peak. On its head was a cap of silver set with pale emeralds—the snow fields and glaciers that crowned it. Far to the west another gray and ochreous giant reared its bulk, closing the vale. North and South the horizon was a chaotic sky land of pinnacles, spired and minareted, steepled and turreted and domed, each diademed with its green and argent of eternal ice and snow.

And all the valley was carpeted with the blue poppy. In wide unbroken fields, blue as the morning skies of mid-June, they rippled mile after mile over the path we had followed, over the still untrodden path which we must take; they nodded, they leaned toward each other, they seemed to whisper—then to lift their heads and look up like crowding swarms of little azure fays, half impudently, wholly trustfully, into the faces of the jeweled giants standing guard over them. And when the breezes walked upon them it was as though they bent beneath the soft tread, and were brushed by the sweeping skirts of unseen, hastening Presences.

Like a vast prayer rug, sapphire and silken, the poppies stretched to the gray feet of the unknown mountain. Between their southern edge and the clustering summits a row of faded brown, low hills knelt—like brown-robed, withered and weary old men, backs bent, faces hidden between outstretched arms, palms to earth and brows touching earth in the East's immemorial attitude of worship.

MR. MERRITT, who has written this absorbing narrative of travel and adventure in the mysterious land of Tibet, has given us one of the greatest stories of the year. The editors can only say that SCIENCE AND INVENTION Magazine readers are indeed fortunate in having presented to them such a well-written tale as that which Mr. Merritt unfolds, and will continue to unfold each month for some time to come. The editors have in the past few months reviewed several hundred scientifiction tales, but this one is the very best that has come to their attention in a long, long time. We could tell you more about this Tibetan adventure, but— Well, if you read this first installment, we'll guarantee you will read all the rest.

A MAN APPEARS IN THE WILDERNESS

Half I expected them to rise—and as I watched, a man appeared on one of the bowed, rocky backs, with the ever-startling suddenness with which objects spring into vision in the strange light of these latitudes. As he stood, scanning my camp, there arose beside him a laden pony, and at its head a Tibetan. He waved his hand and came striding down the hill.

As he approached I took stock of him. Young, well over six feet, a square fighting jaw, his nose snubbed a bit pugnaciously, clear brown eyes.

"Name's Drake," he said without preamble, holding out his hand. "Richard Keene Drake. Home's San Francisco. Business engineering. Just now, plain tramp. But Lord, I never expected to run across another white man way up here!"

He grinned, engagingly.

"My name is Thornton," I took his hand. "Dr. Louis Thornton. I am also an Amer——"

"Why I know you," he interrupted. "At least my father did. He was Alvin Drake, and he admired you greatly. Used to say that you were the only man except himself with a sane view of the evolution of something or other from the Carboniferous up through Quaternary. Used to get quite enthusiastic about it."

I flushed with pleasure. For Alvin Drake I had a great respect, considering him one of the soundest and most brilliant of paleontologists. And then a thought struck me.

"You said, I think, your father—was?" I asked. Drake's face shadowed.

"Yes," he said. "He's dead. Died on the New Year. It's why I'm here. I was all he had and after I came back from the War we palled it pretty closely. I—was very fond—of father, Dr. Thornton. After he died I felt like getting rather far away——" he was silent for a moment. "Well, I couldn't think of anything further away than Tibet, since the Polar Caps are getting

(*Continued on page 539*)

Nov. BROADCAST WRNY STATION 25 Cents

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Is This Possible?

Can the Young Lady See as Much of Herself in a Plain Mirror as is Indicated on the Front Cover?

By JOSEPH H. KRAUS

THE problem of viewing oneself in the mirror is frequently a difficult one, as many of the fairer sex know. Girls frequently have to move the mirror around in order to see their whole face while, judiciously or otherwise, applying the

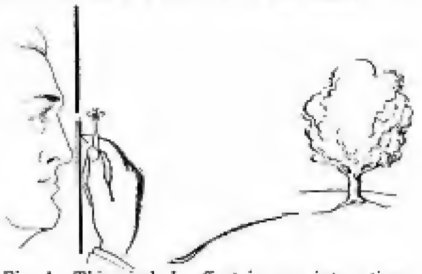


Fig. 1—This pin-hole effect is very interesting. Looking at a close object through a pin hole, the object appears magnified. Looking at a distant object, it appears smaller.

cosmetics to enhance their beauty. In order to see her whole face, a girl should measure the size of her face from side to side and top to bottom and then secure a mirror just half this size. In that way she can view her entire make-up at one and the same time. The peculiar point which is to be brought out here is that it is absolutely impossible to see more than twice the size of the mirror, regardless of how far that person may be away from the mirror. We are assuming here, of course, that we are using the plain mirror, not the convex or concave type of mirror with which entirely different results are obtained. It thus becomes impossible for anyone to see themselves in a plain mirror as is indicated on the cover.

You can easily make a few tests along this line yourself. Place a mirror on the table in front of you and then move back. In order to actually demonstrate the size of the image, hold a ruler in front of your nose in a vertical position midway between the eyes, of course. When close to the mirror, you will not see as much as you do as you recede from that point, but at any event you will never be able to see more than twice the height of the mirror on the ruler scale. If the mirror measures 4 inches, you will not be able to see 10 inches of the ruler, but only 8.

This factor is doubly interesting when one places the mirror at an angle of 45° and looks at some distant objects. He will find that he can see almost the entire city in a small mirror if that mirror is held close to the eyes, but as the mirror is moved further from the eyes, the vision becomes more limited, until finally only one object will be apparently centered in the glass and, stranger still, is an apparent magnification of the object as the mirror is moved further away from the eyes. This is an illusion which is not difficult to explain.

Size of distant objects is generally compared with other known sizes. Here we have a mirror bordered by a frame. The image of the object apparently in the mirror is compared with the edges of the frame and, as the mirror is withdrawn, one single image becomes apparently larger when we also compare it with the mirror border. It is for this reason that we obtain an illusion of enlargement. The reasons, therefore, are explained in the figures at the end of this article which show closely that, regardless of how far away the eye is from the mirror, as long as the object is the same distance from that mirror, the image is constant and seems as far back of the mirror as the object is in front of it and of the same size as the object. Mirrors frequently play strange tricks upon us, particularly in regards to their poor reproduction of color values.

It has frequently been said that were we ever able to produce a perfect mirror, we would not see the mirror. This lesson is brought home at times in some of our amusement resorts where mirrors are placed at 45° angles, at the end of a passage but dimly lighted. Those carelessly walking through this passage run head on into the mirror.

Another strange mirror experiment can be made with the ordinary concave shaving mirror. This produces a variety of images

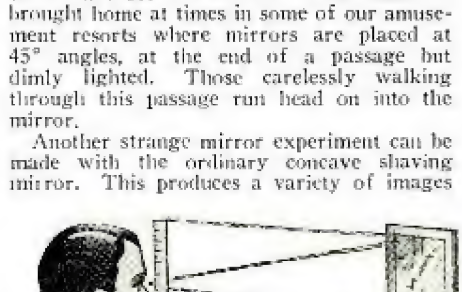


Fig. 3—One can never see more than twice the size of a mirror in a mirror, regardless of one's position with reference to that mirror.

which are quite strange. For instance, when the object is an infinite distance beyond the mirror, and consequently beyond the center of curvature of the mirror (because the center of curvature of the average shaving mirror is only a short distance away from the mirror itself), the image produced is real. That is, it can be thrown upon a sheet of paper. It is in front of the mirror and smaller than the object. If the object or the person looking at the mirror should arrive at the center of curvature of the mirror, the image is real, inverted, and of the same size as the object and in the same plane of the object. Should the object be made to approach the mirror still further, the image produced is again real, inverted and larger than the object, but here the image is beyond the center of curvature. Now, when the object is at the principal focus, the rays which are reflected from the mirror are parallel to the principal axis of the mirror and no image is formed. And lastly, with this same mirror, when one approaches so closely that he is between the principal focus and the mirror, a virtual image is produced; that is, the image is in back of the mirror. It is erect and larger than the object.

Fig. 2—If a mirror is held at a 45° angle, and a distant scene observed, and then the mirror is pushed away from the eyes, and the same scene contemplated, it appears to get larger. This is an illusion.

With convex mirrors such as are employed as automobile mirrorscopes, recourse is had to both the plain and convex mirrors. In the convex mirror the image is always virtual; that is, it is in back of the mirror and it is always erect and smaller than the object.

The only possibility then of duplicating the effect on the front cover would be to employ a convex mirror where the image produced would, as specified, be erect and smaller than the object and, consequently, more of the object than twice the size of the mirror could be seen.

This brings to mind another peculiar effect, namely, that of magnification of an object when viewed through a pin hole. If we place the wing of a fly in front of a pin whole and look at it, we will observe that this wing is considerably magnified. If, instead of looking at a close object such as a wing of a fly, we look at a distant object, we will find that the distant object appears considerably smaller than if it is viewed through the naked eye. This illusion again shows us how our eyes frequently fool us. In Fig. 5, MN is the mirror. The eye of the observer is at E, and C is an image of EA at E^1A^1.

By the law of reflection of light the angle ANO equals angle ENO equals angle O^1NA^1. And ON equals O^1N, since the image appears as far behind the mirror as the object is in front. Hence by geometry and by the symmetry of the figure, the image E^1A^1 equals EA equals 2EO equals 2KN. Hence the portion of the image that is visible below the level of the eye is exactly twice the length of the portion of the mirror KN that is below the same level. In a similar manner it can be shown that that portion of the image that is visible above the level of the eyes is just twice KM. Hence the full image that is visible is A^1B^1, which is twice the height of the mirror MN.

(*Continued on page* 671)

Fig. 4 — When far away from a shaving mirror, the image is inverted and smaller.

As one approaches, the image appears the same size, still inverted.

Still closer, the image of an object is larger and still inverted.

Finally a point is reached where there is no image at all.

At a distance of about 1½ feet from a mirror the image is erect and larger.

The Metal Emperor

by A. Merritt
Author of "THE MOON POOL" "THE FACE IN THE ABYSS" etc.

And now before us stood a monstrous pillar, a geometric prodigy. Two great globes surmounted it. At left and right the incredible knobbed arms, fully fifty feet in length, writhed and twisted, flexing themselves in grotesque imitation of a boxer. At the end of each of the six arms the spheres were clustered thick and studded with the pyramids—dreadful parodies of the spiked gloves of those ancient gladiators who fought before the Caesars.

CHAPTER V

"METAL WITH A BRAIN"

"YOU feel strong enough now to try it?" the relief in his voice betrayed the tension and anxiety which until now he had hidden so well: and hot shame burned me for my dread of again passing through the haunted vale.

"I certainly do. Drake—don't you agree?"

"Sure," he replied. "I'll look after Ruth ah—Miss Ventnor"

The glint of amusement in Ventnor's eyes faded abruptly; his face grew somber.

"Wait," he said. "I carried away some—some exhibits from the crevice where I heard the noises. Thornton."

"Exhibits?" I echoed, surprised.

"Put 'em where they'd be safe," he continued. "I've an idea—just the faintest idea—that they're of more importance than our armored men. Far, far more importance. At any rate we must take them with us. Go with Ruth, you and Drake, and look at them. And bring them back with the pony. Then we'll make a start. A few minutes more probably won't make much difference—but hurry."

He turned back to his vigil. I ordered Chiu-Ming to stay with him, and followed Ruth and Drake down the ruined stairway. At the bottom she came to me.

"Louis," she breathed, "I'm frightened. I'm so frightened that I'm afraid to tell Mart. He doesn't like them, either, these things you're going to see. He likes them so little that he's afraid to let me know how little he does like them."

"But what are they?" asked Drake. "What's to fear about them?"

"See what you think," she led us slowly, almost reluctantly, toward the rear of the fortress. "They lay in a little heap at the mouth of the cleft where we heard the noises. Martin picked them up, and dropped them in a sack before we ran back through the hollow. They're grotesque, and they're almost cute, and they make me feel as though they were the tiniest tippy-tip of the claw of some incredibly huge cat just stealing around the corner—a terrible cat, a cat as big as a mountain!" she ended breathlessly.

We climbed through the crumbling masonry into a central, open court. Here, a clear spring bubbled up in a ruined and choked stone basin. Close to the ancient well was their pony, contentedly browsing in

Synopsis

Dr. Louis Thornton is traveling through Tibet with his Chinese servant-cook, Chiu Ming and two ponies that carried the impedimenta. They came upon a white man who introduces himself as Richard Keene Drake. Drake's father had been very friendly with Thornton. The three decide to carry on. One evening, they see the rays of the setting sun broken up in a most spectacular display and the aurora which follows sucked down as if by a purposeful hand. Shortly thereafter they discover a gigantic foot-print in the fresh meadows, so heavy that it imbedded flowers in a smooth matrix which it made of the crushed rock and rubble.

Traveling through a veritable pit of despair from which they scarcely escape with their lives, they come upon Martin Ventnor, a geologist, and Ruth, his daughter. The latter are guarding themselves against hundreds of soldiers who belong to an age at least twenty centuries back. They speak in an archaic Persian language which is fairly well understood by Ventnor. It would be hopeless for the party to try to attack these ancients, so they decide to slip out of their fortress.

the thick grass that grew around it. From one of its hampers Ruth took a small bag.

"To carry—them," she said, and trembled.

We passed through what had once been a great door into another chamber, larger far than the one we had just left; and it was in better preservation, the ceiling unbroken, the light dim after the blazing sun of the court. Near its center she halted us. Before me ran a three-feet-wide ragged crack, splitting the floor and dropping down into black depths. Beyond was an expanse of smooth flagging almost clear of debris.

"There they are," she said. In her eyes was a curious fear, puzzled fascination as well. She was pointing at what seemed to be a raised and patterned circle on the dust-covered floor. It was about a foot in width and gleamed with a pale, metallic bluish lustre as though recently polished.

"Martin put them there so——" she hesitated, then added, amazingly, "so they couldn't run away. They can't jump the crack."

Wondering, I stepped over the crevice, Drake beside me. Leaning over the ring, I observed that it was not continuous. The circle was made up of sharply edged cubes about an inch in height, separated from each other with mathematical exactness by an inch of space. I counted them—there were nineteen. Within this circle was a second ring of pyramidal shaped objects—tetrahedrons—sharply edged and of similar base dimensions, that is one inch. They were not upright but on their sides, with tips pointing to six spheres clustered like a conventionalized five-petaled primrose, in the exact centre

(Continued on page 630)

Dec.

BROADCAST WRNY STATION

25 Cents

Science and Invention

HANDS CREATE RADIO MUSIC

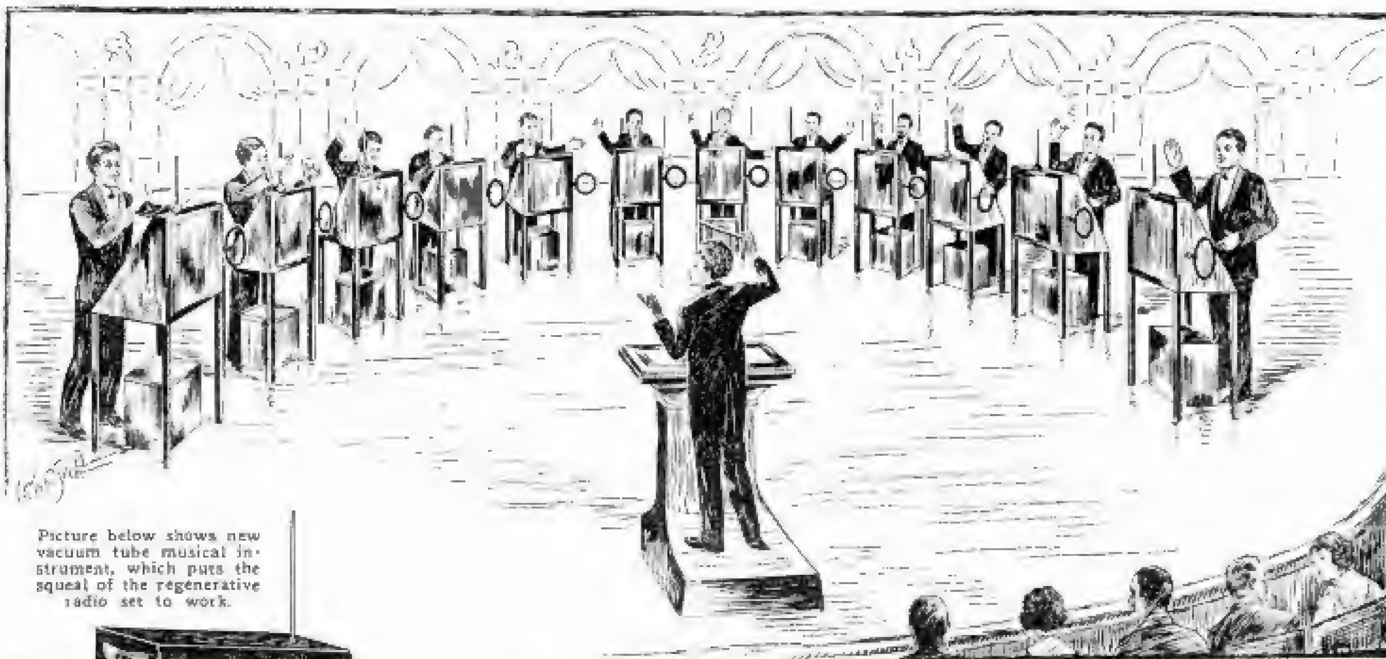
See Page 694

EXPERIMENTER PUBLISHING COMPANY, NEW YORK; PUBLISHERS OF
RADIO NEWS - RADIO LISTENERS' GUIDE - SPARE-TIME MONEY MAKING - FRENCH HUMOR - AMAZING STORIES

Hands Create Radio Music

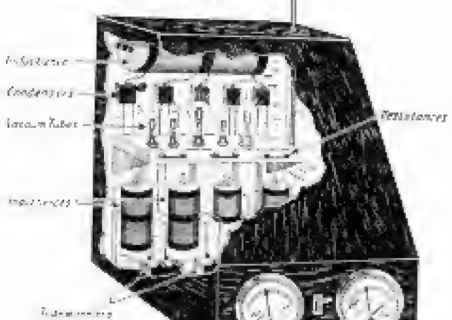
New World of Musical Tones Discovered by Experimenting with the Squeal of Radio Receiving Set

By H. WINFIELD SECOR



The strange looking semicircle of musical instruments we see in the above picture represents the latest scientific discovery by Prof. Theremin, a Russian scientist. Moving the hands toward or away from the brass rod and circle protruding from the cabinet, the consequent changes in body capacity in turn cause variations in the frequency of the currents in the apparatus, and thus produce changes in the tones heard in the loud speakers. In the apparatus shown on the front cover, a horn type loud speaker is indicated, in the apparatus shown above, cone speakers are provided inside the cabinets, with silk screens over them. It is best to use a separate loud speaker on each instrument.

Picture below shows new vacuum tube musical instrument, which puts the squeal of the regenerative radio set to work.



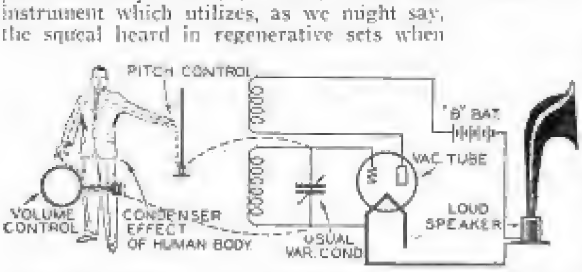
SOMETHING new in the musical world has been accomplished by Prof. Leo Theremin of the Physicotechnical Institute of Leningrad, who recently gave a remarkable demonstration before a large group of musicians, scientists, and music lovers in Berlin. The accompanying pictures show the appearance of the new instrument devised by Prof. Theremin, and he is at present engaged in building twelve of the instruments, so that a full orchestra effect can be demonstrated. Thus far a solo instrument has been demonstrated, and also duet playing on two instruments.

Practically all of the musical instruments with which we are acquainted require careful and tedious training for at least several years on the part of the student. This new instrument which utilizes, as we might say, the squeal heard in regenerative sets when the tickler is improperly manipulated, enables anyone with a musical ear soon to learn to produce a wonderful range of musical notes. Aside from the fact that one does not have to spend years in training or taking musical lessons, Prof. Theremin has accomplished something infinitely greater. With the advent of this new apparatus for producing musical tones, the inventor has made it possible to produce musical notes and tone colors never heard before by the ear of man.

Prof. Theremin's apparatus for utilizing the principle of heterodyning or super-imposing, one electrical current frequency upon another will, the inventor states, free the composer from the despotism of the twelve-note tempered piano scale, to which even violinists must adapt themselves. The composer can now construct a scale of the intervals desired; he can even have intervals of thirteenths, if he desires them. It is in fact now possible to produce any gradation of musical tone or tones detectable by the human ear. Also an entirely new range of tonal colors are available, and instead of the usual average of say, twenty tone colors, represented by that number of different orchestral instruments, Prof. Theremin opens up an almost limitless field comprising thousands of tone colors.

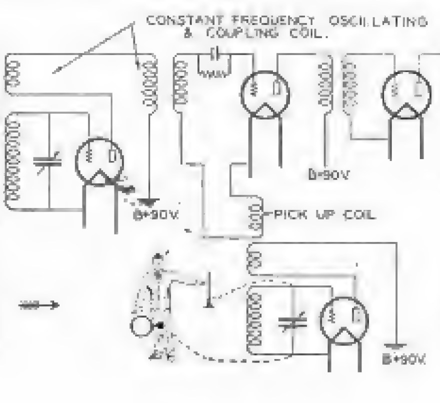
As the pictures on this page show, each instrument comprises suitable arrangement of coils or inductances, condensers, and vacuum tubes. The instrument is similar to a super-heterodyne radio receiving set, as the larger diagram below at once indicates. As explained in the captions, variations in the body capacity are created by moving the hands toward or away from the brass rod or circle, and these variations in capacity in the control oscillator circuit, cause variations in the oscillator current superimposed, through the pick-up coil, on the detector circuit. The constant frequency current is supplied by a master oscillator, as shown at the left of the large diagram. The note heard is that due to the difference between the two frequencies.

(*Continued on page 754*)



The simple vacuum tube oscillator circuit shown above will provide a clear idea as to the general electrical action taking place in Prof Theremin's new musical instrument. With the proper size coils connected in a circuit like that shown, the different notes in the musical scale are obtainable by varying the capacity connected across the main inductance, as indicated.

Changes in the body capacity caused by moving the hands, cause variations in the frequency superimposed by the first oscillator upon the circuit energized by the master oscillator at left. The difference between the two oscillator frequencies produces a third frequency.



The "difference frequency" causes the musical note heard in the loud speaker. The note frequency is amplified by two stages of audio frequency amplification.

The Metal EMPEROR

by A. Merritt

Author of "THE MOON POOL", "THE FACE IN THE ABYSS" etc.

CHAPTER VIII

THE SHAPES IN THE MIST (Third Installment)

DRAKE rolled a cigarette and lighted it. The hand that held the match shook a bit, and its flare betrayed the whiteness of his face. I knew mine had no more color. Suddenly, Ruth crumpled, dropped to her knees, her hands over her eyes.

"Buck up, Ruth," Ventnor bent over her and ran his hands through her hair. "Buck up, old fellow. Whatever we're up against, it's better than the armored men."

"Is it?" wept Ruth. "Is it, Martin? I'm not so—sure."

"Well, I am," Drake crouched beside her. "We know exactly what would have happened to us if that crowd had won out. This interesting lady and her musical friends who pulled us out of the hole can treat us no worse, that's sure. We're better off where we are than where we would have been if they hadn't turned up. You must admit that, Miss Ventnor."

"In—in a way I do," faltered Ruth. "But wh-what about later on?"

"Later on is—later on," replied Drake, puffing at his cigarette. "A brilliant remark, but incontrovertible. Now at first," he went on with careful casualness, "I thought these things might possibly be automatons, extraordinarily clever and complex mechanisms run by something like wireless. On the same principle maybe as the Hammond torpedo."

"Oh," cried Ruth, forgetting her panic in the interest aroused by this explanation, "you mean they're not—alive—at all. And that Norhala—operates them?"

"Who else?" asked Drake.

"Hm-m!" said Ruth, straightening up, her curly head lifted. "But wait—Norhala was nowhere near when those—babies—raced out of the ruins. And she couldn't have made them do what they did to you and Louis. No, she couldn't. And that dreadful thing that killed the soldiers—why, it just *enjoyed* it! No—it couldn't have been Norhala. Because she wouldn't have enjoyed it. She would just have been calm and emotionless and—well, inhuman about it. But—*it*—had—well, a lot of fun. No, Mr. Drake—it's not Norhala—"

She was silent for a little.

"There's just two sides to it," she said at last. "Either those things are astonishing machines, as you thought. Or else they're—alive. But I'm not afraid any more—so don't worry about me."

"Good!" Ventnor patted her shoulder. "Good for you, Ruth! You're on your feet again, old fellow, and it's my own sister talking. Of course they're alive. Take your idea of the Hammond torpedo, Drake. Could any torpedo break itself into each of its parts—propeller, body, engine and all of it—and then reassemble itself? And, after that, break again and reintegrate in an entirely different shape? Well, that's what we saw that thing in the hollow do."

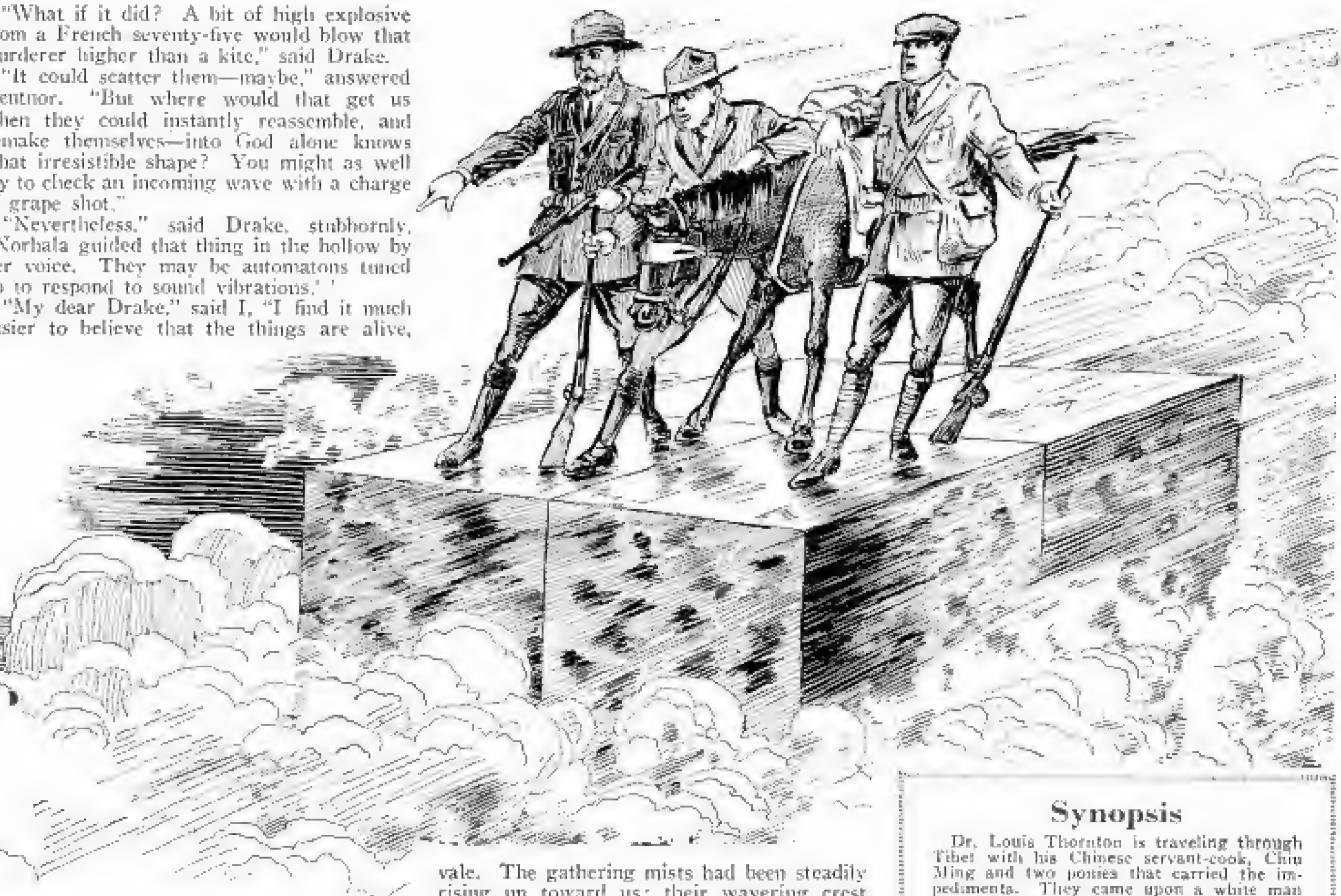
"The block that bore Ruth and Norhala swept away. I saw Ruth crouching, head bent, her arms around the knees of the woman, standing like us, erect. . . . The cubes moved with entire absence of vibration. . . ."

"What if it did? A bit of high explosive from a French seventy-five would blow that murderer higher than a kite," said Drake.

"It could scatter them—maybe," answered Ventnor. "But where would that get us when they could instantly reassemble, and remake themselves—into God alone knows what irresistible shape? You might as well try to check an incoming wave with a charge of grape shot."

"Nevertheless," said Drake, stubbornly, "Norhala guided that thing in the hollow by her voice. They may be automatons tuned up to respond to sound vibrations."

"My dear Drake," said I, "I find it much easier to believe that the things are alive, than that such very remarkable changes and movements which we beheld could be induced by vocal sounds—"



"Alive?" drawled Ventnor. "Of course they're alive, Drake. You are only trying to argue yourself out of that truly terrifying fact. They are volant and thinking things, each one of them. To meet whatever emergency is before them, their separate wills melt into one. They become a thing of interlocked intelligences—harmonious, co-ordinate; a thing with as many brains as it has units—and with all those brains acting as one; a fluid intelligence limited in its strength only by the number of its parts.

"I'm afraid—I'm—deadly afraid," whispered Ruth. She walked forlornly over to the pony. "But whether I am or am not—you must eat."

As Drake jumped to her side, and began to unstrap a saddle-bag, my heart went out to the girl. Terrifying as had been the phenomena through which we had passed, perilous as was our present situation and hedged by mysteries, I felt that we had been moving only through a prelude. Would Ruth be able to endure?

"You needn't worry about me, any of you," she said. "I won't do anything to make you ashamed of me. Only just now, I'm—I'm a little—tumbled up." She drew a hand over the wet blue eyes and smiled up at us. "Well, that's *that*," said Ruth. "Now help me get something together."

We were silent as we drew a spare supper from Ventnor's all too meager store. There was water, fortunately, in the canteens; over the spirit lamp we made some coffee. There was sufficient grain for the pony; we shared the water with it.

The valley was still, as though sound had been withdrawn from it. The shimmering radiance suffusing it had thickened perceptibly. It hovered over the valley floor and hid it. We repacked the saddle-bags and girthed the pony. Silently we awaited Norhala's return.

I had noted that the place on which we stood must be raised above the level of the vale. The gathering mists had been steadily rising up toward us; their wavering crest was still a half score feet below us.

A MYSTERIOUS VISITOR

OUT of them broke a faintly phosphorescent square. It lifted slowly; then swept, a dully lustrous six-foot cube, up the slope. It came to rest almost at our feet. It contemplated us from its myriads of deep-set, sparkling striations.

In its wake swam, one by one, six others—their tops raising from the vapors like the first, watchfully; like shimmering backs of sea monsters, like turrets of fantastic submarines. One by one they skimmed over the ledge, and one by one they nestled, edge to edge against the cube which had come first. In a forty-two-foot crescent, six feet high, they stretched in front of us. Back from them, a pace, ten paces, we retreated.

They lay staring at us.

Up from behind them came Norhala. She drifted over them like some spirit of light, and stood before us. Her veils were about her, golden girdle and sandals of gold and turquoise in their places. She walked toward us, turned and faced the watching crescent. She uttered no sound, but, as at a signal, the central cube slid forward and halted before her. She rested a hand upon its edge.

"Ride—with me," she murmured to Ruth.

"Norhala," Ventnor took a step forward. "Norhala, we must go with her. And this"—he pointed to the pony—"must go with us."

"I meant—you—to come," the faraway voice chimed, "but I had not thought of that."

She turned to the six waiting cubes. Again as at a command, four of the things moved, and swirled in toward each other. They joined and stood before us, a platform twelve feet square, six high.

"Mount," sighed Norhala.

Ventnor looked helplessly at the sheer front facing him.

"Mount!" There was half-wondering impatience in her command. "See," she caught Ruth by the waist—with the same bewildering swiftness with which she had vanished from us when the aurora had beckoned, she appeared, holding the girl, upon the top of the single cube.

"Mount," she whispered again, looking down upon us.

Ventnor began to bandage the pony's eyes. I placed my hand upon the edge of the barrier and sprang. Unseen hands caught me, raised me, and set me on the upper surface.

"Lift the pony to me," I called to Ventnor.

"Lift it?" he exclaimed, incredulously.

Drake laughed.

"Catch," he called and placed one hand beneath the little beast's belly, the other under its throat. His shoulders heaved—and up shot the pony, laden as it was and landed softly upon four wide-stretched legs beside me.

"Follow," cried Norhala.

Ventnor leaped for the top, Drake beside him. In the flash of a bird's wing they were gripping me. The unseen hold angled, struck upward, clutched us from ankle to thigh and held us fast—men and beast.

The block that bore Ruth and Norhala swept away. I saw Ruth crouching, head bent, her arms around the knees of the woman, standing like us, erect. They slipped into the mists and vanished. After them, like a log in a racing current, we, too, dipped beneath the vapors.

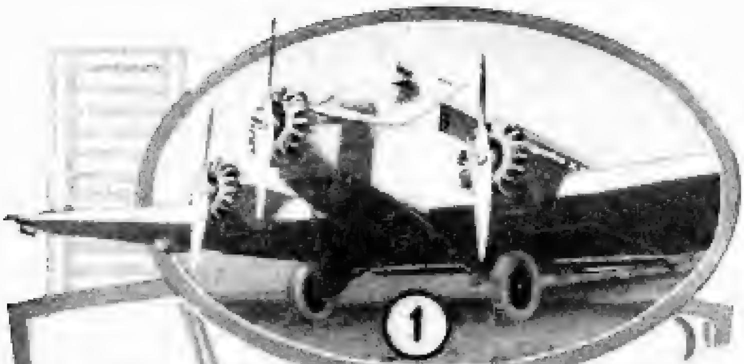
(*Continued on page 741*)

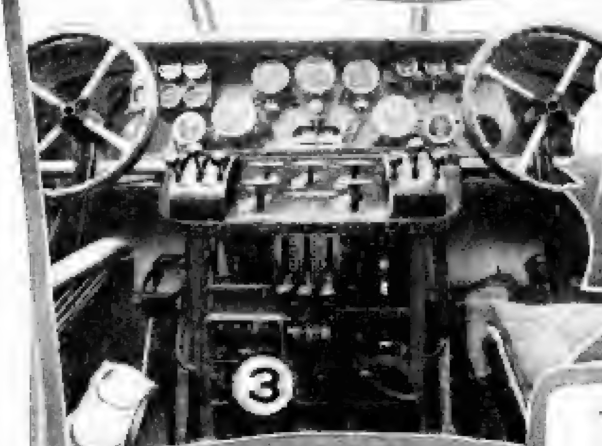
Synopsis

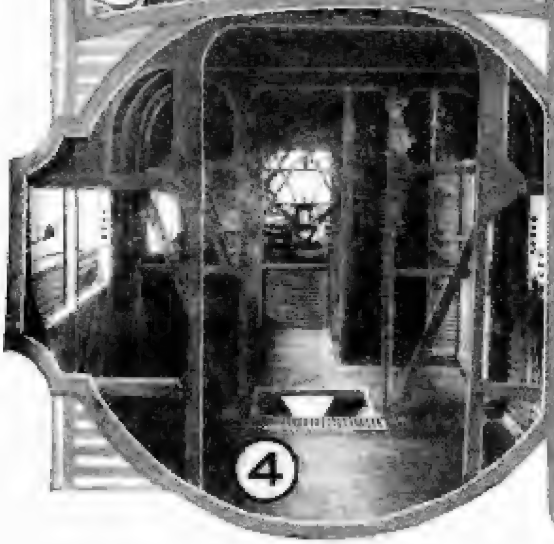
Dr. Louis Thornton is traveling through Tibet with his Chinese servant-cook, Chiu Ming and two ponies that carried the impedimenta. They came upon a white man who introduces himself as Richard Keene Drake. Drake's father had been very friendly with Thornton. The three decide to carry on and come upon Martin Ventnor, a geologist, and Ruth, his daughter. The latter are guarding themselves against hundreds of soldiers who belong to an age at least twenty centuries back. While escaping they are attacked and would have been exterminated, were it not for the timely intervention of Norhala, a tall beautiful metallic-haired woman whose control over lightning and over heavy metallic blocks was phenomenal. These blocks, at her command, would make a bridge for her to walk on or form themselves into battling monsters to protect her or obey her every whim. Chiu-Ming is killed in the battle, the survivors leaving with Norhala.

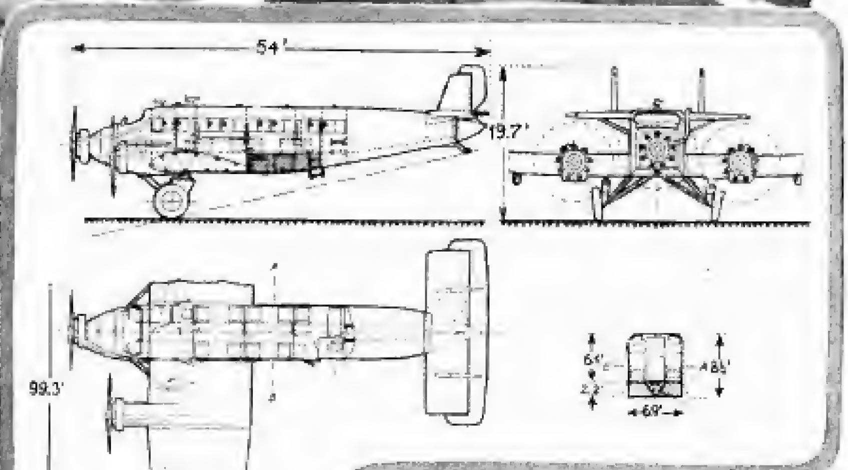
Huge All-Metal

REMARKABLE DEVELOPMENT IN JUNKERS
ALSO CARRY BAGGAGE,









The details and size of the plane are shown in illustration No. 5 appearing above. The passenger cabin itself is approximately 6 feet high and 7 feet wide. A storage compartment, a little over 2 feet high and of the same width as the cabin is arranged in the bottom of the plane. The plane will hold two dozen passengers and the two pilots with ease.

Photograph No. 1 appearing at the top of the page shows a front view of the new Junkers all-metal monoplane. This tri-motored plane develops tremendous horse-power and has made record flights throughout Germany. Photograph No. 2 shows a side view of this monster airplane. Note the two wind-driven generators mounted on top of cabin, near the forward part of the plane. The shape of the body and placement of wings are clearly shown in this photograph. Note the number of windows which admit light to the cabin.

Photograph No. 3 gives an excellent view of the two pilots' seats and dual control. The plane is so arranged that it may be operated from either the left or right hand seat of the pilot's compartment. Photograph No. 4 gives a view of the interior of the plane when it was under construction. Note that the floor of the plane is also made of metal. The entire plane has been made of an alloy similar to duralumin. Illustration No. 5 shows the details of the plane which is 54 feet long and 19 feet 8 inches high.

SINCE the World War, aviation has progressed by leaps and bounds; its phenomenal growth probably only surpassed by the development of radio-communication. One of the greatest achievements along this line is the Junkers all-metal cabin airliner which is made from an alloy closely resembling duralumin. The plane, which is the first of its kind, will be used in the German passenger service. With a length of 54 feet, a height of 19 feet 8 inches, and a wing spread of 100 feet, this huge plane is one of the largest which has been built.

The plane is made of corrugated sheet metal and is completely equipped with all of the latest devices and inventions made in the art of aviation. The passenger cabin has non-breakable windows arranged on either side, comfortable seats provided for the passengers and electric lights. In spite of the fact that it is entirely fire-proof, liquid fire extinguishers have been installed as an added precaution. The plane can be so arranged that hospital patients can be quickly transported from one place to another without any fear of danger or injury which may be produced from excess vibration or bumping. Thus, emergency cases can be rushed to hospitals, from out of the way places and many lives saved. The pilots' dual control compartment, which may be seen in the photograph, is arranged so that the navigator and pilot are afforded a clear view of the route at all times. The plane is equipped with a double set of instruments and controls, so that the craft may be manipulated from either side. Ample space is provided for trunks and luggage which are installed in the side of the body and hot food is carried in special containers of the vacuum wall type.

The methods of joining metallic materials which are available to the aircraft builder are either mechanical or thermal in nature. The thermal means embrace forge welding, gas welding, electric welding, soldering and brazing. All of these involve the partial or complete melting of metal similar to or different from the parts being joined. Gas welding is the most successful of all of the melting processes. The particular means used employs hydrogen and oxygen or acetylene and oxygen to produce the heat necessary to fuse the metal to be joined. This new all-metal plane is held together with rivets and welding has been resorted to only in a comparatively few places.

European Planes

DESIGN OF LARGE ALL-METAL PASSENGER PLANES, WHICH BESIDES SLEEPING AND DINING FACILITIES

At the right is a view of the rear end of the plane. A small door has been arranged so that it may be swung outward and the mechanic can enter. The door is then securely bolted in place. The supporting and the strengthening braces, both in the door and in the interior of the plane are clearly shown. Much of the strength of the plane depends upon the judicious placements of these braces.

Food for the trip is stored in a metal bin which is shown above. The lattice work frame is entirely made of metal and riveted together.

An interior view of the finished passenger cabin is shown at the right. The luggage-rack may be seen above the windows. The upholstered seats may be made into comfortable berths to accomodate over - night passengers. The interior of the cabin is finished in attractive color harmony.

Trunks and suitcases are placed within the body of the plane itself. A door which opens in the side of the plane provides for their insertion. A number of metal tracks, which are clearly shown in the photograph, make it possible for the luggage to be easily shifted. Note that the plane is made of corrugated sheet metal which greatly adds to its strength and durability. During the war the Germans constructed a few planes with metal bodies, but this is the first time that an all-metal plane of such large size has been built in quantities. The plane was designed and constructed at the famous Junkers factory in Germany. The plane has already made several record flights and since 1926 Germany has been provided with the most complete aerial traffic service of any country in the world. The passenger is provided with a specially prepared air map of the route, which enables him to locate places of interest along the way.

Below we have a view of the cabin showing the berths made up. Note the size of these berths which are a great deal larger than those found on most railroad trains today. Thus the passenger travels in luxury and comfort in record time.

Note the size of the individual compartments shown in the photograph above.

Jan. 25 Cen

Science and Invention

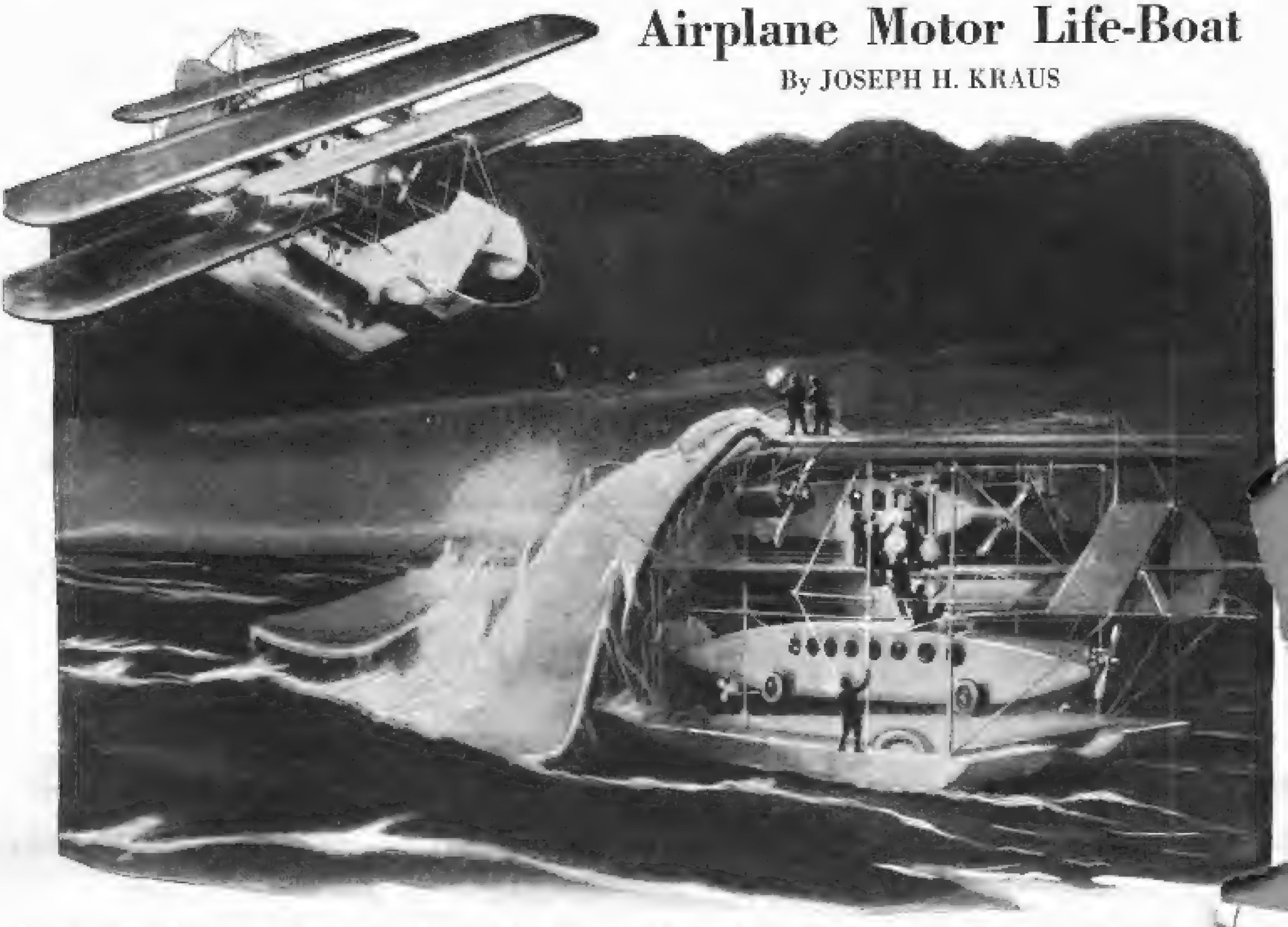
AIRPLANE
MOTOR LIFE-BOAT

See Page 790

EXPERIMENTER PUBLISHING COMPANY, NEW YORK, PUBLISHERS OF
RADIO NEWS - RADIO LISTENERS' GUIDE - SPARE-TIME MONEY MAKING - FRENCH HUMOR - AMAZING STORIES

Airplane Motor Life-Boat

By JOSEPH H. KRAUS

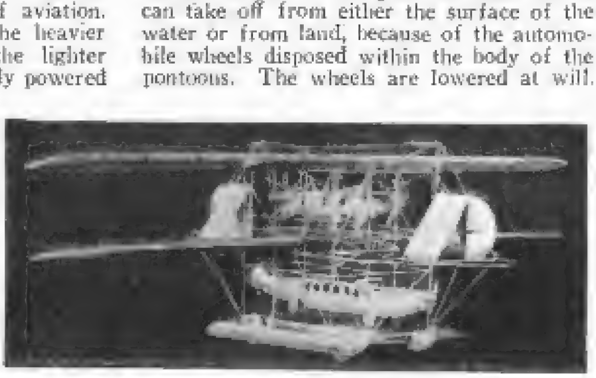


The above photo-drawing indicates an episode in future trans-oceanic flight employing the new types of aircraft indicated in the photos on this page and in our cover illustration. It will be noted that the crew, after examining the wreckage, climb down into the passenger car, which will be cut loose from the airplane, and then proceed on the remainder of its journey like any other motor-boat. Another plane is seen in flight.

EVERY day we hear of new strides being made in the field of aviation. New types of skids for the heavier planes; new constructions for the lighter planes, airplanes that are able to fly powered with but a single motorcycle engine; others which because of their high power attain phenomenal speeds.

But the trend in modern aviation is primarily based upon the factor of safety. Making airplane flights absolutely safe in any kind of weather and in any storm is the aim of modern designers. Even at the present time, aeronauts are busy with devices to prevent stalling and tail spins. Others are making aviation safer by developing ideas similar to that shown on this page.

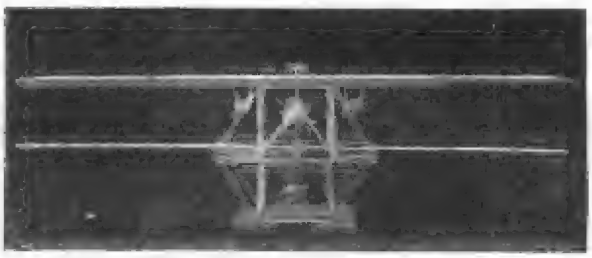
From an examination of the photographs it will be seen that the plane illustrated is an all-metal liner, having a great wing spread; giving it both a slow landing speed and exceptional lifting power. It is propelled by four motors, one of which is in the front of the pilot's cabin, two suspended from the upper wing, and the fourth, on the passenger compartment. This passenger compartment hangs from the rest of the structure, so that it is free to move (within a limited distance) in any direction. This movement will, it is the designer's intention, overcome air sickness. Inasmuch as this depending body is connected by a very simple arrangement with ailerons, it serves also to automatically stabilize the plane in very stormy weather. The pontoons are large enough to permit the plane to float and it can take off from either the surface of the water or from land, because of the automobile wheels disposed within the body of the pontoons. The wheels are lowered at will.



Here is a three-quarter view of the model, illustrating the principles of this unique aircraft construction.

In order to avoid many struts and braces, the wings of the plane are of cantilever construction and covered with metal. The pilot's cabin and the passenger coach are sufficiently cross-braced to prevent accidental damage in case of a rapid forced landing. The latter is impervious to water and, as the illustration indicates, is equipped with both wheels and submergible propeller. The reasons for the latter constructions will become apparent directly. Let us suppose that in landing on the ocean, a huge wave smashed the wing as is depicted by our artist. An examination of the wreckage indicates that there is no possibility of saving the plane, so the crew climbs down into the suspended passenger coach. Locking the hatch in place, they cut loose from the plane, dropping the coach to the platform below. Throwing the motor into gear with the automobile wheels, the 100 or 150-foot passenger coach moves off the platform and drops into the sea. From this point on, the submerged propeller takes care of the coach, which proceeds to the nearest land under its own power. In other words, the wings have been left behind and the remaining part of the airplane now becomes a motor boat.

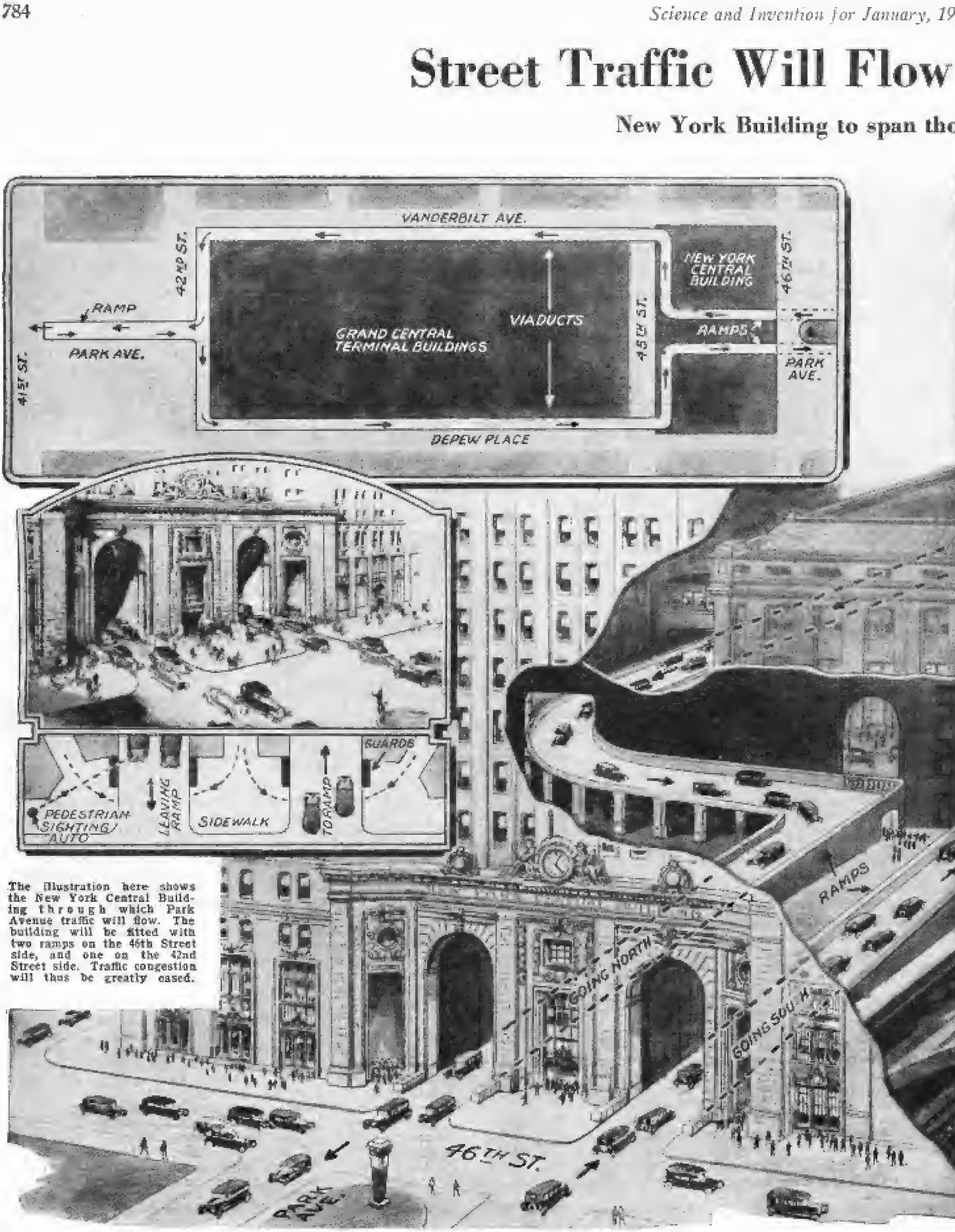
Should the trouble occur suddenly in mid-air, it is conceivable that the passenger coach could be cut loose from the plane on its descent, as our front cover shows. The boat-like cabin could be dropped into the water before the wrecked plane even came to rest on the surface, or because of the impact, be smashed to pieces. This plane was invented by Arnold W. Genrich.



A front view of the model. The wings are not cross-braced, because their cantilever construction can support the weight of the craft.

Street Traffic Will Flow

New York Building to span thor



The illustration here shows the New York Central Building through which Park Avenue traffic will flow. The building will be fitted with two ramps on the 46th Street side, and one on the 42nd Street side. Traffic congestion will thus be greatly eased.

NEW YORK'S most remarkable and interesting skyscraper will be the New York Central Building, which will stand squarely in the middle of Park Avenue, with its huge tower higher than the Washington Monument, 560 feet above the street. The building is anchored with steel piles, sunk in solid rock, fifty feet below the pavement. These pass through two levels of railroad tracks. It seems incredible that through the building itself will pass all the automobile and pedestrian traffic that now goes up and down Park Avenue. Furthermore, the traffic across 45th Street will flow beneath the north and south bound Park Avenue traffic, a feat only made possible by a most novel system of ramps and viaducts placed as shown in the illustration. The main lobby of the building, located between the ramps, carrying the new elevated roadways, will be 20 feet wide and 40 feet high, extending from 45th to 46th Streets. A bridge across Depew Place, at the 15th floor of the new building will connect with the old building where the present offices of the railroad are located. Attractive arcades, passing through the building, will be provided for pedestrians as a continuation of the Park Avenue sidewalks. The ramps will extend entirely through the building, isolated from the lobby.

Through City Skyscraper

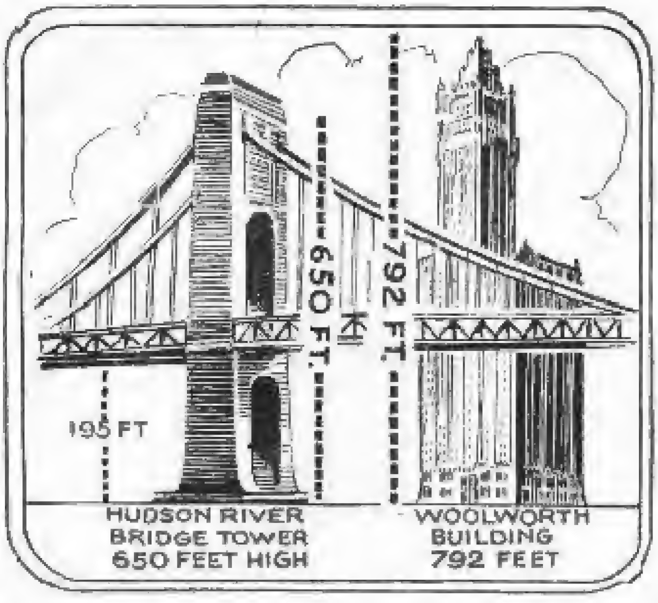
oughfare with rail tracks below

At the right is an illustration showing how the 35 story skyscraper will look when completed. This huge office structure, 560 feet high, will span the traffic thoroughfare with rail tracks below. The situation of the traffic ramps and railroad trains is shown in the large illustration. The building is now under construction on the blocks surrounded by 45th and 46th Streets, Vanderbilt Avenue, and Depew Place.

This improvement will be of vast importance to the traffic on Park Avenue and will eliminate congestion at the north end of the Grand Central Terminal, by the opening of Depew Place. A raised roadway is being built on Depew Place between the Hotel Commodore and the Grand Central Terminal, corresponding to the one already on its western side, so that traffic will flow around both sides. Where the two streams meet at the northern end of the station, a viaduct will be built along and over 45th Street. The northern incline will occupy the block between 45th and 46th Streets, running into the center of the viaducts. The southern incline will extend a block or more on either side of the station, thus there will be a space for the continuous flow of north and southbound traffic. Construction work has already commenced and the building program has been laid out so as to cause the least possible interference with the present street traffic. The roof and tower of the new building is to be illuminated at night and will provide an additional aerial landmark for New York City. The exterior of the building will be of Indiana limestone for the first four stories with exterior brick walls above. The architectural motif is to be along strictly classical lines with decorative features subordinating.

Greatest Bridge

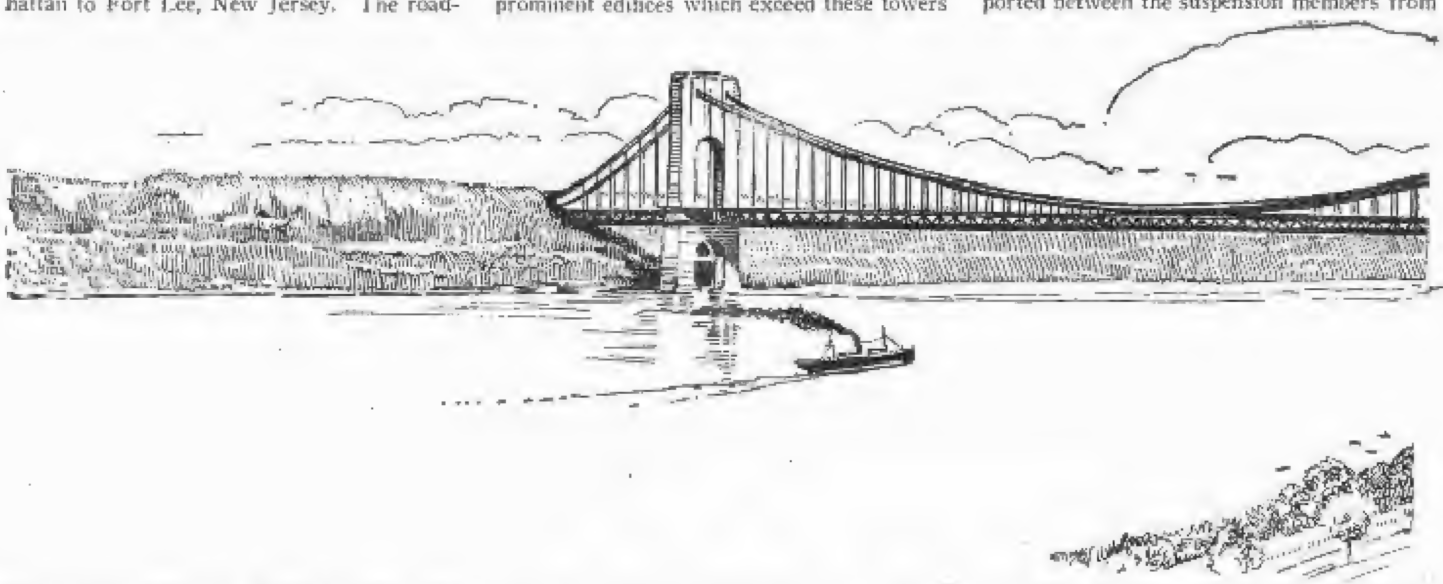
World's largest span, connecting Manhattan with New Jersey, will be 1½ miles long and will tower 650 feet high

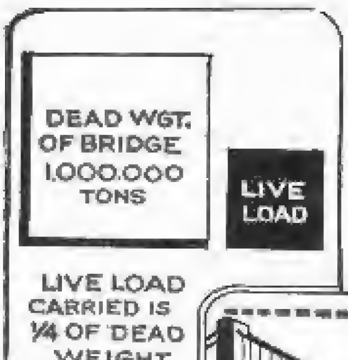


At the left the towers of the Hudson River Bridge are compared to the Woolworth Building. The bridge is to have towers which will be 650 feet high, the Woolworth Building is 792 feet high. The bridge itself will be 195 feet above the river. The total length, including the approaches, will be 1½ miles long and the length of the main span between the two towers will be 3,500 feet. The foundations for the New Jersey towers will be sunk by the coffer-dam method.

Illustrations courtesy N. Y. Port Authority

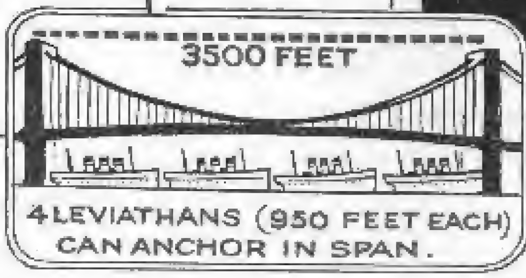
NEW York City is to have the largest bridge in the world. A huge suspension structure one and one-half miles long, with towers standing 650 feet high, is to span the Hudson River from Manhattan to Fort Lee, New Jersey. The roadways will be 195 feet above the river and will accommodate trains, pedestrians, and automobile traffic. The total length of the span between the two towers will be 3500 feet, the longest in the world. Estimated by its span, the Hudson Bridge is not only the longest of bridges but so much so that it stands by itself, outside the range of comparison. The towers of the bridge are one-third higher than the Pharos and four times as high as the Colossus. The only prominent edifices which exceed these towers in height are the Woolworth, and Metropolitan Buildings in New York and the Eiffel Tower in Paris. The greatest pyramids in Egypt have an estimated weight of about 8,000,000 tons. The bridge over the Hudson will weigh 1,000,000 tons, or one-eighth as much as the pyramid of Gizeh, suspended in air, or the total weight of ten Woolworth Buildings. This huge mass of steel and masonry will be supported by four cables, each one 5,000 feet long and 36 inches in diameter made up of smaller cables about one-fifth of an inch thick. The engineers have allowed a sag of 400 feet in the 3500 foot span so that the tension on the cables might not be too great. The weight of the bridge and therefore its inertia will be so great that the force of a gust of wind would be spent before the bridge would move appreciably. The steady force of a high wind would hold the center of the bridge twelve or eighteen inches out of its normal position. A maximum swing of five feet is allowed in the design. In cold weather the contraction of the cables will raise the bridge about five feet and the two towers will move about seven inches towards the center under a load. The concrete floor of the bridge will be supported between the suspension members from the cables by great steel trusses all riveted together, yet this solid structure will be sufficienly elastic to give without cracking or breaking as the bridge swings up and down, or from side to side because of the weather or the movement of traffic. The cables will be anchored on the New York side in a huge mountain of concrete and granite. On the New Jersey side tunnels will be bored more than 100 feet into the ledge of the Palisades and the cables anchored in the rock itself. Each leg of the tower will rest on a separate reenforced concrete base 90 feet by 100, resting on bed rock and faced with granite. To build these foundations the river bottom must be excavated for about 100 feet under water to reach the bed rock. New York has held the distinction of having the world's largest bridge once before. Since 1917, however, the St. Lawrence Bridge at Quebec has been the longest, with a span of 1,880 feet; however, it will be dwarfed by the new Hudson River Bridge. Two sidewalks, eight roadway lanes, and four electric railway tracks will provide communication between the two states. The bridge will be built in two stages, the first including the construction of the span and roadways, sufficient to handle the initial traffic expected; the second including the completion of the roadways and the building of four lanes of rapid transit tracks or bus lines, whichever

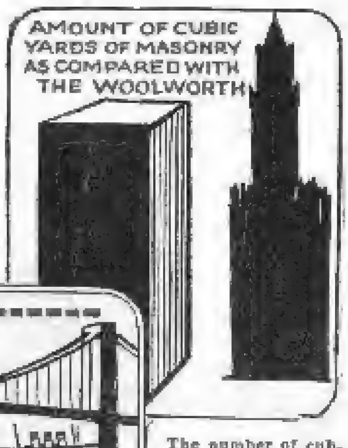




Above the live and dead weight of the bridge is compared. The live load carried is one-fourth of the dead weight.

Four Leviathans, each one 950 feet long, could anchor in the span between the two towers. The span between these two towers is to be 3,500 feet, the largest in the world. The towers are higher than the Washington Monument.



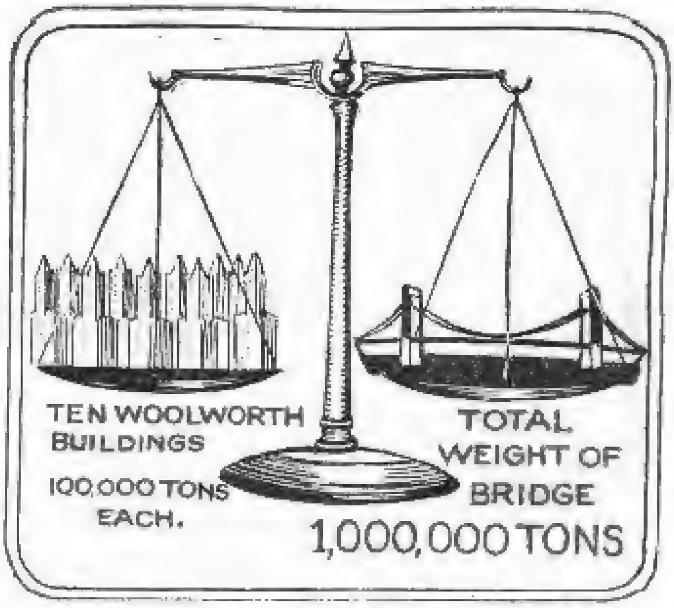


The number of cubic yards of masonry which will be used in the construction of the new bridge compared to Woolworth Bldg.

to Span Hudson

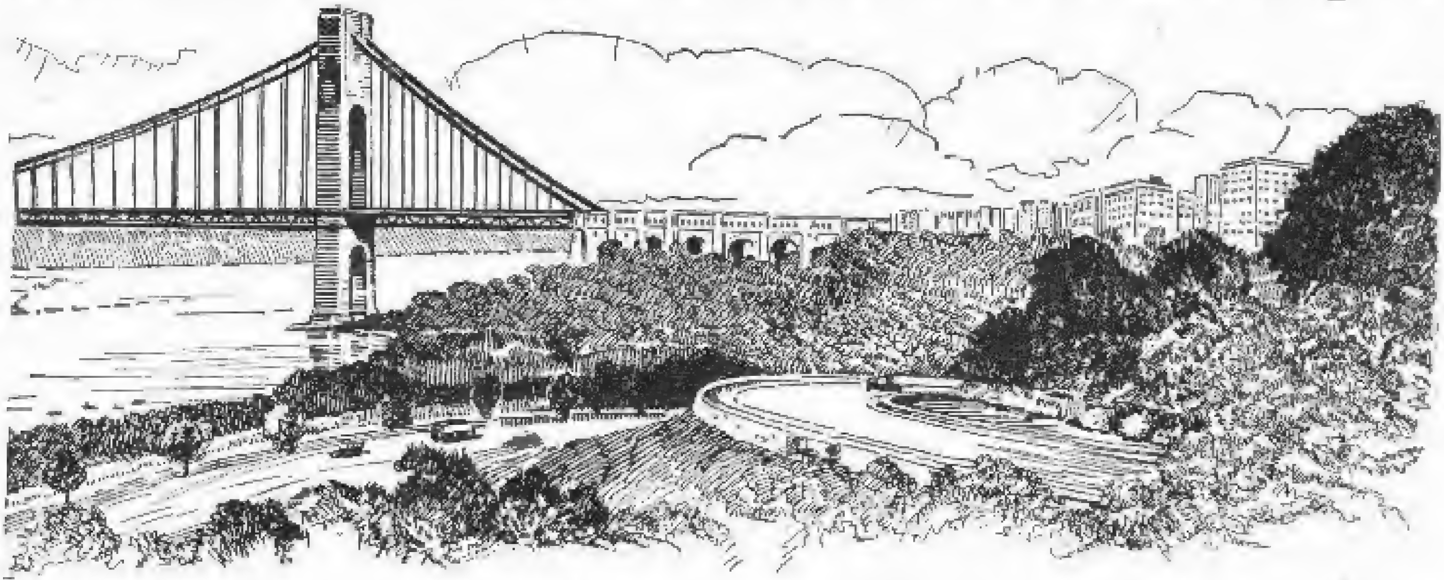
Masonry nearly equal in volume to Woolworth Building. Wire in cables would reach from New York to Columbus, O., 750 miles

The total weight of the new Hudson River Bridge will be approximately 1,000,000 tons, which is equal in weight to ten Woolworth Buildings, each one weighing 100,000 tons. The cables carried by the huge artificial mountain of concrete and granite will be embedded in solid rock. The construction work began on the New Jersey side with the building of a tower. The bridge is expected to be completed in 1932 and will then be opened for initial traffic.



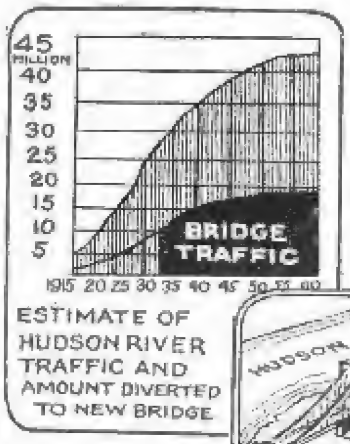
may seem expedient. The first stage will cost approximately $50,000,000, and the latter stage an additional $25,000,000, making the total estimated cost of the completed structure between $60,000,000 and $75,000,000. A work so stupendous as this in its proportions may be contrasted with the previous major achievements of mankind, both ancient and modern, in the engineering and architectural field.

The new bridge will form the closest connection which has ever been made between the two states, New York and New Jersey; it is not expected, however, that it will supercede the ferries now in use or the vehicular tunnel, but rather to supplement and aid them in bridging the gap between the two states and further affording an outlet for the metropolitan area. It will also afford a main auto highway connection between New England and New Jersey, Pennsylvania, and the south, that will avoid to a large extent the congested districts of New York and



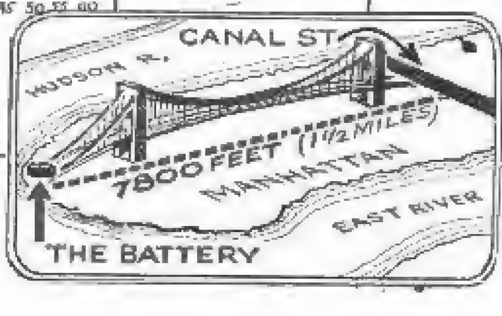
vicinity. Traffic coming along the Lincoln Highway from the south will pass around Newark by a route soon to be constructed and will cross the bridge to Manhattan far above the congested part of the island. The Washington Bridge across the Harlem River will connect the highway with the Bronx and the Boston Post Road. The new bridge will also open a large area of New Jersey as a suburban district for New York. Traffic surveys and estimates indicate that 8,000,000 private vehicles and nearly 500,000 buses will use the bridge in the first year after it is opened. By 1960 this traffic is expected to increase to 16,000,000 pleasure vehicles and 1,600,000 buses. The theoretical capacity of the roadways of the bridge is more than 30,000,000 vehicles a year, but it is assumed that before such a volume of traffic is attained, other Hudson River crossings will have been provided.

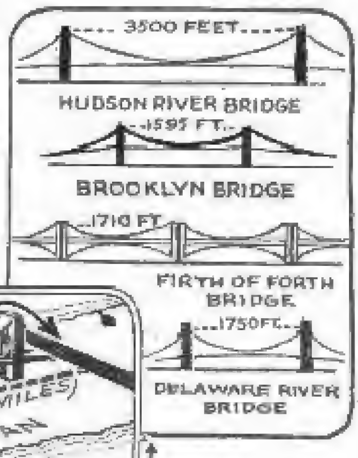
The task of stretching the cables will not be an easy one. The initial step will be the first continuous connection through the air. By use of boats and shore winches, wire ropes are strung across the river from tower to tower. These wire ropes then become the support of a temporary working platform called a "footwalk." Great single cables are the prevailing practice when parallel wires are used, and they are "spun" a wire at a time. Parallel wire cables sufficient to bear the weight of the Hudson River Bridge will have to be thicker than the average tree trunk. These wire cables will have a carrying strength of 330,000 tons each, as compared with 125,000 tons on the Delaware River Bridge, and 45,000 on the Brooklyn Bridge. In the "spinning process" two lengths of wire are looped around a pulley hanging from an overhead travelling rope. The travelling pulley carries the two wires from shore to shore. After being trued up the wires are securely anchored at each end. Beauty has been another factor to receive attention. Cass Gilbert the architect, has added grace to the huge structure which has been worked out by Othmar H. Ammann, the bridge engineer. The proposed design calls for striking utilization of the monumental character of the two towers and approaches.



An estimate of Hudson River traffic and the amount to be diverted to the new bridge is shown in the graph above.

The new bridge, which is to be one and one-half miles long, if placed upon the lower end of Manhattan Island, would reach from the Battery to Canal Street, approximately 7,800 feet, or one and one-half miles, as shown in the illustration below.





Above, the new bridge is compared with other famous bridge spans, which will be greatly outclassed.

The Metal Emperor

by A. Merritt

Author of "THE MOON POOL", "THE FACE IN THE ABYSS" etc.

FOURTH INSTALMENT

Synopsis

Dr. Louis Thornton is traveling through Tibet with his Chinese servant-cook, Chiu Ming and two ponies that carried the impedimenta. They came upon a white man who introduces himself as Richard Keene Drake. Drake's father had been very friendly with Thornton. The three decide to carry on and come upon Martin Ventnor, a geologist, and Ruth, his daughter. The latter are guarding themselves against hundreds of soldiers who belong to an age at least twenty centuries back. While escaping they are attacked and would have been exterminated, were it not for the timely intervention of Norhala, a tall, beautiful, metallic-haired woman, whose control over lightning and over heavy metallic blocks was phenomenal. These blocks, at her command, would make a bridge for her to walk on or form themselves into battling monsters to protect her or obey her every whim. Chiu-Ming is killed in the battle, the survivors leaving with Norhala. Ruth and Norhala get on one of the blocks. The others stand upon a second composed of four smaller ones joined together by their own peculiar super-normal power. The platforms speed through space at a terrific rate. Not entirely without adventure, the group finally arrive at a region of intolerable lite, Ruth still with Norhala—but not the same Ruth.

CHAPTER XII

"WITCH! GIVE BACK MY SISTER!"

HOW long we were within that glare I do not know; it seemed unending hours. It was, of course, only minutes—seconds, perhaps. I became aware of a permeating shadow, a darkness gentle and healing.

I raised my head. We were moving tranquilly, slowly—with a curious suggestion of homing leisureliness, through a soft, blue, shimmering darkness. There seemed to be a film over my sight, dazzlement from the unearthly blaze, I thought, shaking my head impatiently. My eyes focussed upon an object a little more than a foot away, and my neck grew rigid, my scalp prickled, while I stared, unbelieving.

That at which I stared was—a skeleton hand. Every bone grayish black, sharply silhouetted, clean as some master surgeon's specimen, it was extended as though clutching at—clutching at—what was that toward which it was reaching?

Again the prickling over scalp and skin—for its talons stretched out to grasp a steed that Death himself might have ridden, a rack whose bare skull hung drooping over bent vertebrae. I raised my hands to my eyes to shut out the ghastly sight. And swiftly the bony hand moved toward me, was before my eyes, touched me.

The involuntary cry wrested from me was strangled by swift realization.

The skeleton hand was my own. The mournful, ghastly mount of death was—our pony. And when I looked again I knew what I would see—and see them I did—two tall skeletons, skulls resting on their bony arms, leaning against the frame of the beast.

Ahead of us, floating poised upon the surface of a glistening cube, were two women skeletons—Ruth and Norhala.

It was the light about us that did it. A vibration within the partly explored region of the ultra-violet and the unexplored region above it; the home of the Roentgen ray and those other radiant phenomena akin to it. Yet there were differences, for there was none of the misty halo around the bones seen always with the X-rays, reminders of the flesh which even they cannot render wholly invisible. The skeletons stood out clean-cut, with no trace of fleshly vestments.

I crept over.

"Don't look up yet," I said. "Don't open your eyes. We're going through a queer light. It has an X-ray quality. You're going to see me as a skeleton—"

"What?" shouted Drake. Disobeying my warning, he straightened, glared at me. And disquieting as the spectacle had been before, fully understanding it as I did, I could not restrain the shudder that went through me at the strangeness of that skull which was his head thrusting itself toward me.

The skeleton that was Ventnor turned to me and was arrested by the sight of the flitting pair ahead. I saw the fleshless jaws clamp. They opened to speak.

Abruptly upon the skeletons in front of us the flesh came back. Girl and woman stood there once more robed in beauty. So swift was the transition that even to my matter-of-fact mind it smacked of necromancy. The next instant the three of us stood looking at each other, clothed once more in the flesh, and the pony was no longer the steed of death, but our shaggy-haired, patient little companion.

The light changed. The high violet had gone from it. It was shot with yellow gleamings like fugitive sunbeams. We were passing through a wide corridor that seemed to stretch unendingly. The yellow light grew stronger.

The corridor opened into a place for whose immensity I have no images.

Temple it was in solemn vastness, but unlike any temple ever raised by human toil. Within its silence brooded a spirit, unearthly and gigantic. In no ruin of earth youth had I ever sensed a shadow of the strangeness with which this was instinct. No—nor in the shattered fanes that once had held the gods of old Egypt, nor in the pillared shrines of Greece, nor of Rome.

All these had been dedicated to gods that,

whether created by humanity, as science believes, or creators of humanity, as their worshipers believed, still held in them that essence we term human. The spirit, the force, that filled this place had in it nothing of the human.

No place? Yes, there was one—Stonehenge. Within that mystic monolithic circle I had felt a something akin to this; an inhuman, a brooding spirit, stony, stark, unyielding—as though not men but a people of stone had raised the great Menhirs.

This was a temple built by a people of metal.

It was filled with a soft glow, like pale sunshine. Up from its floor arose hundreds of tremendous, square pillars, down whose polished sides the crocus light seemed to flow. So wide was the space between them that Notre Dame itself might have been placed within it—nor would its highest towers have reached their tops.

Far, far as the gaze could reach, the columns marched, oppressively ordered, oppressively mathematical. And from this massiveness distilled an aura mysterious, mechanical, yet living; something priestly, hierophantic—as though they were guardians of a shrine.

High up among the pillars floated scores of orbs, pale-gilt frozen suns. Great and small, through all the upper levels these strange luminaries gleamed, fixed and motionless, hanging unsupported in space. Out from their shining spherical surfaces darted rays of the same pale gold, rigid, unshifting, with that same suggestion of frozen stillness.

". . . The floating figures of Norhala and Ruth had drawn close to the disc . . . Ventnor broke into a run, holding his rifle at the alert . . . For Norhala had soared up toward the flaming rose of the disc . . . and past her floated Ruth . . ."

Slowly, now, we were gliding through the forest of pillars. So effortless, so smooth our flight that we seemed to be standing still, the tremendous columns flitting past us, turning and wheeling around us, dizzyingly. My head swam with the mirage motion, I closed my eyes.

"Look!" Drake was shaking me. "Look!"

Half a mile ahead the pillars stopped at the edge of a quivering curtain of green luminescence. High up past the pale gilt suns its smooth folds ran, into the golden amber mist that canopied the columns. In its sparkling was more than hint of the dancing corpuscles of the aurora. And all about it played shifting, tremulous shadows formed by the merging of the aureate light with the curtain's emerald gleaming.

Up to its base swept the cube that bore Ruth and Norhala and stopped. From it leaped the woman, drew Ruth down beside her, and turned and gestured toward us. That upon which we rode drew close. I felt it shudder beneath me, felt, on the instant, the magnetic grip drop from me, angle downward and leave me free. Shakily, I arose from aching knees. Ventnor flashed down and ran, rifle in hand, to his sister.

Drake stooped for his fallen gun. I moved unsteadily toward the side of the clustered cubes. There came a curious, pushing motion, driving me to the edge. Sliding over upon me came Drake and the pony. The cube tilted, gently, playfully—and with the slightest of jars, the three of us stood beside it on the floor, the little beast stretching its legs, lifting its feet and whinnying.

The four blocks that had been our steed broke from each other. That which had been the women's glided to them. The four clicked into place behind it and darted from sight.

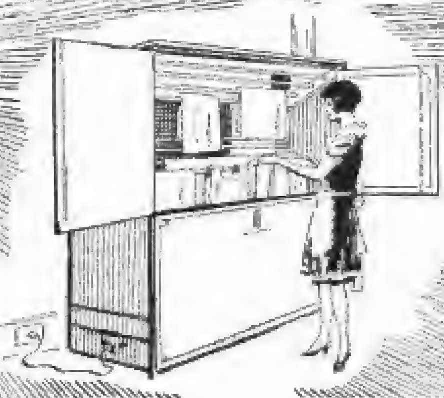
"Ruth!" Ventnor's voice was vibrant with his fear. "Ruth! What has she done to you?"

We ran to his side. He stood clutching her hands, searching her wide, unseeing, dream-filled eyes. Upon her face had deepened the calm and stillness that were mirrored reflections of Norhala's unearthly tranquility.

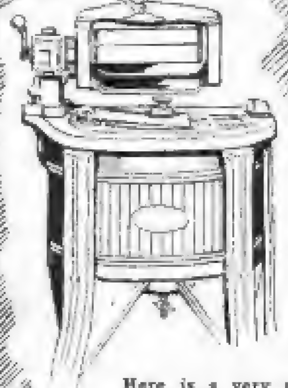
(Continued on page 840)

ELECTRICAL SHOW

The above shows how the new electrical saw is used. With its aid one man can accomplish the work of five.

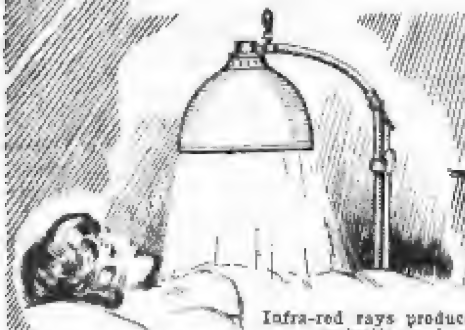


No more need the modern housewife hang her clothes on the line and wait for the sun to shine and the wind to blow. Here is an electrically-heated clothes-drier.



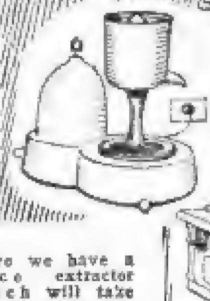
Here is a very reasonably priced combination washer and wringer. Either can be worked independently of the other, if desired.

One of the lightest washing machines is indicated above. This fits into any tub and will handle three sheets or the equivalent.

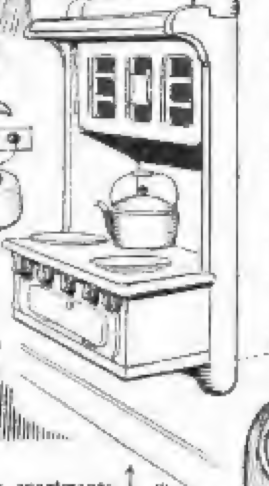


Infra-red rays produce a penetrating heat which will not burn the tissues. This is for medical treatments.

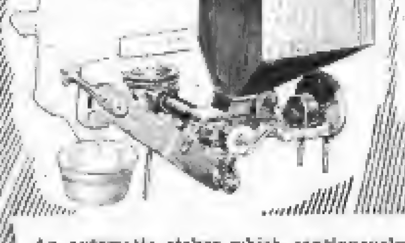
The motor shown above will do everything from slicing potatoes to kneading dough for bread. An attachment will even clean your silverware.



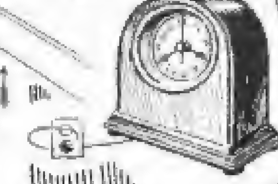
Above we have a juice extractor which will take care of citrous fruits. It is electrically operated.



For the modern apartments, we find the new styles of electrical stoves exhibited at the Electrical Show which set into the wall.



An automatic stoker which continuously feeds the fire and removes the ashes. It can be thermostatically controlled.



An electric clock for alternating current circuits is indicated at the left. This, when once set, remains accurate to the second.

IN NEW YORK—

The newest types of lamp shades are made of celluloid, artistically decorated and opalescent in their texture.

This motor-driven washer washes clothes in your tub by the vacuum cup principle. It can also be used with various attachments for sharpening knives, operating cream whippers, etc.

A floor polisher, waxer or scrubber, motor-driven, is indicated here. When in operation, it can be guided with one finger.

Here is an automatic percolater with a thermostatic arrangement in the base, making overheating impossible. A button re-sets the thermostat.

The sun ray treatment is not left for hospitals alone. Here is an ultra-violet lamp for home use.

A Christmas tree holder with lights at its base, outlets for tree lights, and a well for water is shown above.

Here is a washing machine with a whirling drier, all portions of which are heavily coated with enamel. The drier has no holes.

ONE can always expect to find something new and novel in the electrical field at the yearly Electrical Show held in Grand Central Palace, New York, and on these pages we show only a few of the high-lights of the countless numbers of electrical articles which impressed thousands of visitors who daily surged through this monster exhibition palace.

Unfortunately, in this small space we can say but a few words concerning each of the various items.

For instance, there is a handy electric saw which can be used in many different ways. The saw is of the rotary type, driven by an electric motor. It can be used for breaking up wooden concrete forms, making shelving, sawing out boards, notching rafters, mitering, cutting out pockets and many other purposes. It is attachable to the ordinary socket and can be used wherever wood is to be cut, whether at plants, factories, hotels, machine shops or lumber camps. The physical exertion is entirely absent with an article of this nature, and one man can do the work of five men ordinarily. Well balanced and guarded, with an adjustable cut, the tool presents a very satisfactory product.

A little further on in the exhibition palace we come upon a new washing machine, very reasonable in price. This machine has a corrugated disk in the top, made of aluminum, which forces hot suds through the clothes 120 times every minute. The tub is made of copper, nickel lined, and so is easy to keep clean. The wringer connected with the motor can be operated independently of the washing machine, or both may be operated together. The outstanding feature of this article is its simplicity and its moderate cost.

We have but to turn around and we find another exhibit in the form of a lamp producing an intense penetrative heat. This lamp produces an abundance of infra-red rays and is employed medically in the treatment of pains resulting from inflammations or bacterial invasion. While producing intense heat, there is little danger of a burn. It is claimed that the lamp gives excellent results in the treatment of rheumatism, congestions, colds, and wherever heat is desired.

Many of us have coal furnaces and would like to convert these furnaces into automatic systems. The present age seems to be gradually turning to the employment of things entirely automatic in their action. For those who prefer to keep their coal-fired furnaces, there is an automatic stoker which can be attached to any furnace or boiler, and it will feed buckwheat or rice coal to the fire-pit and insure its proper combustion. This stoker is fitted with a blower, which supplies the air for the proper combustion of the coal, and also has a continuous worm feed for the coal, coupled to a thermostat. The coal placed in the hopper is gradually fed into the furnace at a rate depending upon the desired temperature. As it burns and turns to ash, another continuous worm conveys the ashes out from the fire-pot to the receiving hopper. The only attention which a furnace of this nature requires is the filling of the hopper with coal and the removal of an ash-can occasionally.

Turning our attention for a moment to articles for kitchen use, we find a new style of electric stove which should be ideal for modern small apartments. This is a three-burner type electric range, which fits right into the wall, thus saving space. Each stove is properly ventilated so as to carry off cooking odors and inasmuch as there are no legs, there is no difficulty in sweeping or mopping under it.

For the same kitchen there is an interesting electric range and lemon juice extractor with a whirling spinner run much the same as those used at large soda fountains. The article is easily cleanable.

The housewife who finds that she must prepare meals for a rather large family can see the advantages in a food mixer, meat chopper and general all-around utility motor, which will do everything from peeling potatoes to mixing dough.

Then there is an electric clock which keeps absolutely accurate time. It is connected directly to the 110-volt source of supply and consumes but two watts of energy. Nevertheless, in most cities (depending of course on the source of current supply), this clock continues to accurately check off the hours, correct to the second.

For the home laundry, a clothes drier that will dry the clothes electrically in less than an hour, will be found on exhibition. By its aid, it does not make any difference whether the wind is blowing or whether it is raining, the clothes dry just the same and dustlessly, without the possibility of tearing. This consists of an electrical heating coil in the bottom of a large cabinet, arranged for the free circulation of air with suitable racks upon which the clothes are suspended.

There are, of course, many washing machines of different types. Each individual owner likes his own kind of a machine, but one of the midgets in size that does remarkable work is a motor-driven turbine wheel set right into any wash tub. This sucks in the water through a large number of holes and then ejects it forcibly, causing the water to circulate in and about the clothes and agitating the clothes quite vio-

(*Continued on page 869*)

Feb.

BROADCAST WRNY STATION

25 Cents

Science and Invention

MOTOR WHIP FOR ICE SKATERS

See Page 886

EXPERIMENTER PUBLISHING COMPANY, NEW YORK, PUBLISHERS OF
RADIO NEWS - RADIO LISTENERS' GUIDE - FRENCH HUMOR - AMAZING STORIES

Motor-Whip *for* Ice Skaters

By HUGO GERNSBACK

The motor—whip is here seen in action on an ice-covered pond. A brand new sport.

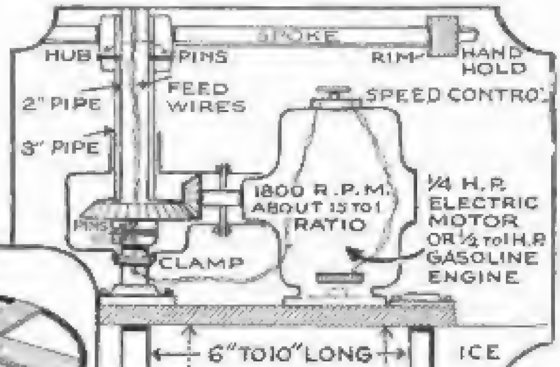
ICE skaters are constantly looking for new pleasure, and any new ice sport that comes along, is usually greeted with enthusiasm. Some years ago, I constructed a simple apparatus which I termed the *Motor-Whip*, and which was used with excellent results on a small lake, in the country. The idea is very simple, and consists in a few words, of a large wagon wheel attached to a small fractional horsepower electric motor. The wagon wheel has ordinary handles, attached at its circumference, as shown in the illustration. The wheel revolves at a fair speed, not too great to make the sport dangerous; say about two revolutions per second or 120 revolutions per minute. The skater comes along, grabs one of the handles and whirls around, one complete turn. At a predetermined point, he releases his hand hold, and the motion imparted to him by the wheel, shoots him off at a tangent. The game is supposed to be played in such a fashion, that the skater is not allowed to move his feet to assist the propulsion speed which he has obtained from the wheel.

Naturally, the distance traversed by the skater is determined by a number of factors, such as sharpness of skates, weight of the skater, wind resistance, skill in skating, that is keeping both feet strictly parallel, and other minor points.

The sport, however, does not consist of this one method alone, but a number of games have been evolved by me, and which are also shown in the illustration. For instance, in figure 1, a double whip is shown, where two skaters are flung out. Thus, the contest can be staged between couples, seeing which one goes out the furthest; the one going the furthest, naturally getting credited with the highest amount of points.

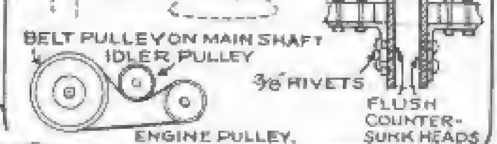
In Figure 2, another simple arrangement is shown, where a marker, with a flag, is stationed on the ice. The skater's problem is to round that marker one full turn, and then it is up to him to see how much further he can go on towards the goal as shown.

It should be understood, that this entire sport revolves about the fact, that a skater at no time must move either his feet or legs to actually propel himself. The feet are not to be lifted from the ice and must be held close together, parallel. Referring again to figure 2, it will be seen that a good deal of skill

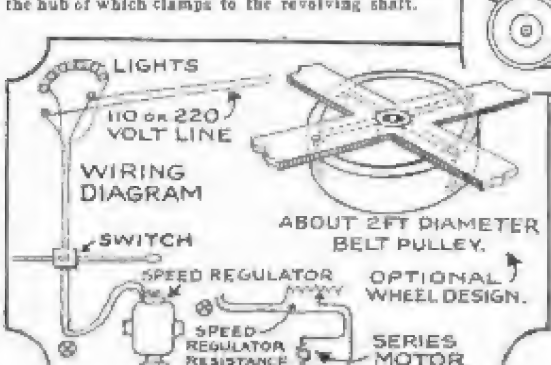


Sectional view through motor-whip showing spur-gear drive from electric motor. The gear teeth ratio may be about 15 to 1.

Wiring diagrams for the motor, as well as the lights atop the pole, are shown below; together with an optional design of home-made wheel. In this design of wheel, two by six-inch planks are mortised at the center, and bolted to a standard machine belt pulley, the hub of which clamps to the revolving shaft.



Two other designs of home-made wheels for the motor-whip are shown above, together with several hints for various belt drives.



Here is a view of the stage of the new Hammerstein Theatre in New York. The organ in this theatre is beneath the stage. The structure is pure Gothic in design.

Storm, with the Entire Stage Flooded with Rain in One Moment and Entirely Dry the Next, Makes the Presentation of "Golden Dawn" Wonderfully Spectacular

By JOSEPH H. KRAUS

IN the new Hammerstein Theatre, recently opened in New York City, we find many architectural wonders, unique in theatre design. The auditorium itself is of pure Gothic design. Beautiful leaded glass panels emblazon the wall. Suspended from the center of the dome-like ceiling, there is an immense Gothic lamp of quite unusual design. The windows themselves are illuminated from behind and most of the lighting effects in the entire theatre are either indirect or semi-indirect. Instead of the organ pipes being arrayed on either side of the proscenium opening, the organ is found in a large sound-proof room immediately beneath the stage. The organ music issues through baffle-controlled openings to the auditorium.

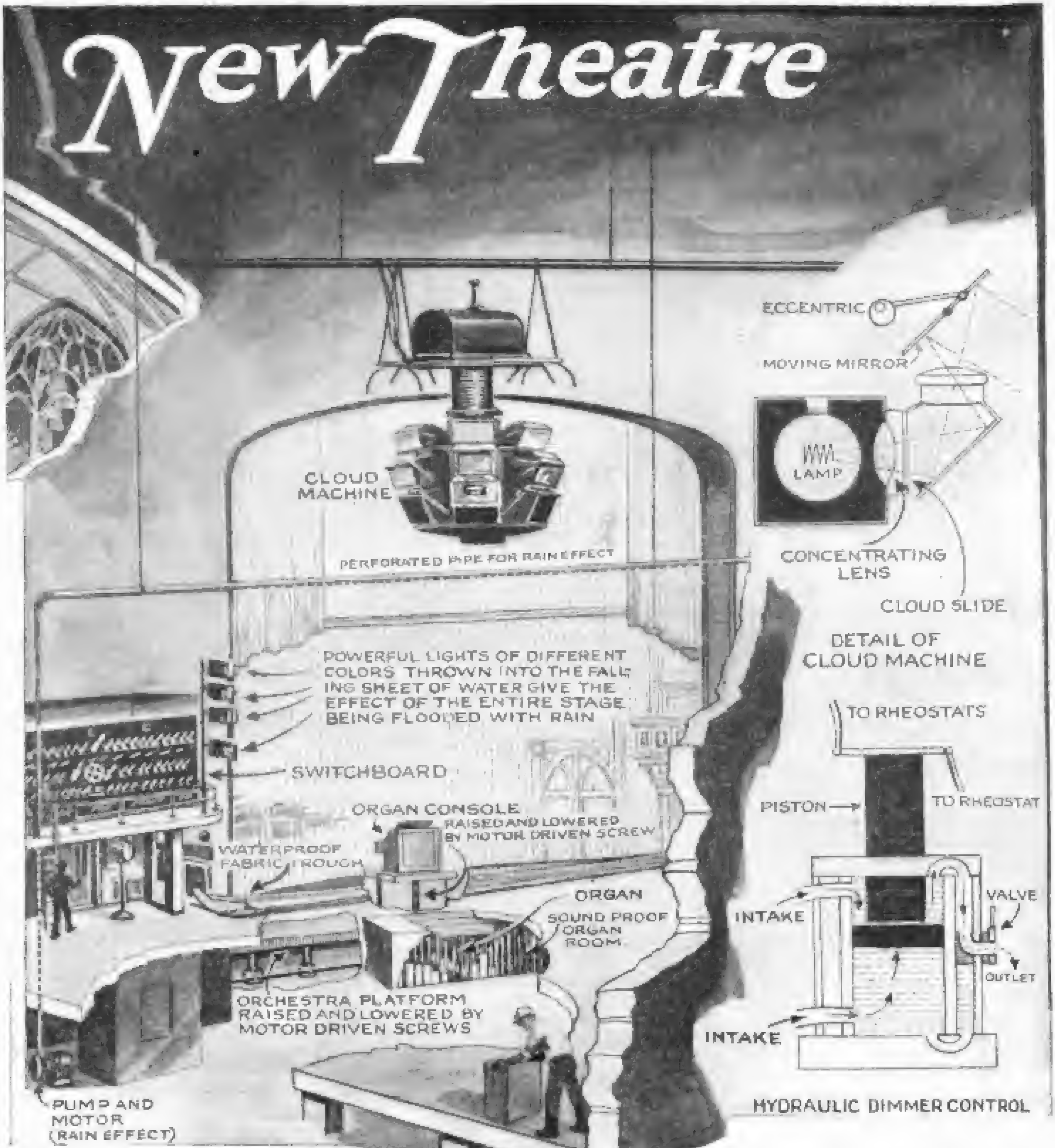
The largest pipe in this organ is 16 feet long. The room itself is immense, yet filled with pipes in such a fashion that one wonders how it is possible for a man to move in and out among them, when changing or tuning them properly. Even the cathedral gongs are confined in this sound-proof room beneath the stage, which is provided with baffles, so that the volume can be controlled at the will of the organist. The console itself is on a special platform which can be raised or lowered by a motor-driven screw; thus the operator at the console can bring himself into view or can gradually descend beneath the stage-floor level. A second control will be found on the switchboard to one side and a little above the stage-floor level.

ORCHESTRA APPEARS ON RISING PLATFORM

The same feature is applicable to the orchestra because the entire orchestra platform can be raised and lowered by motor-driven screws. The electric motor is coupled to a shaft at one end, and it communicates the power through a worm operating a series of screws located under the platform. In this way the orchestra can be made to rise fully into view, or to disappear from sight, and even leave their position in the pit without anyone knowing it.

THE MARVELOUS ELECTRIC SWITCHBOARD

A word or two now concerning the switchboard for which Mr. Dolan, Mr. Hammerstein's electrician is largely responsible. While this is quite a large affair, it is much smaller than those found in theatres of the same size. Here we see merely a series of handles, interspersed with a few pilot lights, and a single master control wheel. These handles are so arranged that they can be twisted to the right or left, engaging in a slotted disk. Ordinarily such switches are manipulated by hand, or operated by rapidly turning a large screw which communicates the motion to all of the switches arranged in tandem but not so at this new theatre. Here we find a hydraulic control dimmer. This is so arranged that it operates all of the rheostats by moving a piston approximately eight inches in diameter up or down. The diagram for the dimmer control is briefly indicated in the insert on these pages. It will be found that when the valve is turned as illustrated, that the piston will have a tendency to move upward if water is let in through the bottom opening. This movement can be so controlled that the lights do not completely dim for several hours, or can be made so rapid that the effect is practically like a flash. At the same time that one of the groups of lights are being gradually dimmed, another group can be made to light up thus producing a perfect dissolve. It is



really uncanny to watch this switch board fairly operate itself.

THE CLOUD PRODUCER

Depending from the grid we find a most unique cloud machine used in one of the scenes in the "Golden Dawn," now playing at the theatre. The "Golden Dawn" is a musical drama of intense appeal. In one of the scenes, a storm is required and here is one place where we have it. Lightning, thunder and rain, torrents of it—it seems as though the whole stage is flooded. The clouds roll from one end of the horizon to the other, and then roll back again. They are absolutely true to nature, and yet far more perfect than they could ever be obtained with a motion picture machine.

The cloud machine consists of a large multiple lens multiple mirror projector, rotating about a center point, the rotation being controlled by a motor. For each lens we find an oscillating mirror which can be controlled from the switchboard to operate slowly or very rapidly. It is these oscillating mirrors which cause the clouds to roll about violently. The housing contains a three thousand watt special incandescent bulb, the light of which after passing through a condensing lens, passes through a slide which is an actual photograph of cloud formation. The slide itself is only one of the series, the entire group being mounted in the ring of projectors. Between the incandescent bulb and the lenses, a vignette of tin is employed which cuts down the possible cloud projections on the building, trees, and other scenery, and limits the projection of clouds to the sky portion of the horizon. The lightning and rumble of thunder are produced in the well know stage-time methods.

REMARKABLE RAIN EFFECT

In order to produce the effect of the storm, a perforated pipe is mounted in back of the proscenium opening. This is supplied with water under pressure and the water is caught in a water-proof fabric trough made to represent the foreground of the scene. This trough is raised at both ends and does not communicate with any drain or other disposal method. Now when it comes time for the storm, and the sky darkens, and after we hear the distant rumbling of thunder, we see a down-pour, the like of which has probably never been duplicated on any New York stage. It appears as if the entire stage from the footlights to the back wall were flooded, yet when the curtain rises again, the water has miraculously disappeared and strange to say, the artists costumes are all dry. The illusion of depth to the effect is obtained by proper lighting.

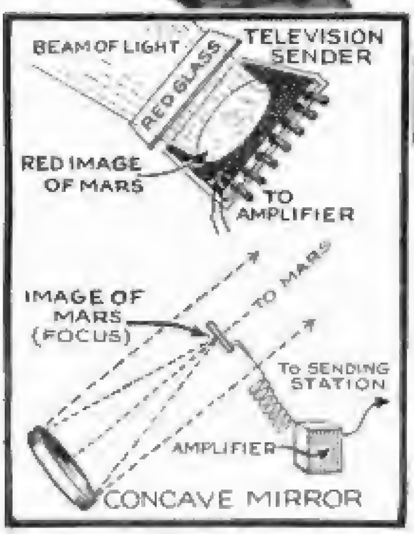
Television May Solve Star Secrets

Color Images of Planets Can Be Broadcast from Observatories and Flashed on Screen at Distant Point

By DONALD H. MENZEL, Ph.D
Lick Observatory

In the upper portion of the drawing, we see the observatory with its battery of telescopes which transmit the television images. These images will be explained by radio messages sent out from the observatory.

The above drawing shows the receiving station and the color projector, which throws the actual image upon the screen.



The details of the telescope and television transmitter are shown in the above illustration.

SOME time ago, it was remarked that the extreme sensitivity and amplifying powers of the vacuum tube would find an application in astronomy. With the advent of practical television looming not so far off in the distance, this possibility is rapidly increasing. The device pictured here will probably be developed soon, and within the space of a few years may be in actual use.

The advantage of the telescope over the eye lies in the greater amount of light it collects. An image of the object observed is formed in the focus of the lens or concave mirror. This is magnified by an ordinary lens placed just back of the focal point, the magnification being controlled by the size of the lens. While it is possible theoretically to obtain any desired magnifying power, the practical limitation is imposed by the fact that too high powers make so faint an image that they cannot be seen. Television will make it possible to receive the image upon the sensitive cell of the sending apparatus, amplify the impulses and magnify them greatly upon reception, thus permitting a more comfortable, detailed study of the object. It is even possible that a battery of telescopes, trained on the same body, may be utilized. If red, yellow, and blue filters, respectively, be placed in front of the image in three telescopes, thus forming colored views of the planet or stars under consideration, then the three separate pictures can be combined into one in the receiving set. The single image, resulting from superposition of three, will present the object in practically its natural colors; in fact, the principle involved is quite well known and is employed as the basis of three-color printing. It is not too much to hope for the future broadcasting of an illustrated astronomical lecture directly from the telescope, thus bringing the inaccessible observatory from its mountain top, far from civilization, into the home or lecture room of the city. The illustration here shows the observatory of the future, with its triple telescopic battery pointed at Mars. The tricolor images, together with a description, are broadcast from the observatory.

The Flying Piano

Latest Stage Novelty Mystifies New York Audience

By H. WINFIELD SECOR

IN the flying piano act, the instrument was suspended from each corner by 3/8-inch steel cables which passed through eye-bolts fastened to the case. The four cables eventually came together in a 1/2-inch steel cable, which was led through the gridiron above the stage, over several pulleys and thence back-stage to a motor winch. This winch wound in or let out the cable, thus regulating the movements of the piano. These movements were further controlled from the fly gallery by a stage hand, who regulated two cables attached to the supporting cables as shown. The stage orchestra was situated upon a moving platform, which further added to the novelty of the performance. A dark back drop was used and all the stage lights, as well as most of the lights in the theatre, were put out. A bank of powerful lights were then directed toward the audience. All these various so-called *stage tricks* prevented the audience from determining just how the piano floated in mid-air, and thus made the act mystifying as well as entertaining. Several small shielded lights were placed above the keyboard of the piano, so that the musician could see the keys clearly. This is one of the most successful means of producing a flying or floating effect, but several others have been used previous to this occasion. The following method was used in theatres some years ago, in connection with an aerial singing act. The singer was seated upon the end of a steel boom, supported by a steel cable which passed through a pulley and thence back-stage. A black velvet drop was used and the steel boom passed through this so that its movements could be regulated by the stage hands. The velvet back drop was slit in the center, allowing for the insertion of the boom. A spotlight was thrown directly upon the singer. A counterweight could also be employed, and in some cases was fastened to

(Continued on page 933)

NEW YORK'S latest stage sensation was recently exhibited at a well-known theatre. The audience was astounded when a piano gently rose from the stage and sailed into mid-air, as gracefully as some huge white bird. During the flying episode a young woman rendered various piano selections. This may seem a strange and thrilling feat when viewed from the audience, but if one goes back-stage as our artist did, this seemingly impossible act is readily explained as shown in the illustration. By the skillful arrangement of the lights the steel cables supporting the piano could not be discerned and did not contrast with the dark back drop which was used. Powerful lights were directed toward the audience and the remainder of the theatre was plunged in almost total darkness. Another novelty used in conjunction with this remarkable act was the moving platform upon which the stage orchestra was seated. During the act the footlights were extinguished and a bank of small shielded lamps, which were placed above the keyboard of the piano, were lighted.

The Illustration above shows the method of obtaining a flying effect as used in some theatres.

The Metal EMPEROR

by A. Merritt

Author of "THE MOON POOL", "THE FACE IN THE ABYSS" etc.

CHAPTER XV.

"FREE! BUT A MONSTER!" (Fifth Installment)

THE peculiar ability of the human mind to slip so readily into the refuge of the commonplace after or even during some well-nigh intolerable crisis has long been to me one of the most interesting phenomena of our psychology. It is instinctive, of course; a habit acquired through precisely the same causes that have given to the animals their protective coloration—the stripes, say, of the zebra and tiger that blend so cunningly with the barred and speckled shadowings of bush and jungle, the twig and leaflike shapes and hues of certain insects; in fact, all that natural camouflage which was the basis of the art of concealment so astonishingly developed in the late war.

Like the animals of the wild, the mind of man moves through a jungle—the jungle of life, passing along paths beaten out by the thought of his countless forefathers in their progress from birth to death. And these paths are bordered and screened, figuratively and literally, with bush and trees of his own selection, setting out and cultivation—shelters of the familiar, the habitual, the customary. On these ancestral paths, within these barriers of usage, man moves hidden and secure as the animals in their haunts—or so he thinks.

Outside them lie the wildernesses and the gardens of the unknown, and man's little trails are but rabbit runs in an illimitable forest. But they are home to him.

Therefore it is that he scurries from some open place or revelation, some storm of emotion, some strength-testing struggle, back into the shelter of the obvious, finding in it a familiar environment that demands no slightest expenditure of mental energy or initiative, and gaining fresh strength to sally forth again into the unfamiliar.

I crave pardon for this digression. I set it down because I remember how when Drake at last broke the silence that had closed in upon the passing of that still, small voice the essence of these thoughts occurred to me.

Determinedly he strode over to the weeping girl, and in his tones was a roughness that angered me until I realized his purpose.

"Get up, Ruth!" he ordered. "He's come back once, so he'll come back again. Now let him be and help us get a meal together. I'm hungry."

She looked up at him, incredulously, indignation rising.

"Eat!" she exclaimed. "You can be hungry!"

"You bet I can—and I am," he answered cheerfully. "Come on; we've got to make the best of it."

"Ruth," I broke in, gently, "we'll all have to think about ourselves a little if we're to be of any use to him. You must eat—and then rest."

"No use crying in the milk even if it's spilt," observed Drake, even more cheerfully. "I learned that at the front where we got so we'd yelp for the food even when the lads who'd been bringing it were all mixed up in it."

She lifted Ventnor's head from her lap and rested it on the silks. She arose, eyes wrathful, her hands clenched as though to strike Drake.

"Oh—you brute!" she whispered. "And I thought—I thought—Oh, I hate you!"

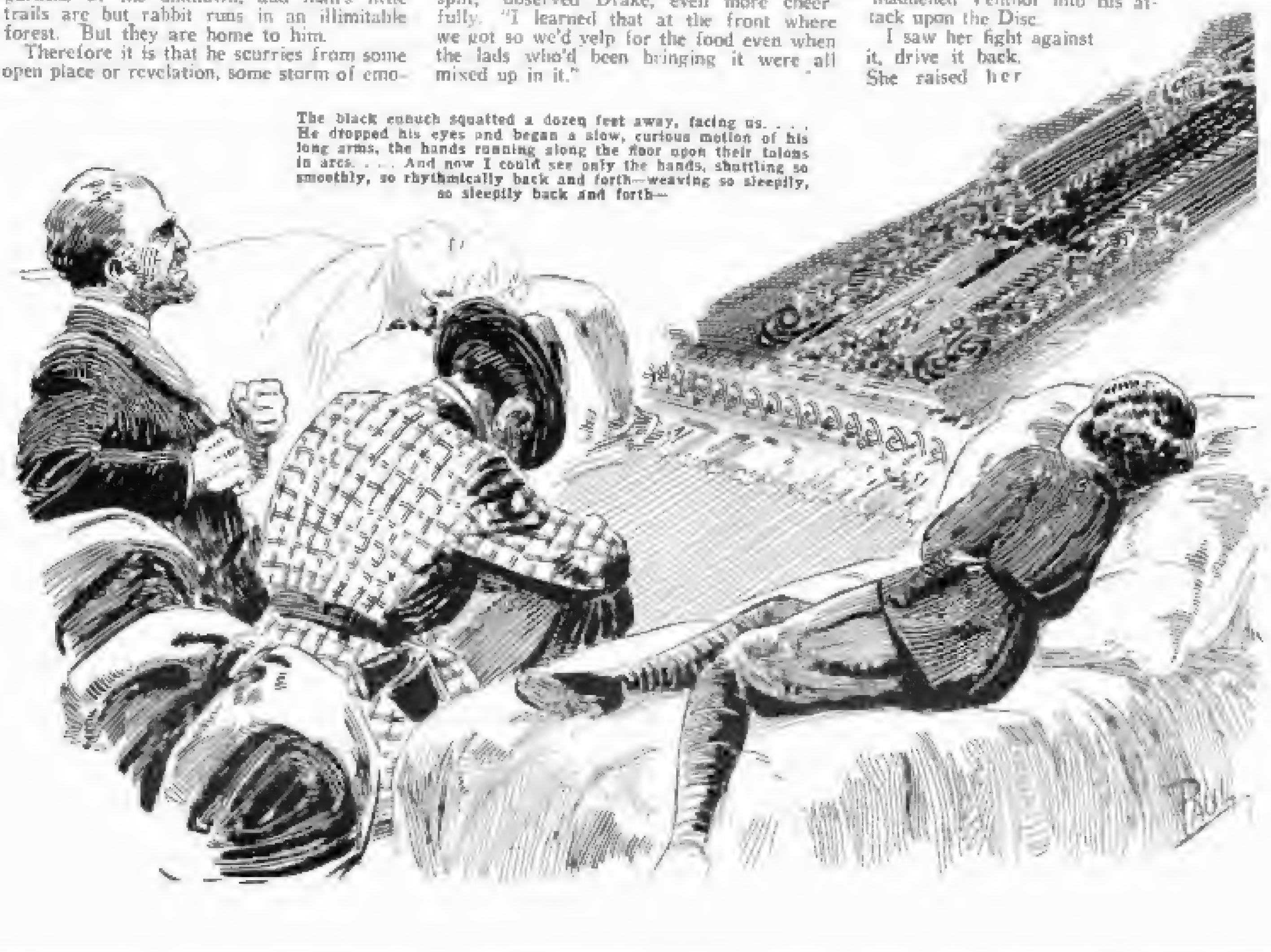
"That's better," said Drake, and smiled upon her. "Go ahead and hit me if you want. The madder you get, the better you'll feel."

For a moment I thought she was going to take him at his word, then her anger fled.

"Thanks—Dick," she said quietly; and while I sat studying Ventnor, they put together a meal from the stores, brewed tea over the spirit-lamp with water from the bubbling spring, and in these commonplaces I knew that she at least was finding relief from that strain of the abnormal under which we had labored so long. To my surprise I found that I was hungry, and with deep relief I watched Ruth partake of food and drink even though lightly.

About her seemed to hover something of the ethereal, elusive and disquieting. Was it the pellucid light that gave the effect, I wondered. And knew it was not; for as I observed her, covertly, I recognized upon her face that shadow of inhuman tranquility, of unearthly withdrawal which, I guessed, had more than anything else maddened Ventnor into his attack upon the Disc.

I saw her fight against it, drive it back. She raised her



The black eunuch squatted a dozen feet away, facing us. . . . He dropped his eyes and began a slow, curious motion of his long arms, the hands running along the floor upon their talons in arcs. . . . And now I could see only the hands, shuttling so smoothly, so rhythmically back and forth—weaving so sleepily, so sleepily back and forth—

head, and met my gaze. In her eyes I read both terror and shame. It came to me that, painful as it might be for her, the time for questioning had come.

"Ruth," I said, "I know it's not necessary to remind you that we're in a tight place. Every fact and every scrap of knowledge that we can lay hold of is of the utmost importance in enabling us to determine our course. I'm going to repeat your brother's question—what did Norhala do to you? What happened to you when you were floating before the disc?"

"There was nothing," she whispered—then defiantly—"nothing! I don't know what you mean!"

"Ruth!" I spoke sharply now. "You do know. You must tell us—if not for our sake, then for his." And I pointed toward Ventnor.

She drew a long breath.

"You're right—of course," she said, unsteadily. "Only I—I thought maybe I could fight it out myself. But you must know—there's a—a taint upon me!"

"A taint!" I cried, and caught in Drake's swift glance the echo of my own thrill of apprehension for her sanity.

"Yes," she said, quietly. "A taint. Some new and alien thing within my heart, my brain, my soul. Something that first came to me from Norhala when we rode the flying block together, and that—it—sealed upon me when I was in—It's . . ." she crimsoned, and whispered—"embrace." A thing that urges me to forget you two—and Martin—and all the world I've known; that tries to pull me from you—from all—to drift untroubled in some vast calm filled with an ordered ecstasy of peace. And whose calling I want, God help me, oh, so desperately to heed!

"It whispered to me first," she went on, breathlessly, "from Norhala—when she put her arm around me. It whispered, and then it seemed to float from her and cover me like—like a substance, and from head to foot. It was a quietness and peace that held within it a happiness and at one and the same time utterly tranquil and utterly lawless.

"I seemed to be at the threshold of unknown raptures—and the life I had known only a dream—and you, all of you—even Martin, dreams within a dream. You weren't—real—and you did not—matter."

"Hypnotism," muttered Drake, as she paused.

"No." She had heard him and shook her head. "No, more than that. The wonder of it grew—and grew. I thrilled with it. I remembered nothing of that ride, except once when, through the peace enfolding me, there pierced a warning that Martin was in peril, and I broke through to see him clutching Norhala and to see floating up in her eyes—death—for him.

"And I saved him—and again I forgot. Then, when I saw that flaming shape—I felt no terror, no fear—only a tremendous—joyous—anticipation, as though—as though—" she faltered, hung her head, then leaving that sentence unfinished, whispered: "And when—it lifted me it was as though I had come at last out of some endless black ocean of despair into the full sun of Paradise!"

"Ruth!" At the shocked wonder in Drake's cry I saw her wince.

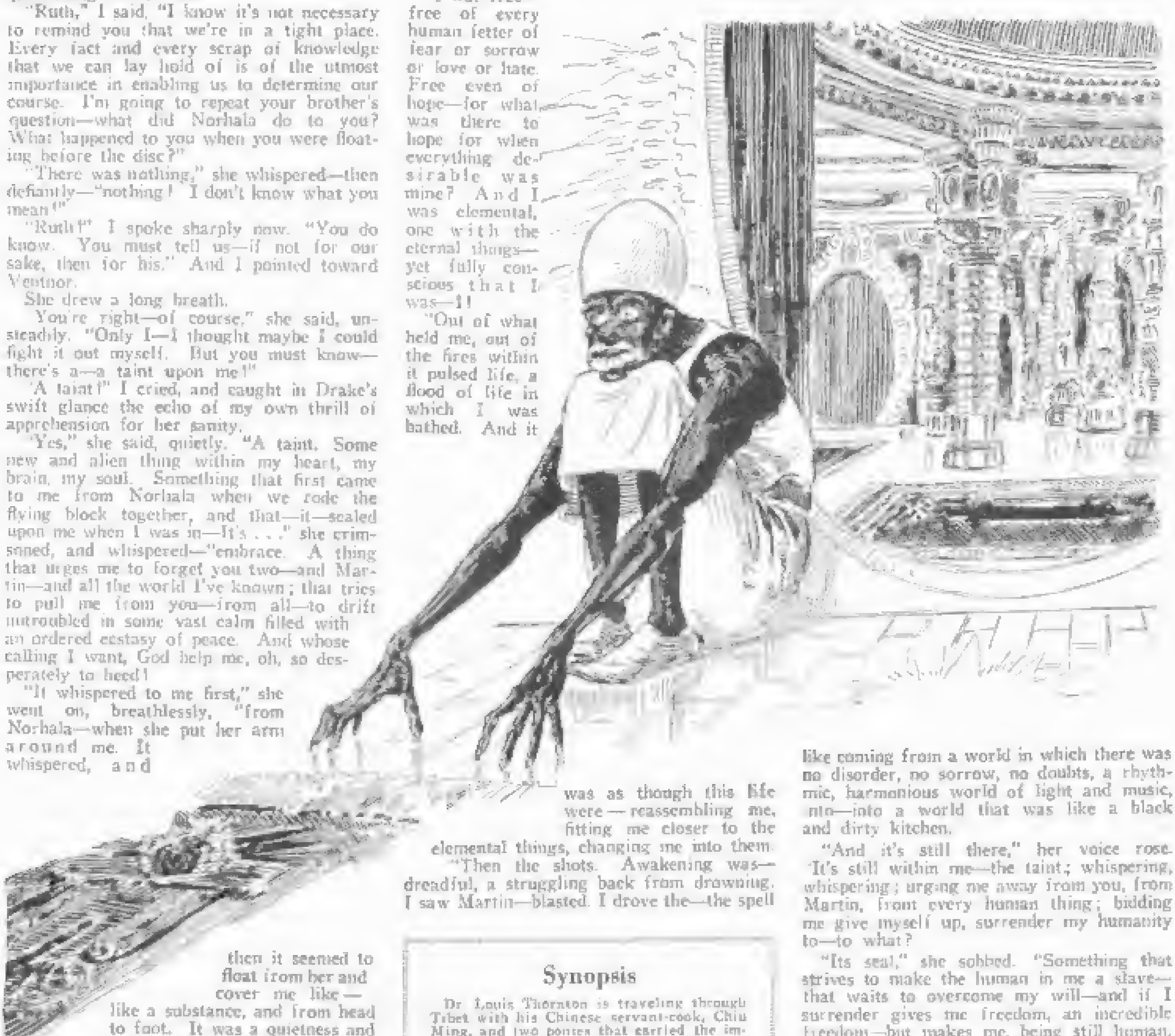
"Wait," she held up a tremulous hand. "You asked—and—you must listen."

When once more she spoke her voice was low, curiously rhythmic, her eyes rapt.

"I was free—free of every human fetter of fear or sorrow or love or hate. Free even of hope—for what was there to hope for when everything desirable was mine? And I was elemental, one with the eternal things—yet fully conscious that I was—I!

"Out of what held me, out of the fires within it pulsed life, a flood of life in which I was bathed. And it was as though this life were—reassembling me, fitting me closer to the elemental things, changing me into them.

"Then the shots. Awakening was—dreadful, a struggling back from drowning. I saw Martin—blasted. I drove the—the spell away from me. I tore it away. And, O Louis—Dick—it hurt—it hurt—and for a breath before I ran to him it was like—like coming from a world in which there was no disorder, no sorrow, no doubts, a rhythmic, harmonious world of light and music, into—into a world that was like a black and dirty kitchen.



"And it's still there," her voice rose. "It's still within me—the taint; whispering, whispering; urging me away from you, from Martin, from every human thing; bidding me give myself up, surrender my humanity to—to what?

"Its seal," she sobbed. "Something that strives to make the human in me a slave—that waits to overcome my will—and if I surrender gives me freedom, an incredible freedom—but makes me, being still human, a—monster!"

She hid her face in her hands.

"If I could only sleep," she wailed. "But I'm afraid to sleep. I think I shall never sleep again. For how do I know that if I sleep—it—may not conquer me?"

I caught Drake's eye. He nodded, understanding fully my unspoken question. I slipped my hand down into the medicine case, and brought forth a certain potent and tasteless combination of drugs which I carry invariably upon explorations.

I dropped a little into her cup, and then held it to her lips. Like a child, unthinking, she obeyed the suggestion and drank.

"But I'll not surrender!" Her eyes were tragic. "Never think it! I can win—don't you know I can?"

"Win?" Drake dropped down beside her, drew her toward him. "Of course you'll win. Nine-tenths of what you're thinking now is purely overwrought nerves and weariness. You'll win—and we'll win, never doubt it."

"I don't," she said. "I know it— It will be hard—but I will—I will—win—"

Her eyes closed, her body relaxed. The potion had done its work quickly. We laid her beside Ventnor on the pile of silken

(Continued on page 937)

Synopsis

Dr. Louis Thornton is traveling through Tibet with his Chinese servant-cook, Chiu Ming, and two ponies that carried the impedimenta. They come upon a white man who introduces himself as Richard Keene Drake. Drake's father had been very friendly with Thornton. The three decide to carry on and come upon Martin Ventnor, a geologist, and Ruth, his daughter. The latter are guarding themselves against hundreds of soldiers who belong to an age at least twenty centuries back. While escaping they are attacked and would have been exterminated were it not for the timely intervention of Norhala, a tall, beautiful, metallic-haired woman, whose control over lightning and over heavy metallic blocks was phenomenal. These blocks, at her command, would make a bridge for her to walk on or form themselves into battling monsters to protect her or obey her every whim. Chiu Ming is killed in the battle, the survivors leaving with Norhala. Ruth and Norhala get on one of the blocks. The others stand upon a second composed of four smaller ones joined together by their own peculiar super-normal power. The platforms speed through space at a terrific rate, arriving eventually in the court of the Metal Emperor. Angered by the influence of Norhala over Ruth, Ventnor raises his rifle and fires at the red ruby-like object he believes to be the brain of the metal monster. He is struck down by a lance of green flame and rendered unconscious. The metal monster gives Norhala the entire company to serve as her toys. She takes them to her home, where she informs Yuruk, her ape-like eunuch attendant, they are not to be harmed. Ventnor talks, then lapses into unconsciousness again. Now go on with the story.

March

BROADCAST WRNY STATION

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Science and Invention

SEE PAGE 982

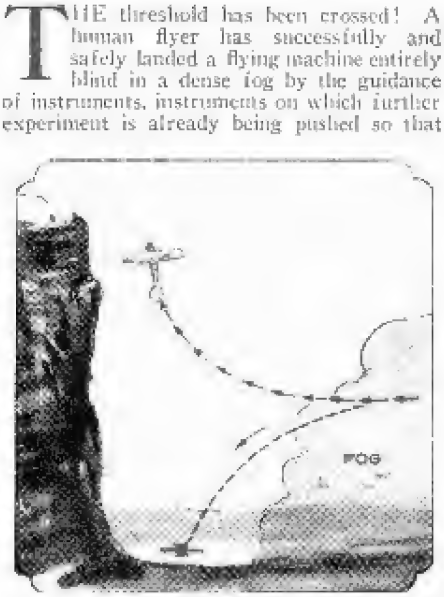
EXPERIMENTER PUBLISHING COMPANY, NEW YORK, PUBLISHERS OF
RADIO NEWS - RADIO LISTENERS' GUIDE - FRENCH HUMOR - AMAZING STORIES

FLYING BLIND

For First Time an Aviator Lands in a Complete Fog, Guided Only by Instruments, Thanks to New Ocker-Myers Flying System

By G. K. SPENCER

THE threshold has been crossed! A human flyer has successfully and safely landed a flying machine entirely blind in a dense fog by the guidance of instruments, instruments on which further experiment is already being pushed so that



The pilot coming out of the fog, was so completely fooled by his "flying senses," that he thought he was about to land the plane at the spot marked X; instead, he finally discovered that he was flying "vertically," and almost wrecked the plane on a cliff.

every man or woman who flies, may with perfect safety enter and pass through fogs without interruption to the aerial journeys.

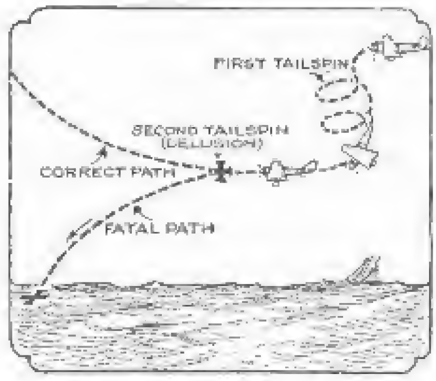
EAR CANALS FOOL FLYER'S BRAIN

The significance of this statement may not be of as great import to the average citizen, as it is to all the military and commercial flying personnel, who today must suspend their flights the moment fog becomes thicker and more extensive than may be flown through in a few minutes.

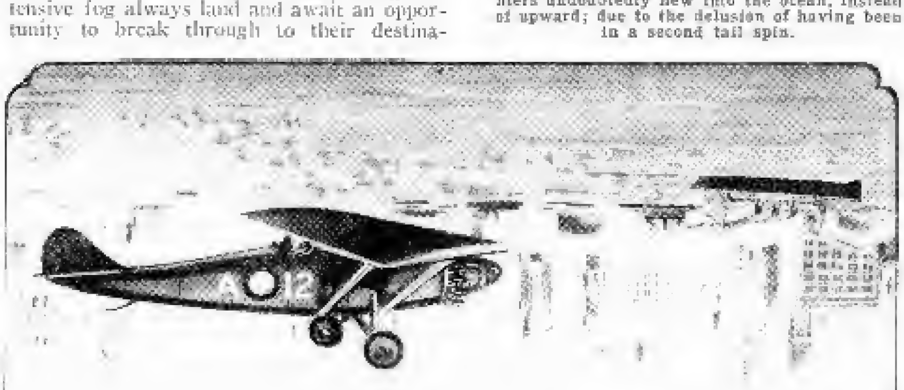
BIRD'S FLYING SENSE NOT PERFECT

Flying at all military fields is suspended when fog descends; the intrepid pilots who carry the air mail, upon encountering extensive fog always land and await an opportunity to break through to their destinations. Civil pilots everywhere recognize the peril of flying through fog, with all land and sky marks obliterated, with the natural horizon clouded from view. They know that no human being can fly more than a few minutes in such a fog, *without losing all sense of position; without encountering vertigo, which causes the vestibular canals of the inner ear to deliberately lie to the brain; to tell the brain it is flying* RIGHT *when in reality the flight is* LEFT, to tell it that *ascension* is being made, when in truth the air machine is *diving* dangerously to the surface below

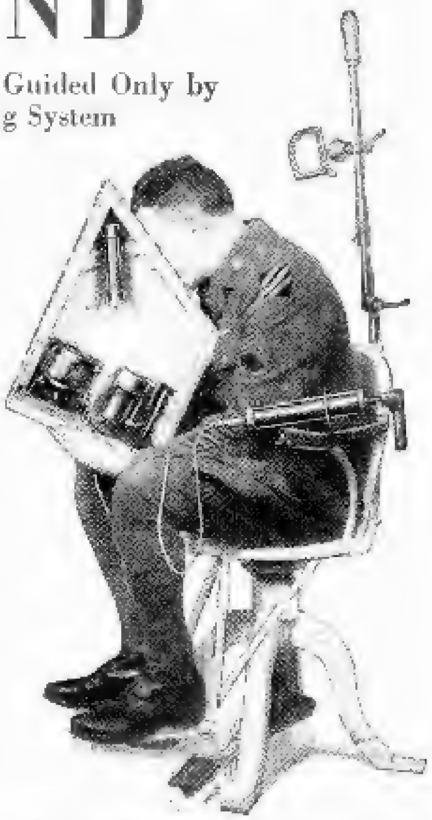
Until the experiments brilliantly conducted at the Presidio of San Francisco by Captain William Ocker, oldest flying officer of the Army Air Corps, and Captain D. A. Myers, Flight Surgeon of the same Command, it has not been realized that even the birds of the air suffer the same limitations as human beings in attempting to fly through dense fogs, that even sea-gulls and pelicans are found dead along the beaches after every great fog, killed as they flew in apparent security, downward, only to be crushed as they met the earth while their *flight sense* informed them they were flying safely.



Relying on "flying sense," one of the Pacific fliers undoubtedly flew into the ocean, instead of upward; due to the delusion of having been in a second tail spin.



This picture, corresponding to that on the front cover, shows how a city appears when a pilot is flying upside down. Due to the tricky action of the human senses, the pilot may only "think" he is flying upside down, and meet with disaster in consequence.



New revolving chair in which airplane pilots are tested. As long as the pilot concentrates on the navigation instruments, all is well.

NO "INHERITED" FLIGHT SENSE

In truth, there is no inherited *flight sense.* This from Captain Ocker, who has been with the United States Army since 1898, one of the first Army pilots, who learned the elements of flying in the first Curtiss flight school, and who was General William Mitchell's personal pilot (though the General himself was one of the good ones) while that officer was assistant chief of the Air Service at Washington. No instinctive flight sense exists—even birds lack it. They fly mechanically, and every human who flies must do likewise, relegating what *feel of the air* he may have to a secondary but valuable position.

"FLYING BLIND" BY THE NEW OCKER-MYERS SYSTEM

After experimenting with more than 600 individual pilots, the first commercial tests of the Ocker-Myers system of flying were made with the pilots of the Pacific Air Transport, a company conducting the Air Mail lines between Los Angeles and Seattle, Washington, over the most extensive fog belt in the United States. The pilots of this company had been taking off in fogs, when telephonic reports from further along the coasts gave assurance that after a reasonable distance there was a lift in the great Pacific fog fields.

Even such take-offs possessed their element of danger, but the mails had to go through, and the persistence of fog during certain hours of the Pacific day, told us that if the planes did not take off many times while fog covered the Pacific slope, there would be no effectual air-mail service for the western coast cities.

Accordingly, the Pacific Air Transport, which by permission of the Army Air Corps has its San Francisco terminal on Crissy Field, Presidio of San Francisco, was chosen for the first commercial experiments, and all the pilots of the company were instructed personally by Captain Ocker in the mechanics of what he wished accomplished, and by Surgeon Myers in the principal in-

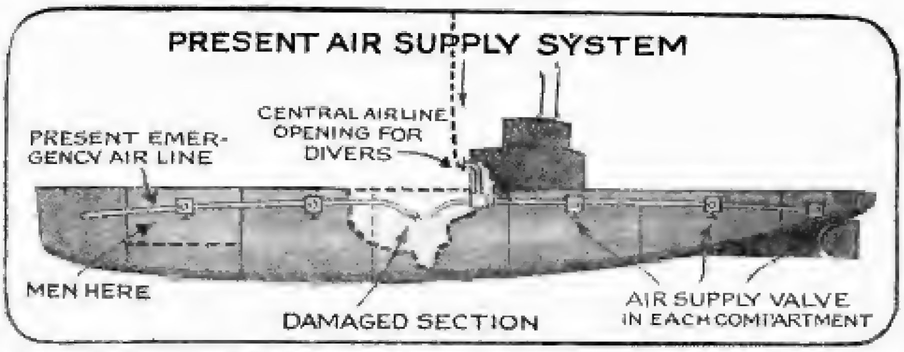
(Continued on page 1031)

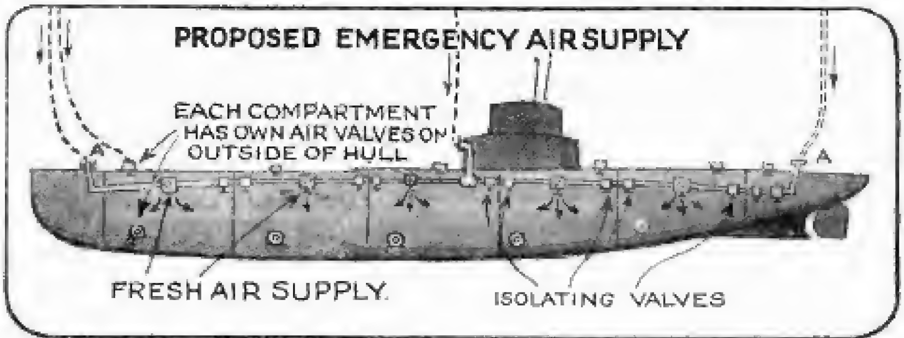
The Case

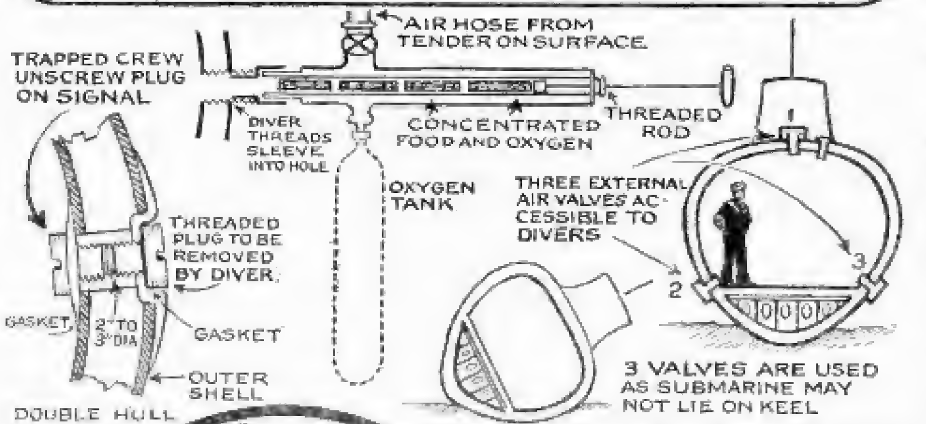
The Present Article Deals with Buoys, and Other Devices—Opinion of Them

By H. WINFIELD

THE editors have been flooded with all kinds of ideas submitted by readers for rescuing the crew of the sunken submarine S-4, as well as raising the vessel itself. Some of the best ideas submitted are here discussed, with the Navy Department's objections to most of them. In a recent interview with one of the U. S. Navy Department's officers stationed at New York, a great many of the submarine salvage ideas and crew rescue methods here illustrated were discussed. This officer stated that out of several thousand ideas submitted by various civilian inventors, only two of the suggestions proved to be new and really worthwhile. These ideas had been forwarded to the naval officers in charge of the salvaging of the S-4 off Provincetown.



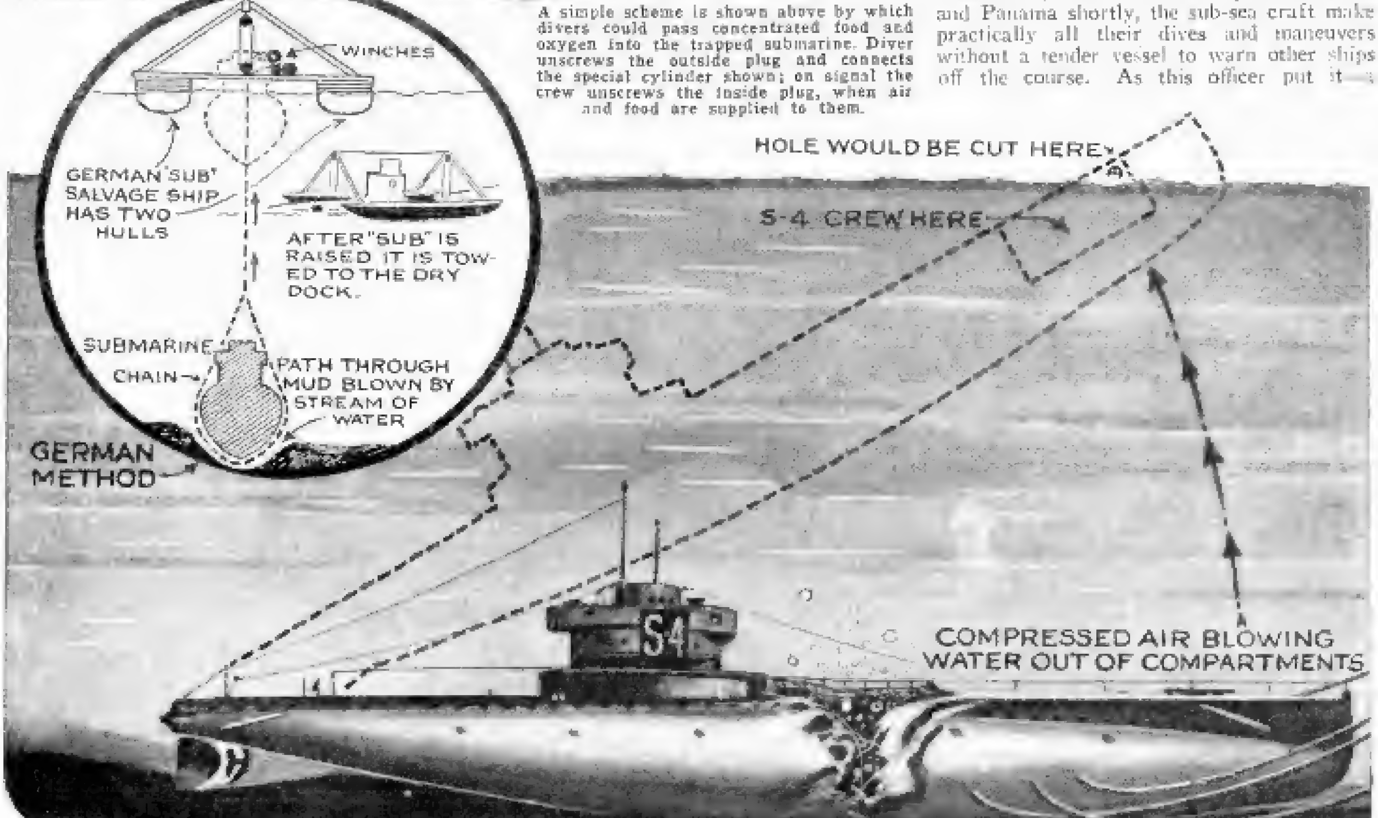




A simple scheme is shown above by which divers could pass concentrated food and oxygen into the trapped submarine. Diver unscrews the outside plug and connects the special cylinder shown; on signal the crew unscrews the inside plug, when air and food are supplied to them.

WHY NO TENDER BOAT WAS USED

THE public press has been very caustic on the point that the submarine S-4 should never have undertaken a practice dive off Provincetown, R. I., without a tender ship on the scene, to warn other vessels off the course. Other criticisms have been to the point that the Coast Guard Destroyer *Paulding*, which rammed the S-4 and caused it to sink within a few moments, had no business in that vicinity at the time. As was pointed out by the naval officer whom the writer interviewed, the Navy Department does not usually operate in conjunction with the Coast Guard, which may or may not be a partial excuse for the sinking of the S-4; and further, it was stated that in the regular peace-time maneuvers of submarines, such as will take place off Cuba and Panama shortly, the sub-sea craft make practically all their dives and maneuvers without a tender vessel to warn other ships off the course. As this officer put it—



German method of using a twin-hull submarine salvage craft is shown in circle. If sufficient water could have been blown out of S-4, bow would have come up, as shown.

of the S-4

Lifting Eyes, Compartment Valves, and the Navy Department's Is Also Given

SECOR

submarine which cannot take care of itself in wartime without a tender standing by, is a pretty useless weapon. But in peace time it is not apparent just why the boat's course should not be patrolled.

In view of the fact that there is apparently no positive form of signal now in use on U. S. submarines, which indicate when a sub-sea vessel is about to come up and break the surface of the water, this argument does not sound so good. The Navy spokesman stated that even though Prof. Fessenden stressed the use of the sub-sea oscillator for sending sound wave signals under water, as well as the fact that submarines are supposed to have sensitive listening devices for hearing the propellers on ships a mile or more away, that owing to the noise of the submarine's own propeller, and other extraneous noises such as surface or wave action, that a man stationed at a listening post on the S-4 for example, probably could not have heard the churn of the propellers on the rapidly approaching destroyer Paulding. As all of the crew were lost, it will probably never be known whether a man was listening for an approaching vessel. It is usually necessary to stop the propeller on the listening ship in order that the sounds from another ship's screws can be clearly heard. It is of course not feasible to stop all the machinery on a submarine when it is rising toward the surface, as the screws have to be kept going. A submarine does not normally rise straight up or down, but is kept in motion by means of the screws as it is coming up or going down, the angle at which the bow is pointed being determined by the position of the steering vanes fore and aft.

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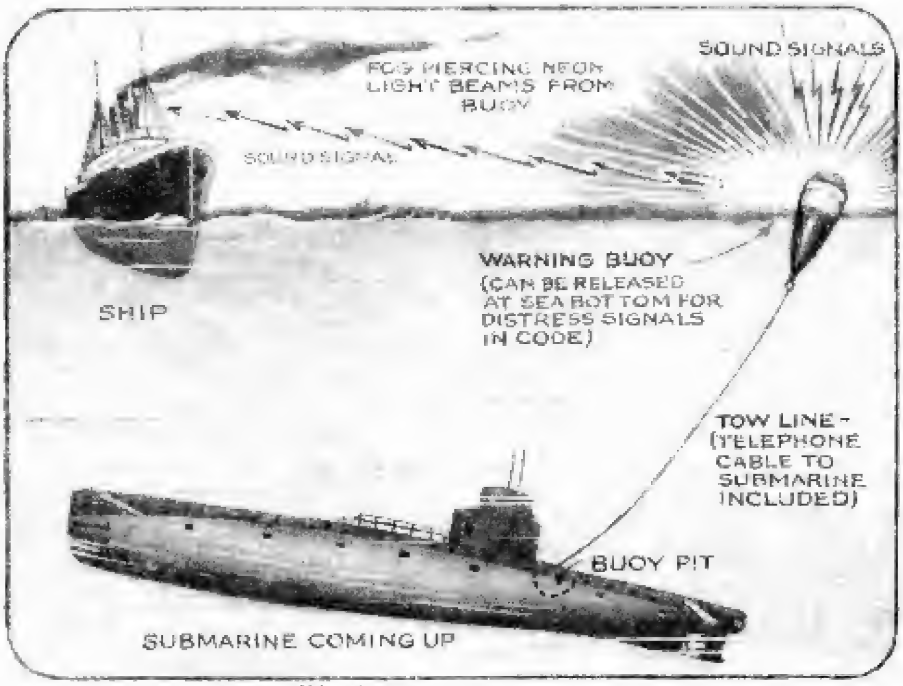
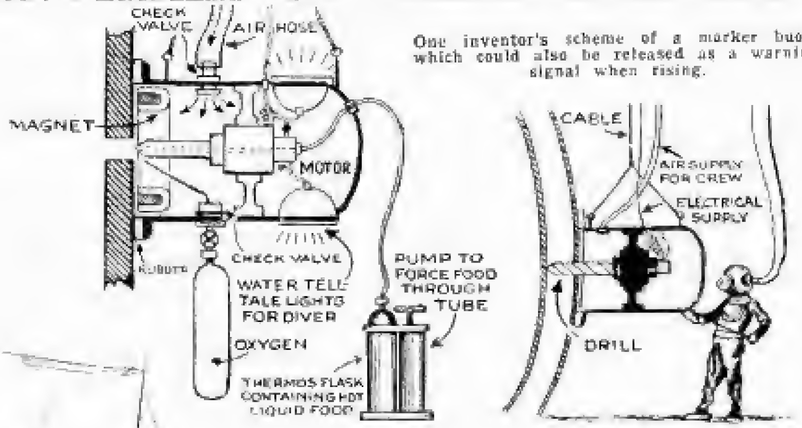
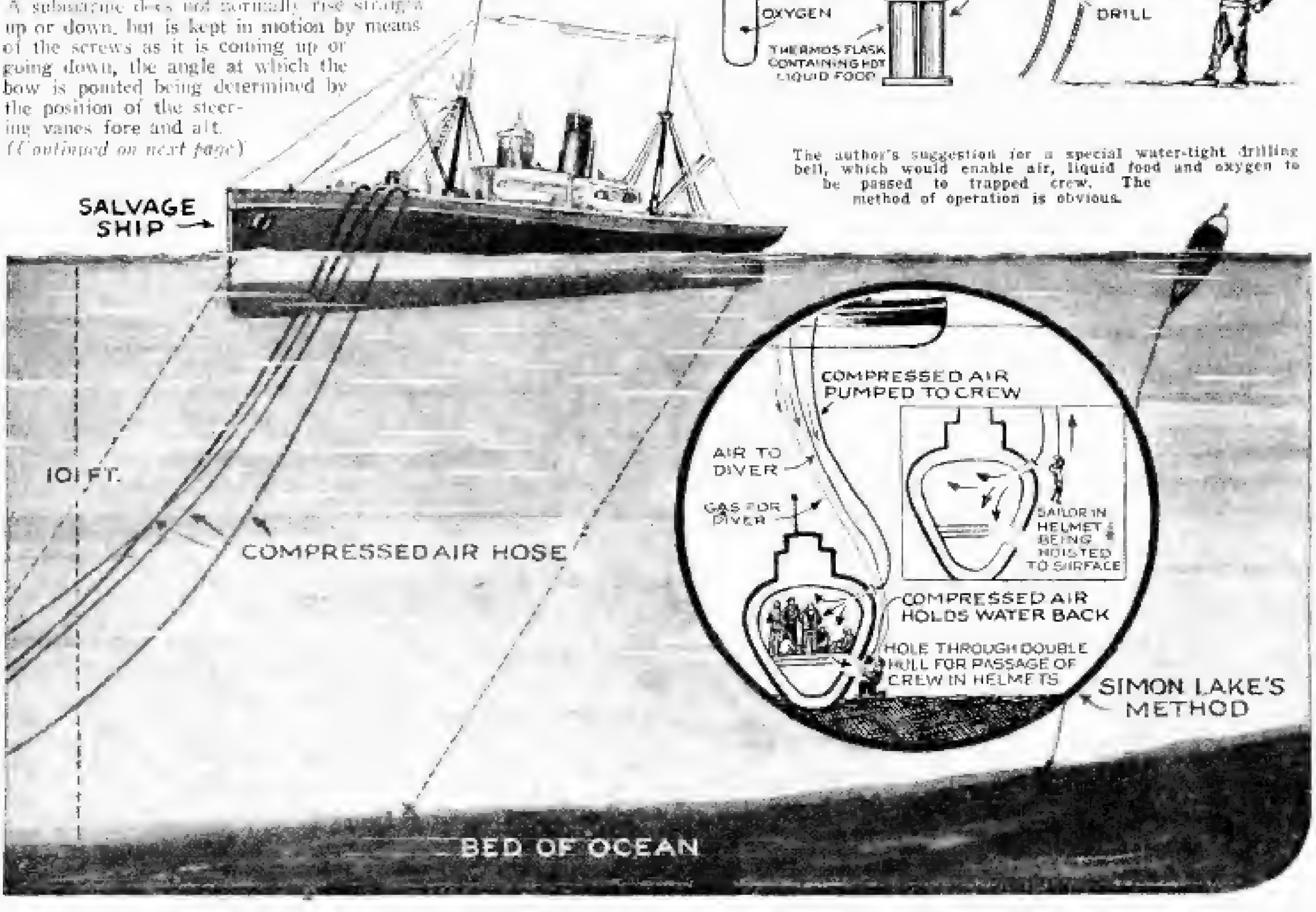


One inventor's scheme of a marker buoy, which could also be released as a warning signal when rising.



The author's suggestion for a special water-tight drilling bell, which would enable air, liquid food and oxygen to be passed to trapped crew. The method of operation is obvious.



Simon Lake's method of rescuing the trapped men on the S-4 is shown in the circle; this is a good method where compressed air can be pumped into the occupied compartment.

The Metal EMPEROR

by A. Merritt

Author of "THE MOON POOL", "THE FACE IN THE ABYSS" etc.

INTO THE PIT. (Sixth Installment)

CHAPTER XVIII

THE sun was high when I awakened, or so I supposed, opening my eyes upon a flood of clear daylight. As I lay, lazily, recollection rushed upon me. It was no sky into which I was gazing; it was the dome of Norhala's elfin home. And Drake had not aroused me. Why? And how long had I slept?

I jumped to my feet and stared about. Ruth nor Drake, nor the black eunuch, was there.

"Ruth!" I shouted. "Drake!"

There was no answer. I ran to the doorway. Peering up into the white vault of the heavens I set the time of day as close to nine; I had slept then five hours, more or less.

I heard Ruth laugh. Some hundred yards to the left, half hidden by a screen of flowering shrubs, I saw a small meadow. Within it, a half dozen little white goats nuzzled around her and Drake. She was milking one of them.

Reassured, I drew back into the chamber and knelt over Ventnor. His condition was unchanged. My gaze fell upon the pool that had been Norhala's bath. Longingly I looked at it, then satisfying myself that the milking process was not finished, I stripped and splashed about. I had just time to get back in my clothing when through the doorway came the pair, each carrying a porcelain pannikin full of milk.

"Oh, Louis," cried Ruth. "You should see the goats! The cutest little silky white things—and so tame. There's nothing the matter with this milk, I can tell you—and that awful black thing isn't around to poison it with his eyes. Ugh-h!" she shuddered.

There was no shadow of fear or horror on her face. It was the old Ruth who stood before me, nor was there effort in the smile she gave me. She had been washed clean in the waters of sleep.

"Don't worry, Louis," she said. "I know what you're thinking. But I'm—me again. It was all quite true. But I'm going to stay—me. And don't you worry."

Synopsis

Dr. Louis Thornton is traveling through Tibet with his Chinese servant-cook, Chiu Ming, and two ponies that carried the impedimenta. They come upon a white man who introduces himself as Richard Keene Drake. Drake's father had been very friendly with Thornton. The three decide to carry on and come upon Martin Ventnor, a geologist, and Ruth, his daughter. The latter are guarding themselves against hundreds of soldiers who belong to an age at least twenty centuries back. While escaping they are attacked and would have been exterminated, were it not for the timely intervention of Norhala, a tall, beautiful, metallic-haired woman, whose control over lightning and over heavy metallic blocks was phenomenal. These blocks, at her command, would make a bridge for her to walk on or form themselves into battling monsters to protect her or obey her every whim. Chiu Ming is killed in the battle, the survivors leaving with Norhala. Ruth and Norhala get on one of the blocks. The others stand upon a second composed of four smaller ones joined together by their own peculiar super-normal power. The platforms speed through space at a terrific rate, arriving eventually in the court of the Metal Emperor. Angered by the influence of Norhala over Ruth, Ventnor raises his rifle and fires at the red ruby-like object he believes to be the brain of the metal monster. He is struck down by a lance of green flame and rendered unconscious. The metal monster gives Norhala the entire company to serve as her toys. She takes them to her home, where she informs Yuruk, her ape-like eunuch attendant, they are not to be harmed. Ventnor talks, then lapses into unconsciousness again. Ruth, after telling about the strange power that holds her enslaved, goes to sleep. Drake and Thornton discourse on the metal intelligences, and come to the conclusion that they are guided by some sort of group consciousness, and that they move by super-rapid molecular "steps?" Yuruk, because of jealousy, informs Drake of the way back to the city, which Ventnor, in a semi-conscious state, told them was their only hope. Yuruk claims that though the inhabitants of the city were hostile, it is much safer to escape.

"Where is Yuruk?" I turned to Drake, and at his wink and warning grimace forebore to press the button.

"You men pick out the things and I'll get breakfast ready," said Ruth. "Oh!" She was looking down into the pool. "Somebody's been in it. We'll have to let it settle."

"I couldn't help it," I apologized.

"We won't have to wait. There's a spring outside," laughed Drake. He picked up the tea kettle and motioned me before him.

"About Yuruk," he said, when he had gotten outside. "I gave him a little object lesson. Persuaded him to go down the line a bit. Showed him my pistol, and then picked off one of Norhala's goats with it. Hated to do it, but I knew it would be good for his soul. He gave a screech, and fell on his face and groveled. Thought it was a lightning bolt, I figure, and decided I had been stealing—their—stuff. 'Yuruk,' I told him, 'that's what you'll get, and worse, if you lay a finger on that girl inside there.'"

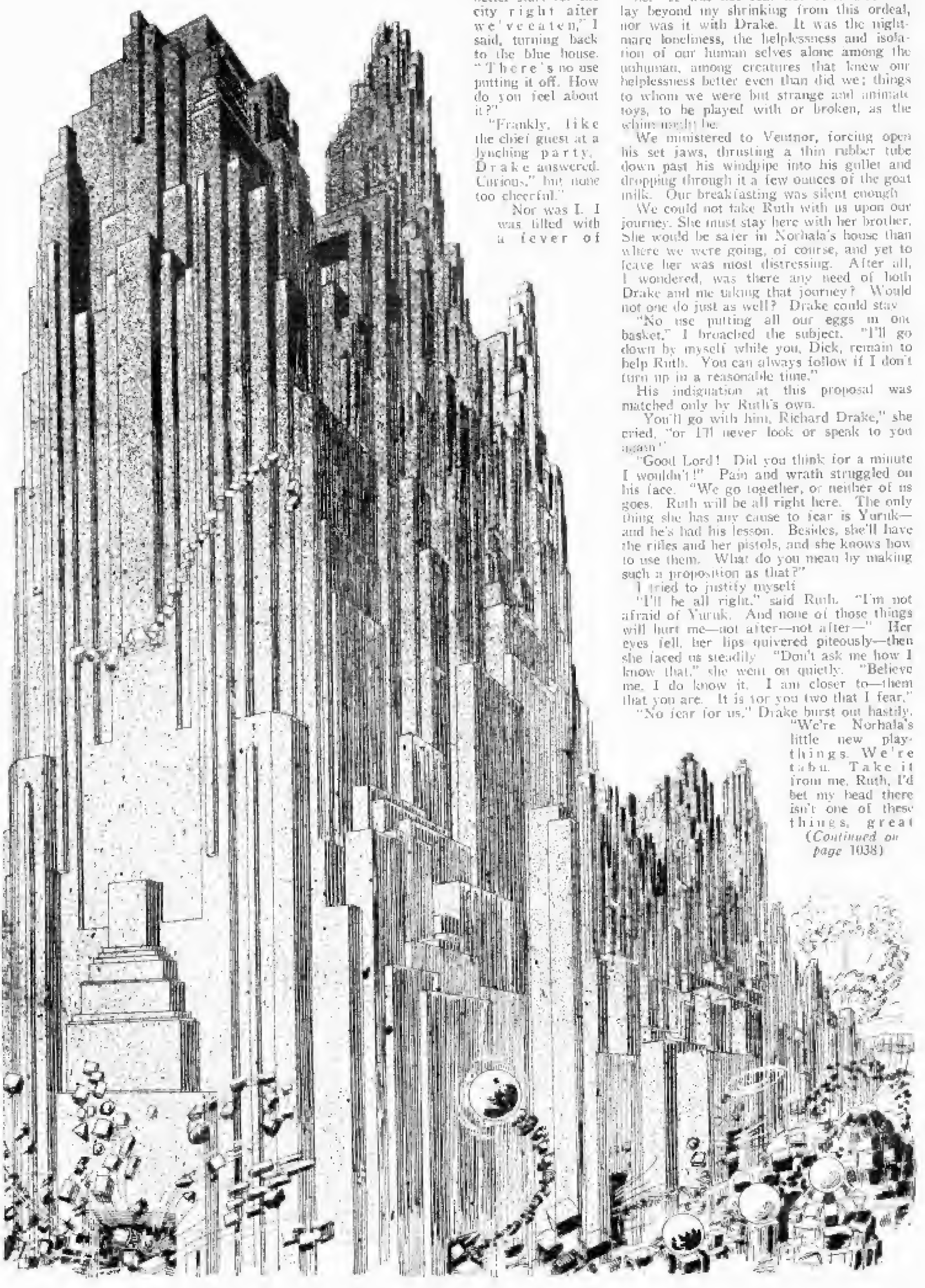
"Then what happened?" I asked.

"He beat it back there like an ostrich-legged rooster pursued by a ravenous smoke with automobile feet," he grinned, pointing toward the forest through which ran the path the eunuch had shown me.

Briefly, as we filled the container at the outer spring, I told him of the revelations, and the offer Yuruk had made to me.

"Whew-w!" he whistled. "In the nutcracker, eh? Trouble behind us and trouble in front of us."

It was a metal city, mountainous. Featureless and smooth, the immense wall heaved heavenward. It should have been blind, that vast oblong face—but it was not blind, and therein lay intangible terror. From it radiated alertness, vigilance. It seemed to gaze toward us as though every foot were manned with sentinels; guardians, invisible to the eyes, whose concentration of watchfulness was caught by some hidden sense more subtle than sight. It was a metal city, mountainous and—aware!



"I think we had better start for the city right after we've eaten," I said, turning back to the blue house. "There's no use putting it off. How do you feel about it?"

"Frankly, like the chief guest at a lynching party," Drake answered. Curious," but none too cheerful."

Nor was I. I was filled with a fever of scientific curiosity. But I was not cheerful—no. It was not fear nor cowardice that lay beyond my shrinking from this ordeal, nor was it with Drake. It was the nightmare loneliness, the helplessness and isolation of our human selves alone among the unhuman, among creatures that knew our helplessness better even than did we; things to whom we were but strange and animate toys, to be played with or broken, as the whim might be.

We ministered to Ventnor, forcing open his set jaws, thrusting a thin rubber tube down past his windpipe into his gullet and dropping through it a few ounces of the goat milk. Our breakfasting was silent enough

We could not take Ruth with us upon our journey. She must stay here with her brother. She would be safer in Norhala's house than where we were going, of course, and yet to leave her was most distressing. After all, I wondered, was there any need of both Drake and me taking that journey? Would not one do just as well? Drake could stay

"No use putting all our eggs in one basket," I broached the subject. "I'll go down by myself while you, Dick, remain to help Ruth. You can always follow if I don't turn up in a reasonable time."

His indignation at this proposal was matched only by Ruth's own.

You'll go with him, Richard Drake," she cried, "or I'll never look or speak to you again!"

"Good Lord! Did you think for a minute I wouldn't!" Pain and wrath struggled on his face. "We go together, or neither of us goes. Ruth will be all right here. The only thing she has any cause to fear is Yuruk—and he's had his lesson. Besides, she'll have the rifles and her pistols, and she knows how to use them. What do you mean by making such a proposition as that?"

I tried to justify myself

"I'll be all right," said Ruth. "I'm not afraid of Yuruk. And none of those things will hurt me—not after—not after—" Her eyes fell, her lips quivered piteously—then she faced us steadily "Don't ask me how I know that," she went on quietly. "Believe me, I do know it. I am closer to—them that you are. It is for you two that I fear."

"No fear for us," Drake burst out hastily. "We're Norhala's little new playthings. We're tabu. Take it from me, Ruth, I'd bet my head there isn't one of these things, great

(*Continued on page* 1038)

Can Siamese

Is Life for One

By JOSEPH H.

Fig. 1. Here is a photograph of the Hilton twins as they appear on the vaudeville circuit. Even though joined together by nature, by an inseparable bond which can only be severed in event that one of the twins should happen to die before the other, they do not look exactly alike. An X-ray photograph of these twins would disclose that they both had distinct pelvises, but that the connection which holds them linked together is a union of the bones at the lower part of the spine, specifically the sacrum and coccyx. Speedy surgical intervention in case of the sudden departure from this life of one of the twins, is the only means of saving the other. No one can prognosticate the end results.

THE name, *Siamese Twins*, is given to practically every form of double-growth in the human race, regardless of how the twins may be joined together. The name dates back from the two youths, Eng and Chang, who were born of Chinese parents in Siam, in the year 1811. They traveled with circuses for many years, and lived to the ripe old age of sixty-three. They popularized the term Siamese Twins, and now every congenitally joined twin is popularly called a Siamese Twin, regardless of whether the twins are joined back to back or side to side.

In the original Siamese Twins, there was a band of flesh stretching from the end of one breast-bone to the same place on the opposite twin. Otherwise the twins were two distinct normal individuals

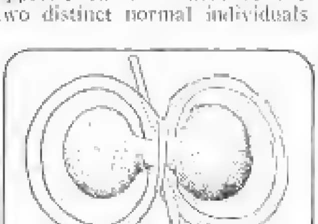


Fig. 2. Diagram indicates an ovum disturbed so as to separate the body into two portions. This may or may not be the cause of Siamese twins.

DIFFERENT STRUCTURE OF DOUBLE-TWINS

Having seen the reason for calling all conjoined beings Siamese Twins, and accepting the popular version of the term, we must, therefore, ask the question—which Siamese Twins does one desire to separate? If we are referring to the original, then the answer is "Yes, they can be parted." If we refer to twins like the Phillipino Twins, again the answer is "Yes"; but when we apply the term to the Hilton Twins, the Blazek Sisters, or to the Indianapolis Twins, the answer is emphatically "No." The latter group cannot be separated because of the eminent danger to either of the two parties. The only possibility of separation is if one twin should die before the other and the surgeons were prepared to operate immediately.

Ordinarily, Siamese Twins are two distinct characters. If one pricks himself with a needle, it has no effect on the other; if one eats or drinks food which does not agree with his constitution, the effect on the other is negligible. There is, of course, some inconvenience, because if one is too ill to remain out of bed, the other must lie down with the ill person; or if one twin develops an infection, the infection may be carried to the other through the bond of flesh (through the intermediary of the blood vessels and capillaries), which holds the two bodies in the position of their birth.

One cannot always be assured that even those twins joined together by a bond of flesh and with no bony junction whatever, can be separated without danger to each other. For instance, there are the Hindu Twins, Rodica and Doodica, who were joined in a fashion similar to the original Siamese Twins, and were divided by an operation in Paris, France, in February, 1902. Rodica survived the operation; her sister succumbed to tuberculosis.

Fig. 6. Whatever can happen in the animal kingdom can likewise occur in man. It is quite possible to have a two-headed human being. The photograph at the left shows a pig with three eyes, two mouths, two noses, and two tongues.

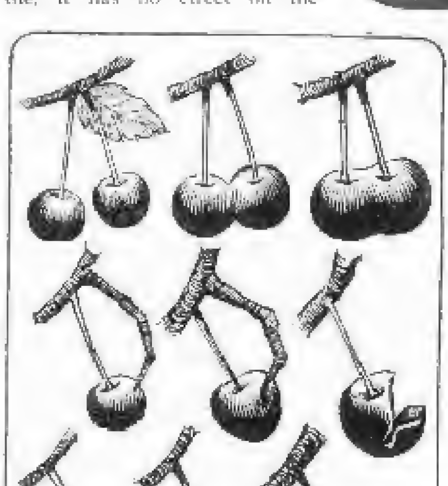


Fig. 4. Two cherries, side by side, finally become but one. This is a possible cause of Siamese births. Second row shows cherry mutilated by outside injury; third indicates growth of a birthmark.

PERCENTAGE OF SIAMESE TWINS BORN

Before proceeding further, let us try to determine exactly what takes place in the case of conjoined twins. There are many other malformations and many different types of monstrosities which develop, but their proportion is not very great. Malformations occur in from 1.55% to 2.83% births. The question as to the cause of these malformations is still a disputed one, but it may be mentioned here that maternal (mental) impressions as such a cause, can be definitely dismissed as a relic of those

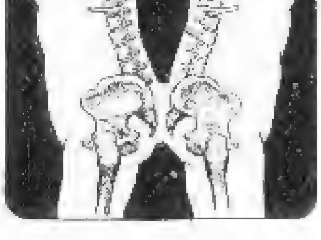


Fig. 3. The diagram here illustrates an X ray view of the Phillipino twins who show no bony connection. They could be separated.

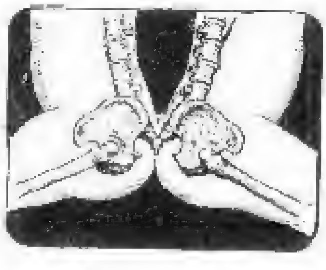


Fig. 5. Twins joined at the sacrum and coccyx are not unusual. The diagram indicates such a union. Separation quite impossible.

Twins Be Separated?

Possible Without the Other?

KRAUS

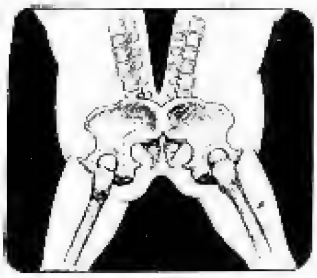


Fig. 7. An X-ray photograph of the Blazek twins which shows them joined together in the manner here indicated, with the ilia fused. They cannot be separated.

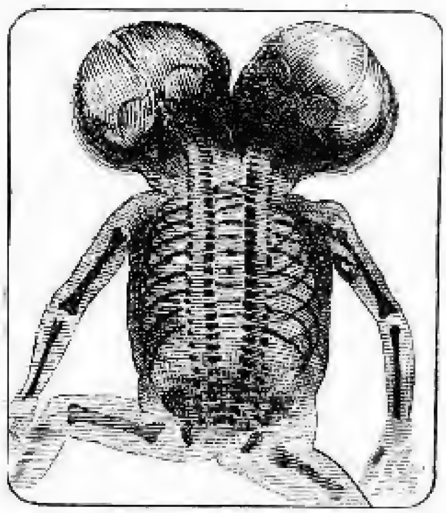


Fig. 8. It is unusual to find a two-headed human child with two complete spinal columns and but one pelvis, yet the diagrammed X-ray photo shows such an existence.

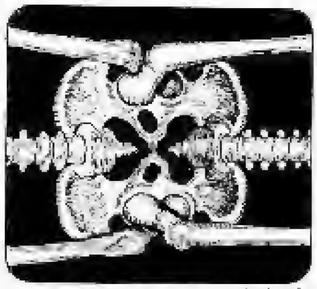


Fig. 9. This diagrammed X-ray gives a view of the Indianapolis twins. Here the bones are fused in the manner indicated. It is impossible to separate these twins.

days when fantastic grounds were looked upon as being explanatory of all things unusual.

HOW TWIN GROWTHS FORM

It has been thought since earliest times that double or multiple monsters are the result of fusion of what were primarily two or more individual embryos. This view is explained in Fig. 4, showing the two cherries hanging from the twig of a tree. In the first view, and when the cherries are quite small, they are seen as distinctly separate fruits. As they grow, they touch each other, and from this point on, they become joined, producing a cherry with two pits and two stems, yet as far as the fruit is concerned, constitute merely one single cherry. The same course may take place in the kingdom of the mammals in which, of course, man is

column. We find several examples of this on the accompanying pages. We see in Fig. 6 a two-headed pig, a two-headed snake, in Fig. 11, and a two-headed calf, in Fig. 16.

and to the lungs, but this two-headed pig has only three eyes and the center eye does not seem to be double. In the case of the snake and also in the case of the human monstrosity, both heads are complete. The calf, on the other hand, can eat with either mouth, but cannot use both mouths at the same time. Unfortunately, this animal is blind in two eyes, but can see with the other two.

Conversely, instead of having two or more heads on one or more spinal columns, attached to but one pelvis and with one complete set of extremities, we can have a single-headed, double-bodied human being. An example of this is illustrated in the diagram on the third page, Fig. 13, where there are two

Fig. 10. The photograph at the right shows Mary and Margaret Gibb, very popular Siamese twins, and their mother in the background. Mrs. Gibb is probably the only American mother to survive the birth of Siamese twins. It is very questionable if these sisters can be separated without danger to each other.

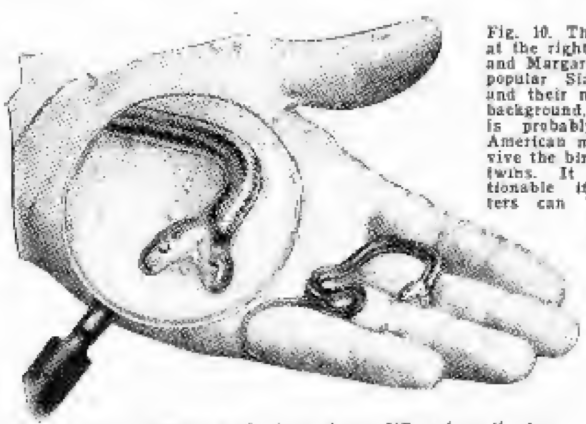


Fig. 11. The two-headed snake here shown differs from the two-headed baby, diagonally above, only by the fact that the one is human and has a double spinal column, while the other has only a double head.

included. On the other hand, the twins may be what is known as unioval; that is, they are produced from one ovum. While commonly they become two separate entities and two individual personalities; due to some arrest in development, or due to some disturbance resulting in an abnormality of position, the two bodies may be fused. Thus there is on record a case in which there were two spinal columns, distinct to the pelvis; one column sustained two heads, whereas the other supported one head, giving us a typical three-headed monster. Triple monsters are quite rare.

TWO-HEADED PIGS AND SNAKES

Then there are those cases of double-headed monsters, some of which are double only, insofar as the head and neck is concerned; others which are double for a greater or a lesser portion of the spinal

We can see a diagram tracing from an X-ray photograph of a two-headed human infant, which is also double for the entire length of the spinal column, but which has but one pair of arms and which has one pair of legs, in Fig. 8. Anatomically, we find that some organs are doubled in this infant.

It is interesting to note that in the case of the pig, there are two complete mouths and noses, each with its own tubal connection to the stomach

Siamese Twins—Their Separation

Fig. 12. Luicio and Simplico Godino, Siamese twins from the Island of Samar, here pictured entering a car they are about to learn to drive.

complete individual bodies joined to but one distorted head, and also joined at the sternum or breast-bone.

In this particular discussion we are primarily concerned with duplicities and triplicities rather than with those monstrosities of a parasitic nature, wherein a more or less perfectly formed body is attached to a well-formed individual, but has no separate existence and receives its nourishment wholly from the well-formed body.

It is quite obvious by what has just been said that it would be impossible to separate one of the heads from a double-headed individual. It also would be impossible to divide the double head of either the calf or the pig or to remove one of the bodies in the double-bodied animal indicated in Fig. 13. There are limits to modern surgery.

Again we return to the question—which twins can be separated? The answer is, primarily, those in which there is no bony connection and, secondly, those where there is a bony connection, but where the life of one or the other of the twins is in such danger that the separation is absolutely necessary for the welfare of the healthy one. One must remember, though, that practically every freak condition found in animals may find a counterpart in man.

Those very pretty and popular sisters known as the Hilton Twins are joined together at the sacrum and coccyx (end of spinal column), as illustrated in Fig. 15. The lower portion of the intestines join together in one common duct. While it is quite possible to separate them, it could only be done in event of the accidental demise of one of the sisters. What the outcome of such surgical interference would be, cannot be even hinted at.

Barring a possible surgical shock, the Phillipino Twins, who are joined together as indicated in the X-ray view in Fig. 3, could be parted from each other.

A very unusual case is presented by the Indianapolis Twins, indicated in Fig. 9. Here the inferior portions of the pelvis are fused with each other, so that one pair of legs of one twin lie beside the body of the other. It is extremely doubtful that either could survive, if surgical intervention was necessary. A similar state exists in the case of the Blazek Twins, indicated in Fig. 7, where they are joined together by fusion between the iliac (hip bone) bones.

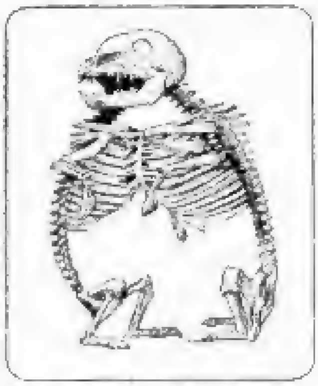


Fig. 13. It is possible to have a single-headed, double-bodied human being, just as it is possible to have a double-bodied single-headed animal, as the diagrammed X-ray shows.

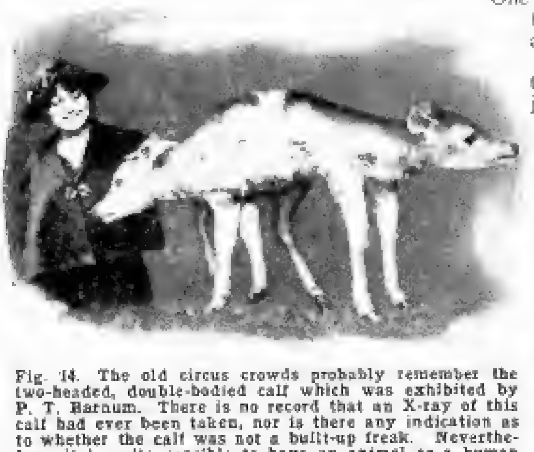


Fig. 14. The old circus crowds probably remember the two-headed, double-bodied calf which was exhibited by P. T. Barnum. There is no record that an X-ray of this calf had ever been taken, nor is there any indication as to whether the calf was not a built-up freak. Nevertheless, it is quite possible to have an animal or a human being born in the form depicted in the above photo.

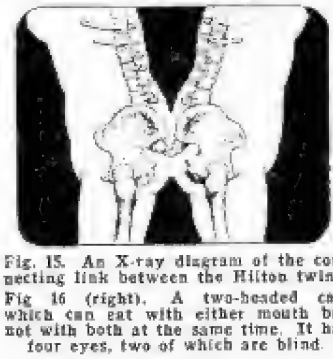


Fig. 15. An X-ray diagram of the connecting link between the Hilton twins.

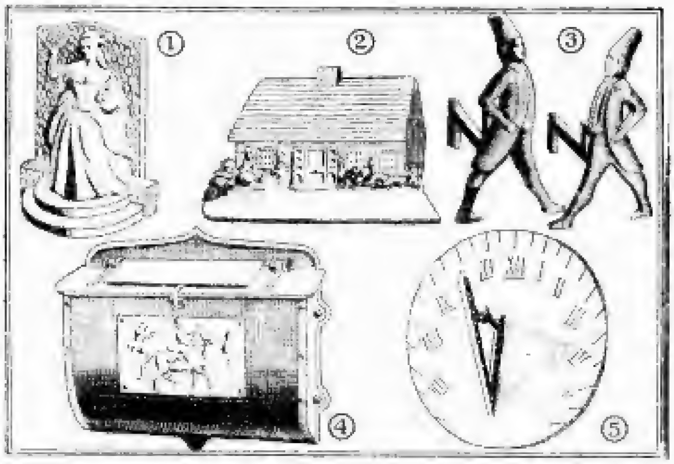
Fig 16 (right). A two-headed calf which can eat with either mouth but not with both at the same time. It has four eyes, two of which are blind.

Fish Harvester

Modern Scientific Method of Wholesale Fishing

The illustration shows the proposed arrangement of equipment to be employed in a new method of wholesale fishing. It will be seen that there is nothing intricate about the construction of the apparatus, for it works upon the well-known principle that fish are attracted by light. It is estimated that a ship constructed as shown here will cost about $45,000.00

New Homecraft



The illustrations at the left show the type of small castings in grey iron, which may be obtained without the usual sharp edges, which gives a desirable appearance of antiquity. Fig. 1 is a book-end. 2 is a door stop, 3 shows a pair of andirons, 4 is an iron mail box and 5 is a sun dial.

The illustration below shows a girl engaged in the pleasant work of decorating one of the small castings which are supplied in many forms.
Illustration courtesy of [illegible] Foundry Co.

THE castings should be decorated with ordinary oil colors sold in tubes, or with the various shades of bronze, enamel or liquid sealing wax. A coating of white paint is applied and allowed to dry before the decorating medium is applied. The surface of the castings is smooth and hard, sharp lines are omitted to imitate the antique. Castings may be obtained in the form of andirons, door knockers, candlesticks, candle sconces, book-ends, door stops, and many other decorative forms.

THIS fish harvester here illustrated and described will remove the last trace of romance connected with the ancient art of fishing. This revolutionary fishing apparatus is essentially the invention of Elwood Blecker.

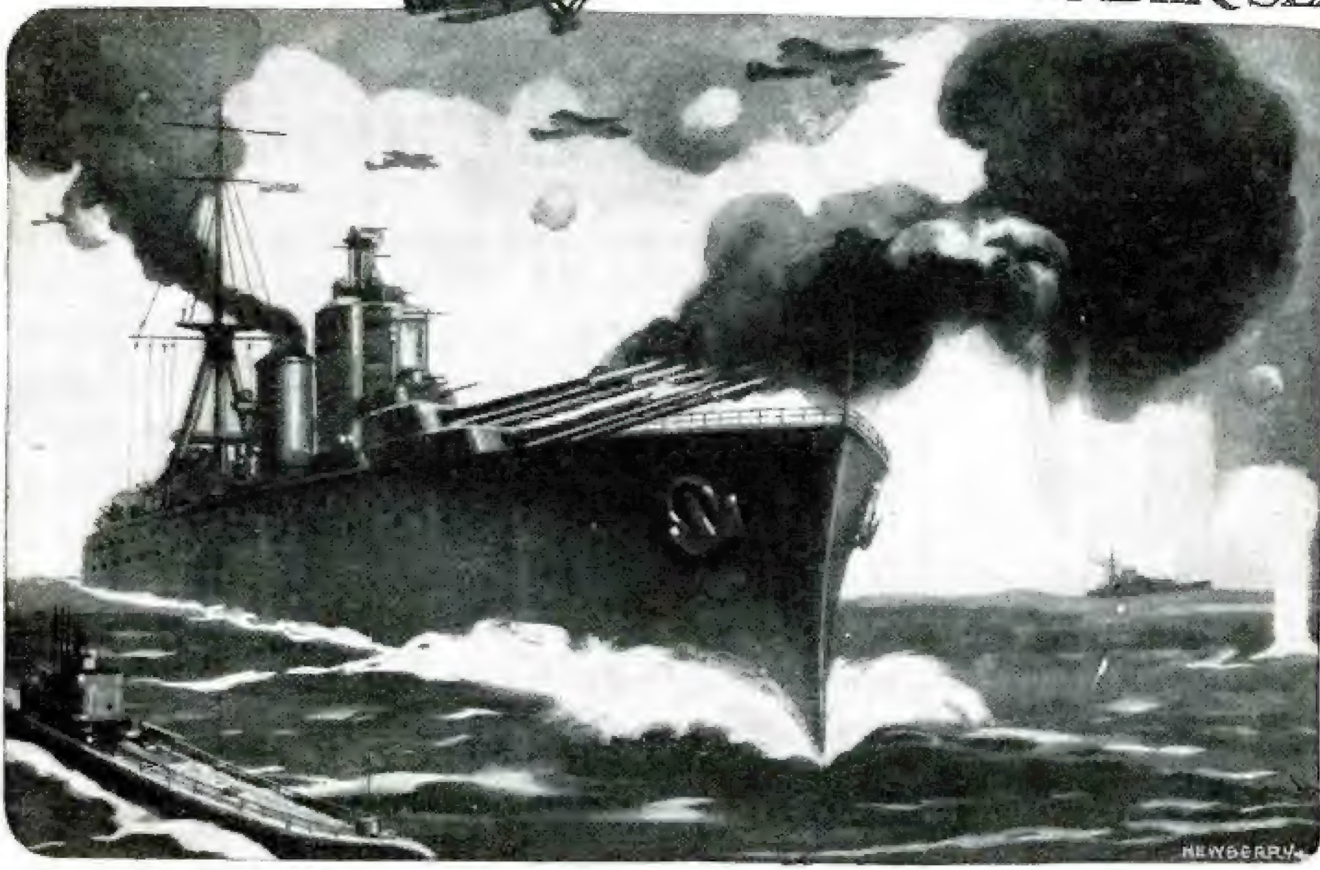
On the way to the fishing grounds, the chain and windlass hold the fishing equipment above the surface of the water. When a suitable site has been reached, the ship is anchored, or if the tide is not sufficiently strong, the ship is moved slowly forward with the metal net just below the surface. The fish in their attempts to get near the light, soon find themselves crowded into the conveyors by the forward motion of the boat or action of the tide and the guiding effect of the metal mesh. After leaving the conveyor at the deck, they simply fall into the hold, and the dangerous and disagreeable work of hauling and emptying the old fashioned nets is eliminated. The rate at which fish are being caught is known at all times by simply watching the conveyors and no time is lost by dragging nets through fishing grounds which contain little or no fish.

This machine will be especially useful for catching fish which move in schools, at or near the surface, such as the herring. The use of this latest type of machinery for the wholesale harvesting of fish must be accompanied by corresponding intelligent activities to prevent the depletion of the present abundant supply of fish.

Illus. courtesy of Scientific Fishing Association.

EXPERIMENTER PUBLISHING COMPANY, 230 FIFTH AVENUE, NEW YORK, N. Y.

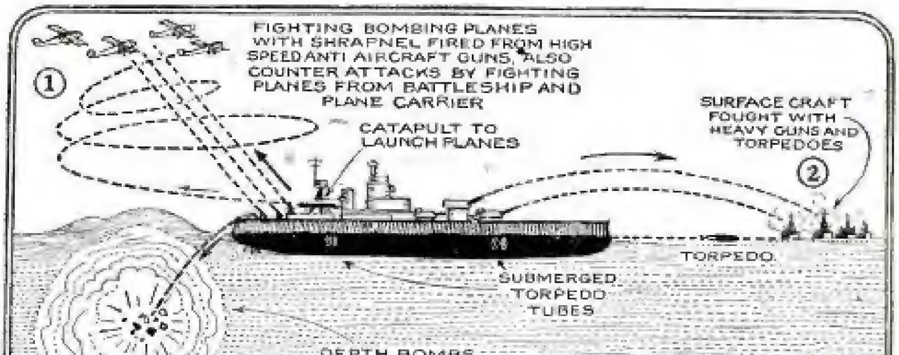
NAVY NOW FIGHTS IN AIR ON SURFACE UNDER SEA

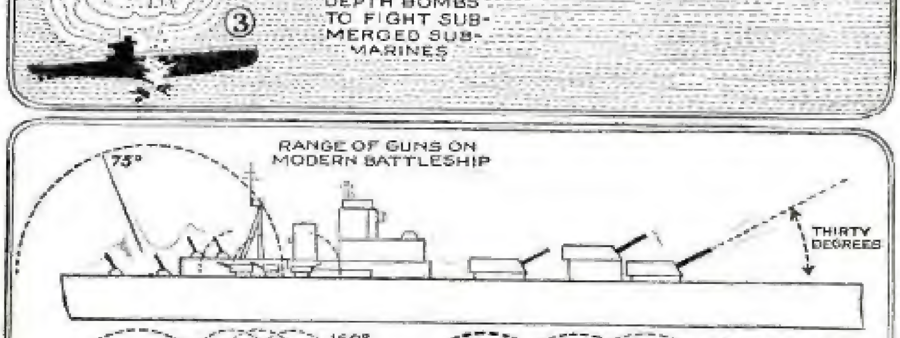


By H. WINFIELD SECOR

ENEMY aircraft, such as bombing planes, are fought by means of the anti-aircraft guns, and they are also open to attack by fighting planes launched by catapults from the warships, supplemented by other planes launched from special airplane carriers. Naval architects have had to practically redesign the super-structure, and protective armor decks of war vessels, so as to withstand the effect of aerial bombing. Enemy surface craft is attacked by fire from the big and medium-size gun batteries, the big guns attacking first if the range is considerable. A very interesting diagram is the lower one, which shows the vertical as well as the horizontal range of the revolving turrets carrying the 16-inch guns on the new British battleships. While a maximum range is attained when a gun is elevated to 45 degrees vertical angle, the big guns on modern warships are not designed to be elevated more than 30 degrees, which gives the desired all-around results. Many of the big guns on our warships cannot be elevated more than 15 degrees, with a consequent loss in range. The anti-aircraft guns have an average elevation range of 75 degrees, and can be swung around through 360 degrees. Surface craft are also attacked by torpedoes fired from submerged tubes on war vessels, as well as from deck tubes. Submarines are attacked when submerged by depth bombs, usually dropped from destroyers.

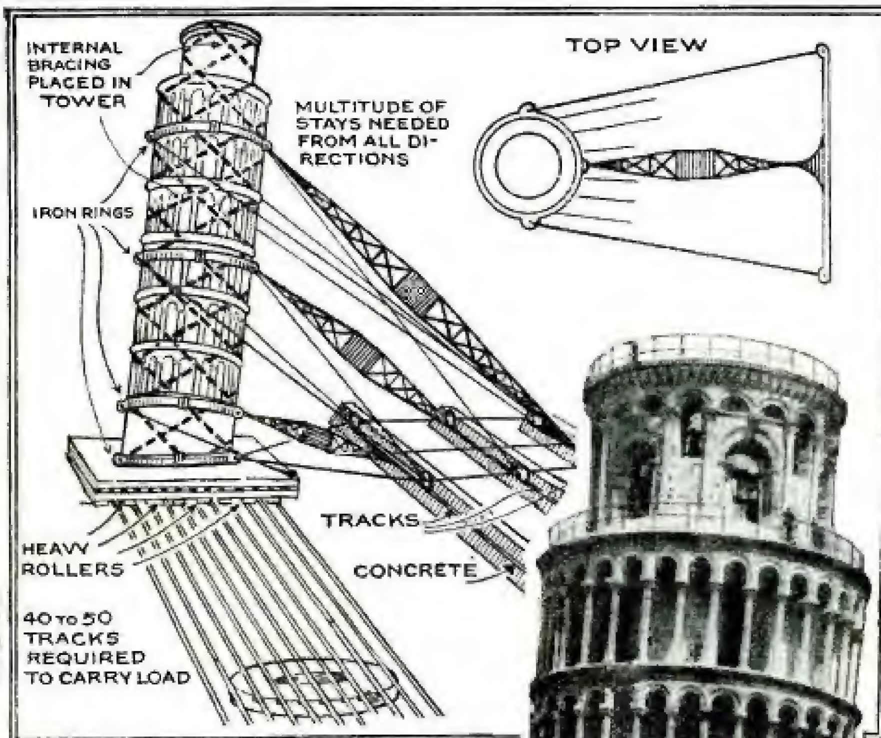
The diagrams at the right show how modern naval battles have to be fought in three zones. Fighting planes and anti-aircraft guns attack the enemy in the air; surface craft are attacked by gun fire, airplane bombs and torpedoes, submarines are fought with depth bombs.





To Save

Modern Engineering



The author's scheme for suitably supporting the leaning tower of Pisa with a multiplicity of arms or braces is shown above. When the tower has been suitably supported and shored up on a platform placed on rollers, which in turn rest on a series of rails, it can be readily moved to a new foundation.

At the right we have a very excellent picture of the world-famous leaning tower of Pisa. This famous architectural wonder leans approximately 13 feet from the true vertical. Water has undermined the foundation, and steps to overcome this or else move the tower have got to be taken immediately.

ONE of Italy's architectural wonders, the Tower of Pisa, is doomed to fall some day unless steps are taken to prevent it from leaning much further than it does now.

Pisa's tower was planned by a native architect, Bonanno, a famous Pisan architect of the Twelfth Century, some 753 years ago. While Bonanno was an excellent architect, he evidently must have been somewhat careless on his foundations. Instead of investigating the site upon which the tower was to be built, he only went down into the swampy soil a few feet, and then started to build. As a matter of fact, the foundation for the tower was only ten feet, which certainly was not sufficient, particularly in a swampy soil for a tower some 179 feet high and 51 feet 8 inches in diameter.

As soon as Bonanno had gotten some 40 feet up with his tower, it was noted that it began to list on one side, out of perpendicular. He, however, hoped for the best, and continued building; at the same time he made the pillars on the sinking side higher than on the other side, in order to compensate for the sinking. This, however, did not seem to do much good, for still the tower proceeded to lean more and more.

For sixty years, the unfinished marble tower was left standing, when the Pisans called in Benenato. He continued to build it up to the fourth story, and still the tower sank. After Benenato had died, the Pisans called in a German by the name of William of Innsbruck, who also tried to force the tower back to the perpendicular by making the pillars of the fifth and sixth stories longer on the sinking side than on the other. He too became discouraged and quit the job, and for another hundred years the tower stood unfinished.

Finally, another local architect, Tommaso Pisàno, proceeded to finish the tower. He merely added the bell cupola on the sixth story and further inclined his cupola toward the perpendicular. The tower by that time was finished, and had its present appearance.

Recent measurements have shown that the tower is still sinking, although very little at the present time, but sufficient so that in time to come, unless something is done, it will surely fall. Once the top of the tower goes beyond its center of gravity, the tower must crash down.

Since 1817, the overhang of the seven stories has increased a minimum of about one-twelfth of an inch per year. Part of this increase was due to excavations made in 1838 and 1839 for the purpose of studying the foundations at their lowest part. Recently, from 1914 to 1927, the last increase of one-third of an inch has been at the rate of about 1/25 of an inch per year. The movement never ceases, although it is exceedingly slow. Recently the municipality of Pisa appointed a commission of engineers to study the cause of the trouble and how to bring about the cessation, and thus insure the stability of the tower for the future. The first report of this commission is dated July 29, 1927, and following are some extracts as published in *La Nature*.

DETAILS OF TOWER OF PISA

THE tower is a structure of eight stories in height, with a total height of 57.05 meters (187 feet) between the bottom of the external foot of the foundation on the north side and the upper part of the last story 56.705 meters (186 feet) on the same side. Opposite this the corresponding south side is only 55.803 meters (183 feet), while the outside part of the foundation proper of this side is (—1.78) or 1.40 meters (4.59 feet) lower than the north. The interior has a diameter of 7.65 meters (about 25 feet). The thickness of the masonry between the first and the sixth cornice is about 2.47 meters (8.10 feet), while between the first cornice and the upper edge of the foundation its thickness is 4.12 meters (13.5 feet), and finally this foundation, which in-

the Tower of Pisa

Methods Can Save Tower

By HUGO GERNSBACK
Member American Physical Society

creases inside and out, has a crown of 7.365 meters (24 feet) of thickness, with an interior space of 4.65 meters (15.25 feet) diameter, (the exterior circle being 19.75 meters (64.69 feet). The height of this foundation is 2.70 meters (8.85 feet) to 2.80 meters (9.28 feet), of which the last 0.40 meter (15 inches) of the base is laid up without cement, as footing stones.

NATURE OF THE SUPPORTING SOIL

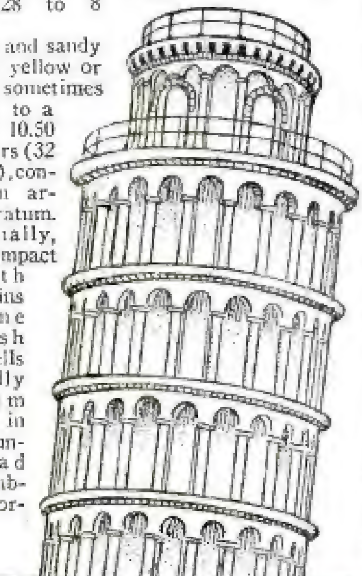
THE supporting soil, according to Canavari, consists of:

1—Layers placed there of natural sand or clay, with a depth of 4.50 meters (14.7 feet) or 5.50 meters (18 feet), and containing the water-bearing stratum into which the foundation penetrates.

2—A layer of gray clay, 1 to 2.50 meters thick (3.28 to 8 feet).

3—Clay and sandy layers fine yellow or greenish, sometimes with turf, to a depth of 10.50 to 11 meters (32 to 34 feet), containing an artesian stratum.

4—Finally, the blue compact clay with the remains of marine and fresh water shells (especially Cardium edule), in which foundations had to be established in order to have a basis somewhat consistent and not affected by subterranean water. Now this water has a slow current toward the sea, and without a doubt draws along with it solid matter finely divided, leaving a void; and besides, there are springs which reach the surface at the foot of the monument, and whose rising speed has been rated at 7 cm. (2.8 inches) per second; finally, in its original construction, as well as in 1838 and 1839, excavations were made on the south side.



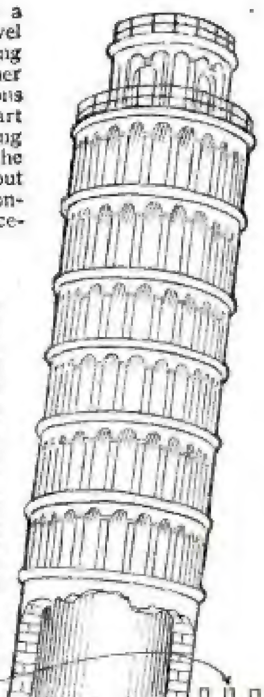
CAUSES OF THE INCLINATION OF THE TOWER

THE pressure in the masonry of the tower is considerable. Cuppari gives a maximum of 15.3 kgs. per square centimeter (about 216 lbs. per square inch) under the plinths of the first row, and 10.12 kgs. (144 lbs. per sq. in.) on the foundation soil. In the face of an uncertain soil and one which is charged with water in motion, it is not astonishing that the tower sank, and that it did so irregularly. The former soil under the campanile was at the level of 3.729 meters (12 feet) and the present level is at 2.75 meters (9 feet), and there is a circular depression giving a paved area of 24.30 meters (79.7 feet) diameter, whose northern edge is at the level 2.72 meters (9 feet), and the southern at the zero point.

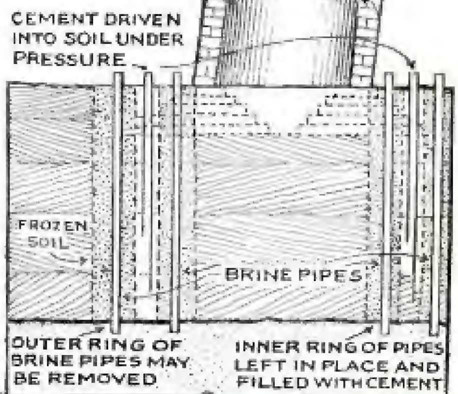
According to this, the principal cause of the progressive inclination of the tower of Pisa seems to lie in the presence of moving water, which produces voids and weakens the soil beneath the foundation, so the following measures are necessary:

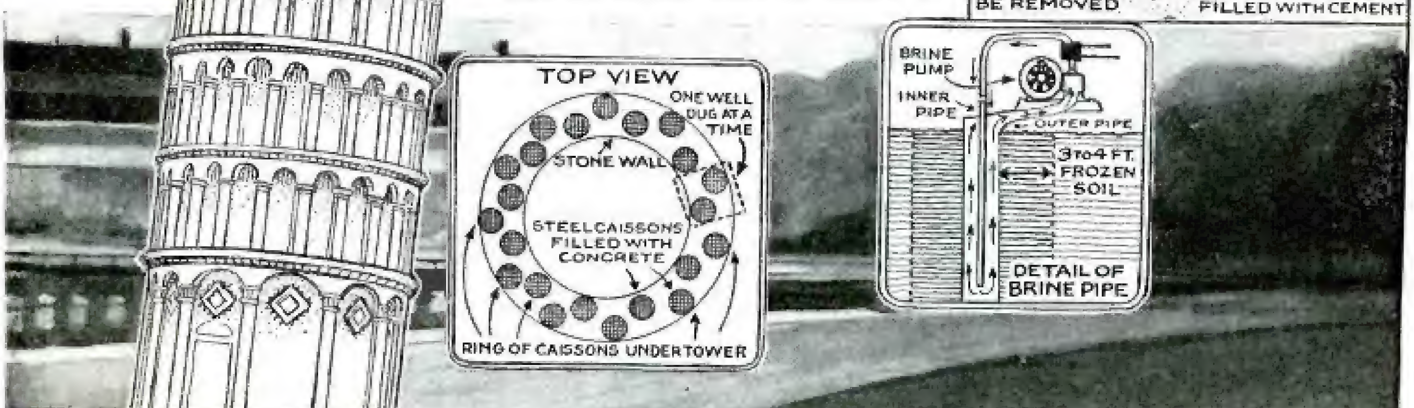
1—To prevent all flow of subterranean water.

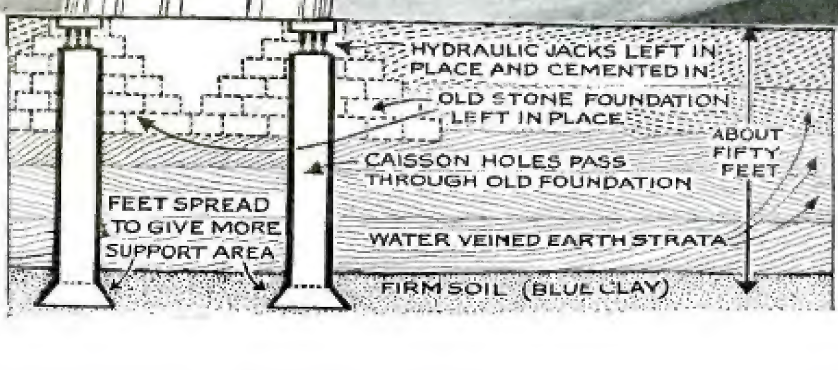
2—To consolidate the soil. For instance, by injecting cement into the voids of the part of the masonry which was laid up dry, and into the pores of the soil so as to displace all or part of the water. This puts aside any solution, which has recourse to excavation, or to a lowering of the level of the water-bearing layers; on the other hand, the injections of cement risk part of this cement being carried away by the water, and to abut against the non-absorbent argillaceous layer.



The diagram below and at the right shows how a famous French engineer proposes to freeze two circular rings of soil about the base of the tower; he will then pump in cement under pressure and in this fashion he eventually will build a water-tight foundation under the tower in its present position. A detail of one of the brine pipes is shown below.







The large diagram at the left, together with the insert, showing a top view of the circular wall of the tower, illustrates the manner in which a famous American foundation company would go about building a substantial foundation under the Tower of Pisa. According to this scheme, the tower would be left in its present position, while caissons would be sunk progressively around under the tower, these being filled with cement.

MOVING THE TOWER TO NEW FOUNDATION

MANY schemes have been proposed how to save the tower, and several are shown in these pages. The first one, which is also the

(Continued on page 1135)

The Metal EMPEROR

by A. Merritt

Author of "THE MOON POOL", "THE FACE IN THE ABYSS" etc.

(Seventh Installment)

Synopsis

Dr. Louis Thornton is traveling through Tibet with his Chinese servant-cook, Chiu Ming, and two ponies that carried the impedimenta. They come upon a white man who introduces himself as Richard Keene Drake. Drake's father had been very friendly with Thornton. The three decide to carry on and come upon Martin Ventnor, a geologist, and Ruth, his daughter. The latter are guarding themselves against hundreds of soldiers who belong to an age at least twenty centuries back. While escaping they are attacked and would have been exterminated, were it not for the timely intervention of Norhala, a tall, beautiful, metallic-haired woman, whose control over lightning and over heavy metallic blocks was phenomenal. These blocks, at her command, would make a bridge for her to walk on or form themselves into battling monsters to protect her or obey her every whim. Chiu Ming is killed in the battle, the survivors leaving with Norhala. Ruth and Norhala get on one of the blocks. The others stand upon a second composed of four smaller ones joined together by their own peculiar super-normal power. The platforms speed through space at a terrific rate, arriving eventually in the court of the Metal Emperor. Angered by the influence of Norhala over Ruth, Ventnor raises his rifle and fires at the red ruby-like object he believes to be the brain of the metal monster. He is struck down by a lance of green flame and rendered unconscious. The metal monster gives Norhala the entire company to serve as her toys. She takes them to her home, where she informs Yuruk, her ape-like eunuch attendant, they are not to be harmed. Ventnor talks, then lapses into unconsciousness again. Ruth, after telling about the strange power that holds her enslaved, goes to sleep. Drake and Thornton discourse on the metal intelligences, and come to the conclusion that they are guided by some sort of group consciousness, and that they move by super-rapid molecular "steps!" Yuruk, because of jealousy, informs Drake of the way back to the city, which Ventnor, in a semi-conscious state, told them was their only hope. Yuruk claims that though the inhabitants of the city were hostile, it is much safer to escape. Leaving Ruth with Ventnor, Thornton and Drake decided to skip away from Norhala. They informed Ruth that Yuruk has learned the meaning of the pistol. After rather spectacular adventures, they come upon the Metal City, where geometrical and intangible forms are seemingly endowed with super-intelligence. The city saw and was alive. Norhala appears unexpectedly and is just as quickly blotted out from sight.

CHAPTER XX

THE CORRIDOR EJECTS US

I THINK that for a moment we both went a little mad. I know we started running once more, side by side, gripping, like frightened children, each other's hands. Then Drake stopped.

"By all the hell of this place," he said, "I'll run no more! After all—we're men! If they kill us, they kill us. But by the God who made me, I'll run from them no more. I'll die standing!"

His courage steadied me. Defiantly, we marched on. Up from below us, down from the roof, out from the walls of our way the hosts of eyes gleamed and twinkled on us.

"Who could have believed it?" Drake muttered, half to himself. "A living nest of them; a prodigious living nest."

A nest? I caught at the word. What did it suggest? That was it—the nest of the army ants, the city of the army ants, that William Beebe had studied in the South American jungles, and once described to me. After all, was this more wonderful, more unbelievable than that—the city of ants which was formed by their living bodies precisely as this was of the bodies of the Cubes?

How had Beebe phrased it—"the home, the nest, the hearth, the nursery, the bridal suite, the kitchen, the bed and board of the army ants." Built of and occupied by those blind and deaf and savage little insects, which by the guidance of smell alone carried on the most intricate operations, the most complex activities. Nothing in this place was stranger than that, I reflected—if once one could rid the mind of the paralyzing influence of the shapes of the Metal Folk. Whence came the stimuli that moved them, the stimuli to which they reacted? Well then—whence and how came the orders to which the ants responded; that bade them open this corridor in their nest, close that, form this chamber, fill that one? Was one more mysterious than the other?

Breaking into my thought came consciousness that I was moving with increasing speed. Simultaneously with this recognition, I was lifted from the floor of the corridor and levitated with considerable rapidity forward. Looking down I saw the floor level several feet below me.

"Closing up behind us," Drake muttered. "They're putting us—out."

It was, indeed, as though the passageway had wearied of our deliberate progress and had decided to—give us a lift. Rearward, it was shutting. I noted with interest how accurately this motion kept pace with our own speed, and how fluidly the walls seemed to run together. Our movement became accelerated. It was as though we floated buoyantly, weightless, upon some swift stream. The sensation was curiously pleasant, languorous—what was the word Ruth had used?—elemental—and free. The supporting force seemed to flow equally from walls and floor to reach down to us from the roof. It was even, and effortless. In advance of us the living corridor was opening even as behind us it was closing.

All around us the little points twinkled. Deeper and deeper dropped my mind into the depths of that alien tranquility. Faster and faster we floated—onward.

Abruptly, ahead of us shone a blaze of—daylight. We passed into it. The force holding us withdrew its grip. I felt the solidity beneath my feet. I stood and leaned back against a smooth wall.

The corridor had ended and—had shut us out from itself.

"Bounced!" exclaimed Drake.

We were upon a ledge jutting from the barrier. Before us lay spread the most amazing, the most extraordinarily fantastic scene upon which, I think, the vision of man has rested since the advent of time.

It was a crater. A mile on high and ten thousand feet across ran the circular lip of its vast rim. Above it was a circle of white and glaring sky in whose center flamed the sun. Instantly, before my vision could grasp a tithe of that panorama, I knew that this place was the very heart of the Metal City.

Around the crater lip were poised thousands of concave disks, vernal green, enormous. They were like a border of gigantic, upthrust shields, and within each, emblazoned like a shield's device, was a blinding flower of flame—the reflected, dilated face of the sun. Below this glistening diadem hung, pendent, clusters of other disks, swarmed like the globular hiving of Hercules' captured suns. And in each of these also hung prisoned the image of the day star.

A hundred feet below us was the crater floor.

Up from it thrust a mountainous forest of the pallidly radiant cones, bristling, prodigious. Tier upon tier, thicket upon thicket, phalanx upon phalanx they climbed. Up and up, pyramidically, they flung their spiked hosts.

They drew together two thousand feet above, clustering close about the foot of a single huge spire which thrust itself skyward for half a mile above them. The crest of this spire was truncated. From its shorn tip radiated scores of long and slender spokes, holding in place a thousand feet wide wheel of wan green disks whose concave surfaces, unlike those smooth ones girding the crater, were curiously faceted.

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This amazing structure rested upon a myriad-footed base of crystal, even as had that other cornute fantasy beside which we had met the great Disc. It was in size to that as Goliath to David; no—as Leviathan to a minnow. From it, streamed the same baffling suggestion of invincible force transmuted into matter, energy coalesced into the tangible, power concentrate in the vestments of substance.

Half-way between crater lip and floor began the Hordes of Metal.

In animate cheveau-du-frise of thousand-foot girders they thrust themselves out from the curving walls — walls, I now knew, as alive as they. From these beams they swung into ropes and clusters — spheres and cubes studded thickly with the pyramids. Group after group they dropped, pendulous. Coppices of slender columns of thistle globes sprang up to meet the festooned joists. Between the girders they draped themselves in stellated garlands, grouped themselves in innumerable, kaleidoscopic patterns. They clicked into place around the ledge in which we crouched. In fantastic arrases they swayed in front of us, hiding and revealing through their quicksilver interweavings the mount of the cones.

Steadily those flowing in below added to their multitudes, gliding up cable and pillar, building out still further the living girders, stringing themselves upon living festoons and living garlands, weaving in among them, changing their shapes, rewriting their symbols.

They swung and threaded swiftly, in shifting arabesque and *cocquillage*, in Gothic traceries, in lace-like Renaissance fantasies, arches and brocatteled astragals, unutterably bizarre, unutterably beautiful — crystalline, geometric always.

Their movement ceased—so abruptly that the stoppage of all the ordered turmoil had in it a quality of appalling silence.

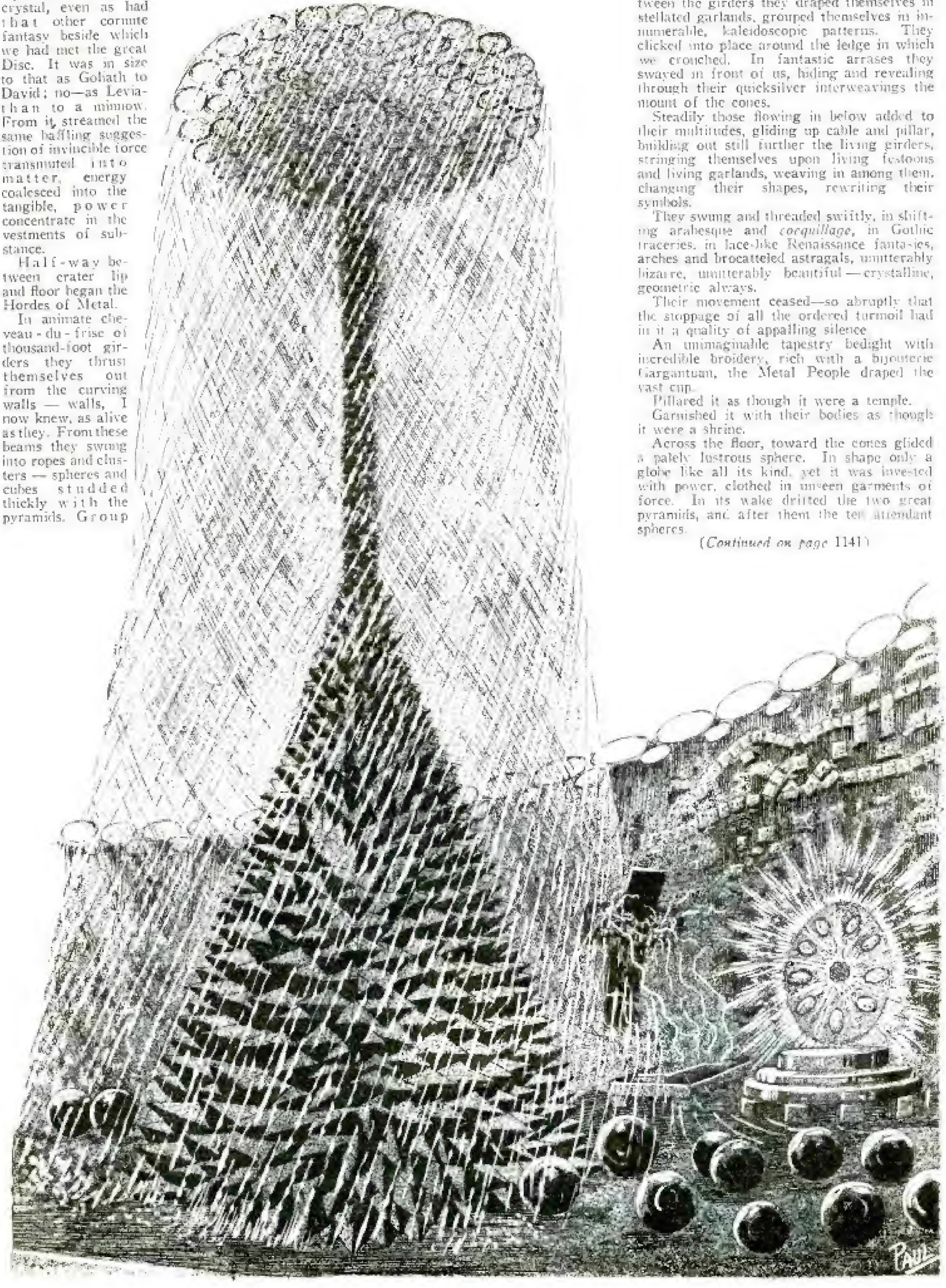
An unimaginable tapestry bedight with incredible broidery, rich with a bijouterie Gargantuan, the Metal People draped the vast cup.

Pillared it as though it were a temple.

Garnished it with their bodies as though it were a shrine.

Across the floor, toward the cones glided a palely lustrous sphere. In shape only a globe like all its kind, yet it was invested with power, clothed in unseen garments of force. In its wake drifted the two great pyramids, and after them the ten attendant spheres.

(*Continued on page* 1141)

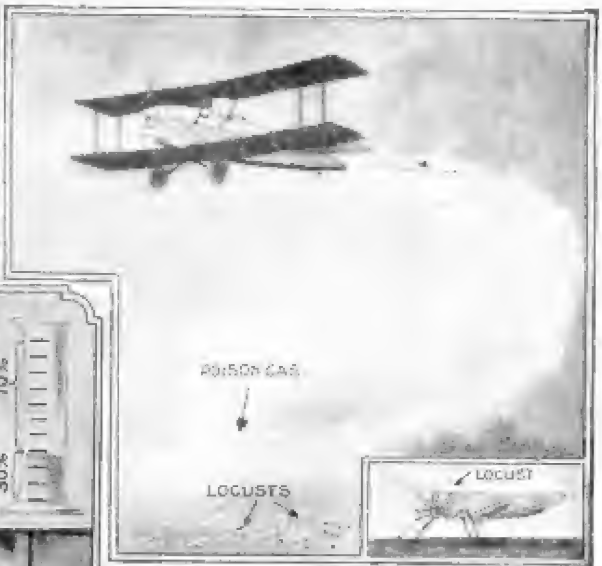



May
BROADCAST WRNY STATION
25 Cents
Science and Invention
IN THIS ISSUE
"DIRIGIBLES"
By C. E. ROSENDAHL, U.S.N.
Commander of U. S. S. Los Angeles
U.S. NAVY
LOS ANGELES
SEA ANCHOR
FOR AIRSHIPS
See Page 14
EX NG COMPANY, 230 FIFTH AVENUE, NEW YORK, N. Y

The Month's Scientific News Illustrated

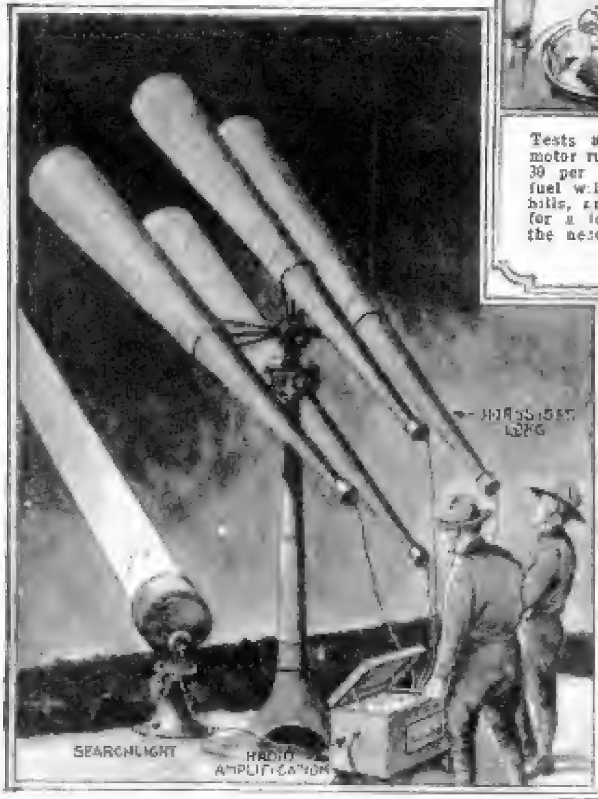
By GEORGE WALL

A new self-discharging collier has recently been put in service by a Montreal concern. Features of the boat's design are conveyor belts situated below 40 hoppers holding the cargo, which carry the coal over a boom extending 75 feet out from the vessel's side when discharging. When the boom is not in use, it can be lowered between the hatches and lashed in place. The ship is called the "Coalfax," and has a dead-weight capacity of 3,050 tons. She made a 20-day voyage from England, where she was built, to Montreal, Canada.

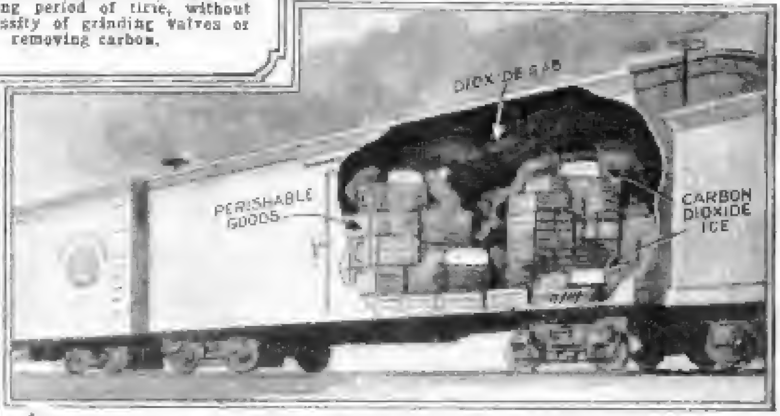


The Egyptian government is taking active measures to combat an invasion of locusts. The young locusts are now in the crawling stage, and efforts are being made to kill them before they reach the flying stage. The British air force is lending assistance in the campaign, and will use poisonous gas emitted from an airplane to destroy these pests.

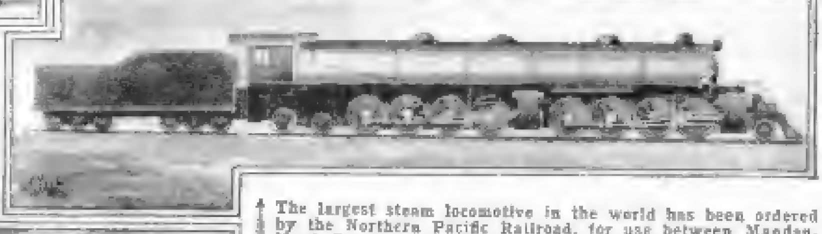
Tests are being made on a new motor fuel which contains from 20 to 30 per cent of alcohol. This new fuel will give great acceleration on hills, and the engine may be used for a long period of time, without the necessity of grinding valves or removing carbon.



The U. S. Army has perfected a sound locator which picks up a plane 15 miles away. A 15-foot horn picks up the sound made by an airplane, which is further amplified by a bank of radio tubes. At night a searchlight is synchronized with the sound-locator. The horns work in pairs and these are attached to two observers. One for the horizontal, the other for the vertical movement.



Ice cream and perishable foods are now sent from New York to Cuba and arrive in perfect condition. Solid carbon dioxide "ice" or "snow," so-called "dry ice," is used for the refrigerant. The reduction of this substance by evaporation is only about 10 per cent in 24 hours. The carbon dioxide gas given off, being heavier than air, forms a frigid insulating blanket and keeps warm air away. This new refrigerant is about fifteen times as efficient as water ice.



The largest steam locomotive in the world has been ordered by the Northern Pacific Railroad, for use between Mandan, North Dakota, and Glendive, Montana. The Northern Pacific engine will be 121 feet in length, over half as long as a city block. It will be carried by 22 wheels, 16 of them will be "drivers." The engine tender will hold 26 tons of coal and 20,000 gallons of water. The area of the grate will be approximately 183 square feet. The fire-box measures 266 inches x 114 inches. The tender is to be 33 feet long and about 16 feet high, at its front end

Eight of America's largest railroads are considering plans for constructing airport landing decks above city terminals. The planes would be used in connection with rail transportation. Complete plans have been formulated for railroad terminal landings, at about twenty of the largest cities. Mr. F. Naulty, an aeronautical engineer, has been engaged to work out details of the construction. He is also the originator of the airport landing deck idea as outlined recently by Postmaster General New. It is considered that this method of airplane landing offers the best practical solution of the airport problem in congested communities.

The Commanding Officer of the Giant Tells Here Some of the Little Known That You Have Always Been Curious to Dirigibles? Read What

Lieut.-Commander C. E. Rosendahl, U.S.N.

QUESTIONS ASKED BY H. GERNSBACK, EDITOR, FOLLOWING RADIO TALK OF LIEUT. COM. C. E. ROSENDAHL, U. S. N., FROM WRNY.

1. Q. In your opinion, can a huge dirigible of the Los Angeles' type compete successfully with airplanes in carrying passengers?

A. There is no competition between the airplane and airship if each is properly employed. To use an airship to do the work of an airplane is as extravagant and inefficient as the use of a sea-going steamer on a short coastal run or on ferry boat duty. The airplane is and will probably always be a short range carrier, while the airship is fundamentally a long range vehicle.

2. Q. What do you believe the maximum speed that airships can obtain for commercial traffic?

A. It is believed that a speed of about 100 miles per hour will be attained by dirigibles of future commercial size.

3. Q. What provisions if any have been made in passenger carrying across the oceans to safeguard passengers if airships were forced down into the ocean?

A. An airship in trouble is not necessarily forced down in the ocean—in fact, she would fly as a free balloon, in case all motors failed; but there is extremely little likelihood that all of six or eight individual power plants would fail simultaneously. Airships carry sea anchors similar to surface ship practice. There are many instances on record where German Zeppelins—badly damaged in war—returned safely to their bases. Safety lies with staying with a ship and flying to her base.

4. Q. If lightning struck one of these huge helium-inflated airships, what damage would be done?

A. Even hydrogen-inflated airships have been struck by lightning without any damage. An airship is a huge, thoroughly bonded metallic structure, that would readily dissipate an electric charge; added safety being assured by the use of the absolutely non-inflammable helium gas as the inflation medium.

5. Q. Can this country produce sufficient helium for any amount of dirigibles?

A. The United States has practically a world monopoly of the supply of helium. Nowhere else in the world is there a sufficient quantity of helium-bearing natural gas to pay for its production. Recent reports indicate that there is practically an unlimited supply of helium in certain gas-bearing fields in the United States—certainly enough for all the airships we shall operate for scores of years to come.

6. Q. What are the advantages of helium over other lifting gases?

A. Helium is a safe lifting gas in that it will absolutely not combine with any other element and therefore cannot burn nor explode. It is next to the lightest gas known and available for airship inflation. It has 92% of the lifting power of hydrogen, and its much greater safety over hydrogen makes its use of the utmost value.

7. Q. Can an airship, while moored to its mast, outride practically any storm that may come along, including a hurricane?

A. An airship moored to a mast can ride out very severe storms—certainly any containing winds up to the speed at which the ship itself is designed to fly. In the case of hurricanes or tornadoes greater safety lies in taking the air and flying out the storm, just as a steamer puts out to sea in severe storms, heaves to at sea, or runs around severe disturbances.

THE year 1928 will be an unusually important and spectacular one for dirigibles; it is not necessary to consult an astrologist to glean this from the stars, as there are other unmistakable signs already apparent. 1927 saw many triumphs for the airplane—its records are written in history. Outwardly, 1927 was a quiet one for dirigibles; actually, much unseen and vital experimental work progressed and some new construction continued in its early stages. It is on this dirigible or airship phase of aeronautical activity that I wish to discuss briefly.

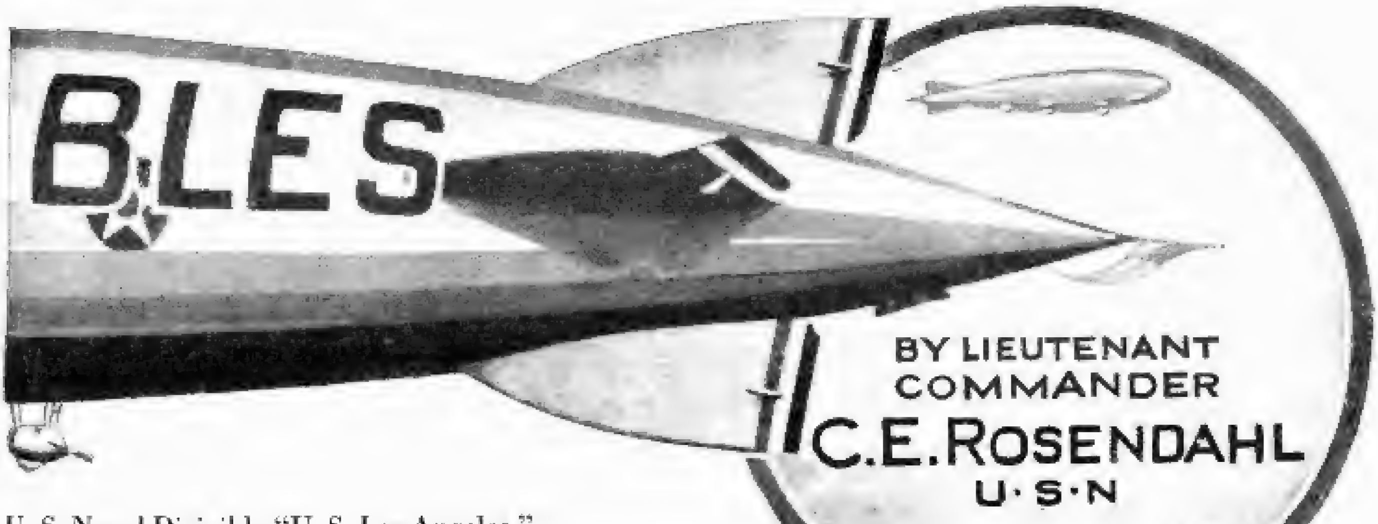
HEAVIER-THAN-AIR CRAFT DEFINED

MANY people do not distinguish between "heavier-than-air" craft (i.e. airplanes) which must depend on their engines to hold them aloft as well as to drive them through the air, and "lighter-than-air" craft (or dirigible balloons) which are sustained by some buoyant medium such as helium gas and devote practically the entire effort of their engines towards propelling them. Thus the term "airship" is sometimes used indiscriminately for all forms of aircraft. We in the lighter-than-air branch of aeronautics feel that the term "airship" properly should be applied only to lighter-than-air craft, as they are fundamentally "ships" and incidentally ships that float in air. Airplanes are much more widely distributed than airships, and naturally the plane and its habits and character-

One method of mooring dirigibles is shown above. The ship is tied to a land mast.

When landing upon the deck of a ship, a number of ropes are employed as shown here.

One of the newest inventions is a sea anchor for dirigibles used as shown



BY LIEUTENANT COMMANDER C.E.ROSENDAHL U·S·N

U. S. Naval Dirigible "U. S. Los Angeles," Things About Lighter-Than-Air Craft Learn About. Should We Build More Commander Rosendahl Says

ships have therefore become more commonly known than those of its scarcer cousin, the airship. However, this unfamiliarity with the airship will soon vanish, for the realization is dawning that large airships—often referred to in the past as "Zeppelins"—are essential both to commercial transport and to the national defense.

DIRIGIBLES FOR SAFETY AND COMFORT

MANKIND continues to demand greater speed in transportation—think of the vast amount of effort spent to obtain speed! Is there anyone who hasn't been thrilled at the tales of the magic carpet of the Arabian Nights and its ability to annihilate distance? High speed trains and fast steamships demand extra fare and we continue to patronize and support them. Further increases in railroad and steamship speeds are very expensive and difficult to obtain. As soon as the speediest transport of all—that by air—becomes more generally realized with safety—mankind is sure to take quite liberally to the use of aircraft, particularly if comforts and conveniences may be had simultaneously with the greater speed. Airplanes and airships are the next available means of supplying speedier travel—the airplane for short or moderate distances, the airship for long distances. Airplanes can provide a certain degree of comfort but it is the airship which can supply the maximum of comfort and safety in the air for longer voyages.

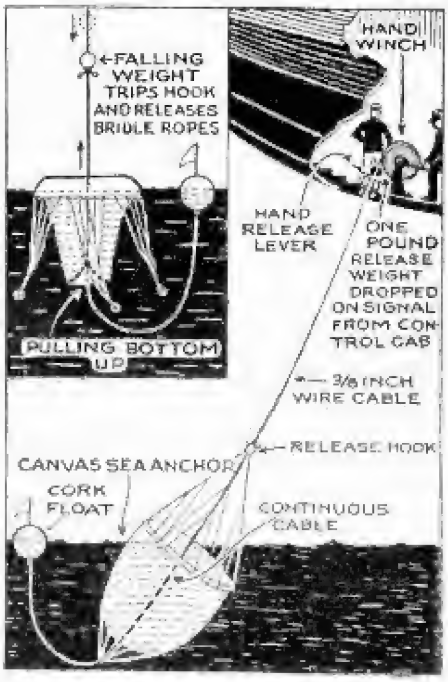
EVOLUTION OF THE AIRSHIP

PERHAPS you might be interested in the evolution of the airship. In 1783, that is, about one hundred and forty five years ago, the first balloon flight was made. Men had observed that hot air would rise; therefore by inflating a bag or container of light material with heated air, the container could be made to rise and take with it a basket or car in which to carry the passengers and other loads. Soon man was able to produce hydrogen gas in sufficient quantity to inflate a balloon and since hydrogen is so much lighter than air, it has always been a most efficient lifting gas. Of course, balloons drift with the wind and man soon became desirous of providing them with motive power so that he might go in any direction independent of the wind. Early effort consisted of rowing with silken oars but of course this method was not practical. In 1852 the first power driven or dirigible balloon was built. It derived its motive power from a three-horsepower steam engine. The modern airship had to wait for the development of the gasoline engine and a light strong material with which to build the structure. It was in 1900 that Count Zeppelin completed and flew his first rigid airship in Germany. Our first American airship was built in 1908.

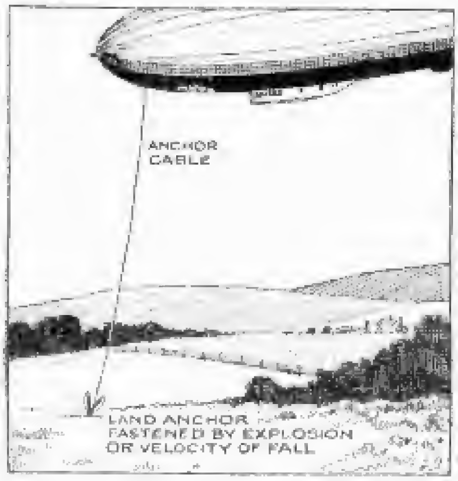
LIGHTER-THAN-AIR CRAFT CLASSIFIED

AT this point let me classify for you lighter-than-air craft or those forms of

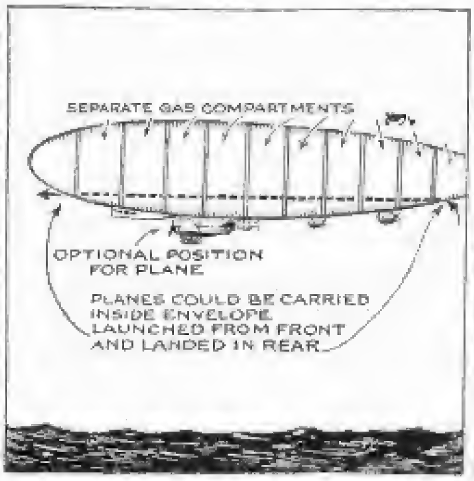
(*Continued on page 79*)



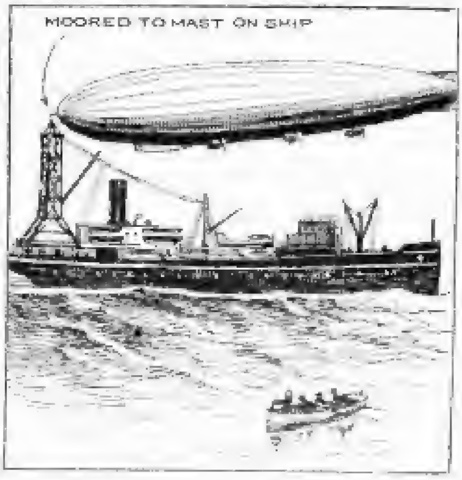
The above illustration gives all the details of the new canvas sea anchor.



An emergency landing can be effected by using a land anchor which can afterwards be cut loose.



Modern dirigibles have separate gas compartments. The U. S. Navy will fit dirigibles for carrying airplanes.



A dirigible can be moored to a special mast on a ship, as was recently done with the "S. S. Patoka."

The Metal EMPEROR

by A. Merritt

Author of "THE MOON POOL", "THE FACE IN THE ABYSS" etc.

(Eighth Installment)

Synopsis

Dr. Louis Thornton is traveling through Tibet with his Chinese servant-cook, Chiu Ming, and two ponies that carried the impedimenta. They come upon a white man who introduces himself as Richard Keene Drake. Drake's father had been very friendly with Thornton. The three decide to carry on and come upon Martin Ventnor, a geologist, and Ruth, his daughter. The latter are guarding themselves against hundreds of soldiers who belong to an age at least twenty centuries back. While escaping they are attacked and would have been exterminated, were it not for the timely intervention of Norhala, a tall, beautiful, metallic-haired woman, whose control over lightning and over heavy metallic blocks was phenomenal. These blocks, at her command, would make a bridge for her to walk on or form themselves into battling monsters to protect her or obey her every whim. Chiu Ming is killed in the battle, the survivors leaving with Norhala. Ruth and Norhala get on one of the blocks. The others stand upon a second composed of four smaller ones joined together by their own peculiar super-normal power. The platforms speed through space at a terrific rate, arriving eventually in the court of the Metal Emperor. Angered by the influence of Norhala over Ruth, Ventnor raises his rifle and fires at the red ruby-like object he believes to be the brain of the metal monster. He is struck down by a lance of green flame and rendered unconscious. The metal monster gives Norhala the entire company to serve as her toys. She takes them to her home, where she informs Yuruk, her ape-like eunuch attendant, they are not to be harmed. Ventnor talks, then lapses into unconsciousness again. Ruth, after telling about the strange power that holds her enslaved, goes to sleep. Drake and Thornton discourse on the metal intelligences, and come to the conclusion that they are guided by some sort of group consciousness, and that they move by super-rapid molecular "steps!" Yuruk, because of jealousy, informs Drake of the way back to the city, which Ventnor, in a semi-conscious state, told them was their only hope. Yuruk claims that though the inhabitants of the city were hostile, it is much safer to escape. Leaving Ruth with Ventnor, Thornton and Drake decided to skip away from Norhala. They informed Ruth that Yuruk has learned the meaning of the pistol. After rather spectacular adventures, they come upon the Metal City, where geometrical and intangible forms are seemingly endowed with super-intelligence. The city saw and was alive. Norhala appears unexpectedly and is just as quickly blotted out from sight. They observe the metal hoards and make the acquaintance of the Metal Emperor, to be subsequently brushed out of his presence, after which they glide away rapidly

CHAPTER XXII

THE BIRTH CHAMBER OF THE HORDE

"PROFESSOR," Drake broke the silence, "this isn't the way to get out. We're going in, going away all the time from the—gates."

"What can we do?" my anxiety was no less than his, but my realization of our helplessness was complete.

"If we only knew how to talk to these Things," he said. "If we could only have let the Disc know we wanted to get out—damn it. I believe it would have helped us!"

Grotesque as the idea sounded, I felt that he spoke the truth. The Disc meant no harm to us. In fact, in speeding us away, I was not at all sure that it had not deliberately wished us well. I could not forget the strangling tentacles of the Keeper of the Cones.

"Pushed us away as though we were children—or the cat." Drake echoed my thoughts. "Shooed us off as though it were saying 'Run along now and play—or you may get hurt!'"

Still up we sped along the shaft. A thousand feet, two thousand feet I knew we must be now above the level of the valley.

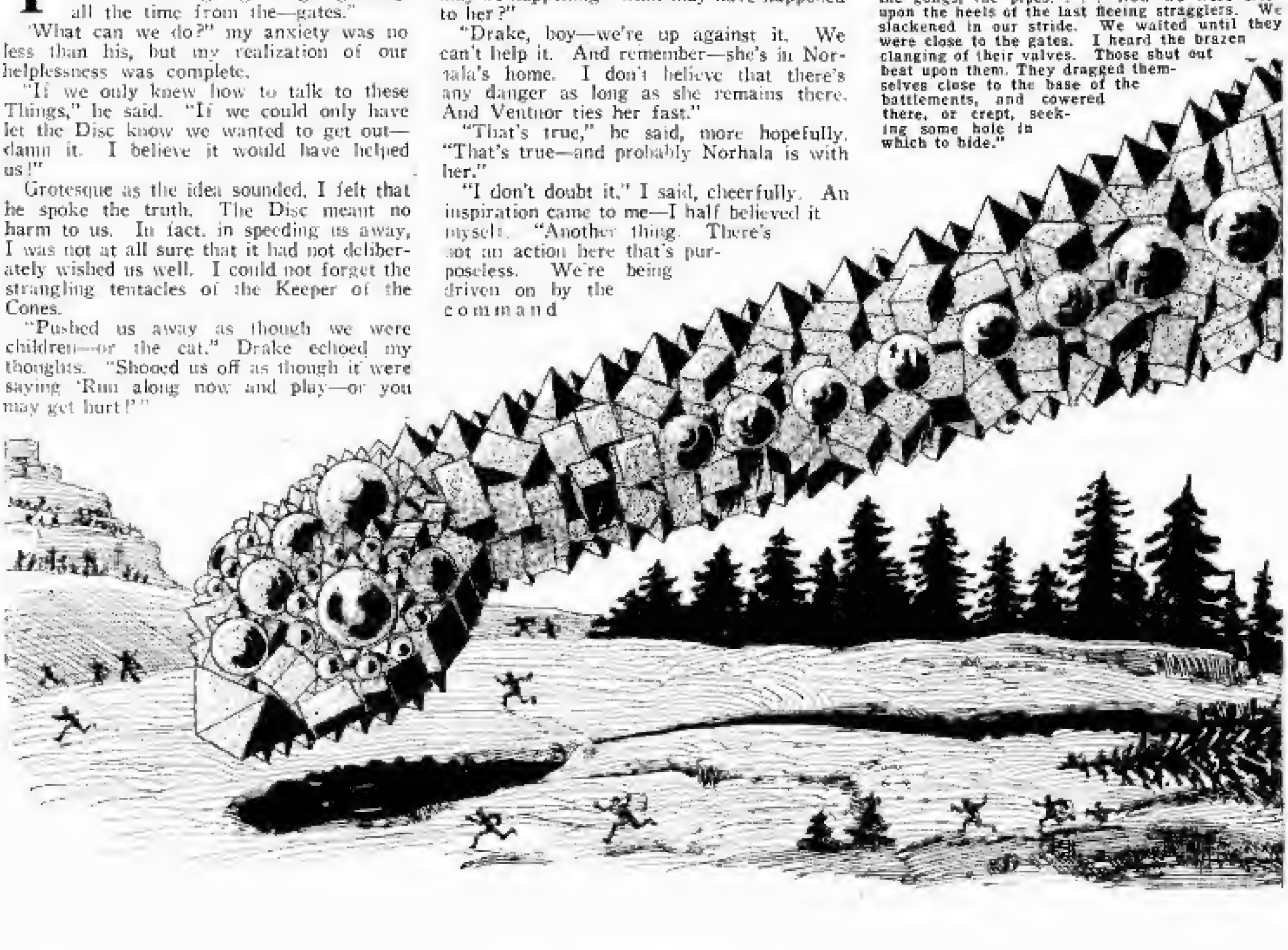
"We've got to get back to Ruth! What will she be thinking?—It's night! And what may be happening—what may have happened to her?"

"Drake, boy—we're up against it. We can't help it. And remember—she's in Norhala's home. I don't believe that there's any danger as long as she remains there. And Ventnor ties her fast."

"That's true," he said, more hopefully. "That's true—and probably Norhala is with her."

"I don't doubt it," I said, cheerfully. An inspiration came to me—I half believed it myself. "Another thing. There's not an action here that's purposeless. We're being driven on by the command of that Thing you have called the Metal Emperor. It means us no harm. Maybe—maybe this is the way out."

"Again the monster shook beneath us. Faster we moved. Louder grew the clangor of the drums, the gongs, the pipes. . . . Now we were close upon the heels of the last fleeing stragglers. We slackened in our stride. We waited until they were close to the gates. I heard the brazen clanging of their valves. Those shut out beat upon them. They dragged themselves close to the base of the battlements, and cowered there, or crept, seeking some hole in which to hide."



"Maybe so." He shook his head doubtfully. "But I'm not sure. Maybe that long push was just to get us away from there. It strikes me that the impulse has begun to weaken. We're not going anywhere near as fast as we were."

I had not realized it, but our speed was slackening. I looked back—hundreds of feet behind us fell the slide.

"There are other passages opening up along this shaft," Drake urged. "I'm not for trusting the Emperor too far—it has other things on its metallic mind, you know. The next opening we get to, let's try to slip into it—if we can!"

I had noticed the openings along the ascending shaft, corridors running apparently transversely to its angled way. I nodded.

Slower and slower became our pace. I glimpsed one of the apertures, a hundred feet above us. Could we reach it? Slower and slower we arose, and nearer it came, nearer—our feet began to slip backward along the steep way. Now the gap was but a yard off. But we were motionless—were tottering.

Drake's arms wrapped around me. With a tremendous effort he hurled me into the corridor. I dropped at its edge, writhed swiftly around, saw him slipping, slipping down, and thrust my hands out to him.

He caught them. There came a wrench that racked my arm in its sockets. But he held. I writhed back into the passage, dragging up his almost dead weight.

For a minute or two we lay, flat upon our backs, resting. I sat up. The passage was broad, silent, apparently as endless as that from which we had just escaped. Along it, above us, under us, the crystalline eyes were dim. It showed no signs of movement. Drake arose.

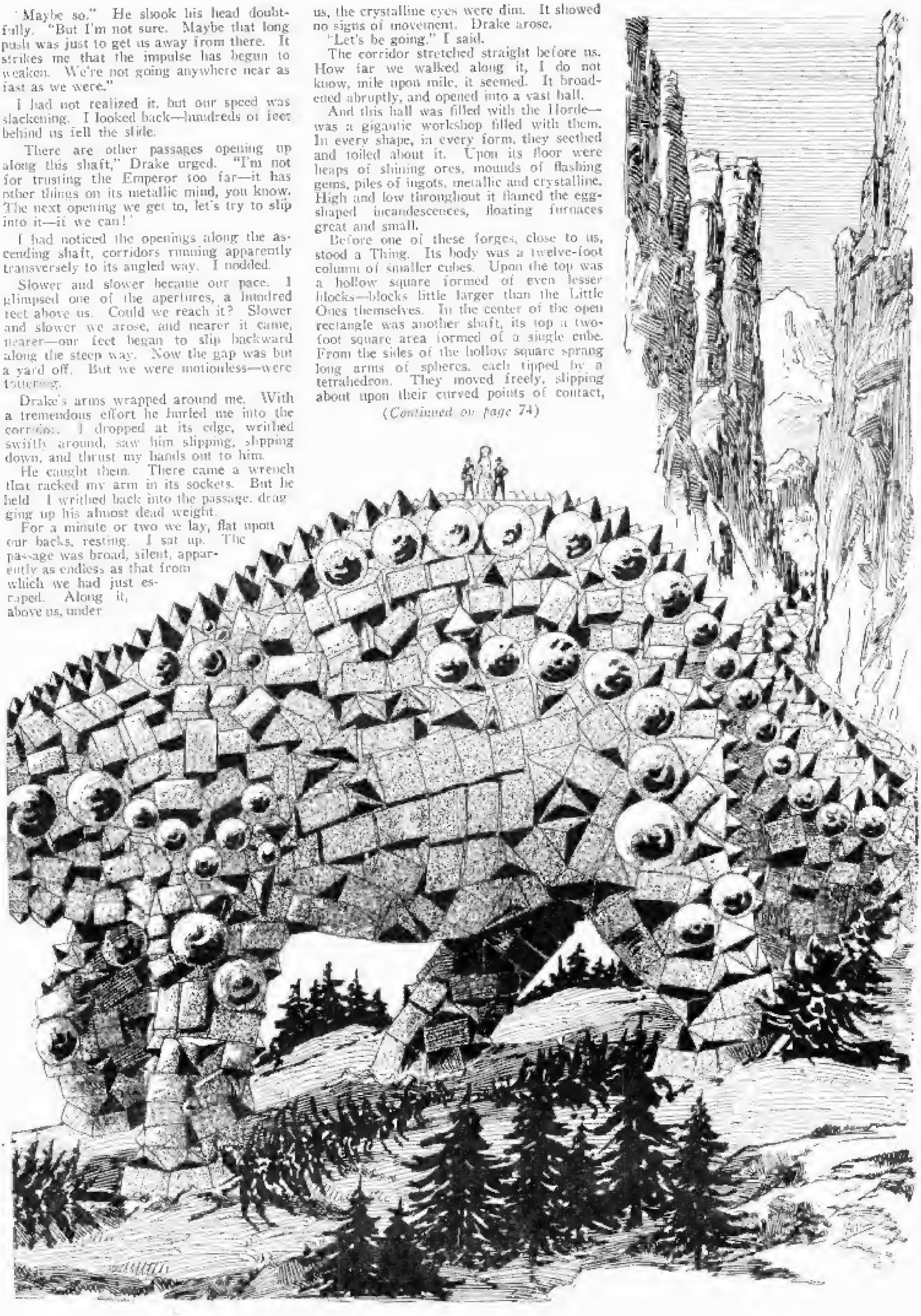
"Let's be going," I said.

The corridor stretched straight before us. How far we walked along it, I do not know, mile upon mile, it seemed. It broadened abruptly, and opened into a vast hall.

And this hall was filled with the Horde—was a gigantic workshop filled with them. In every shape, in every form, they seethed and toiled about it. Upon its floor were heaps of shining ores, mounds of flashing gems, piles of ingots, metallic and crystalline. High and low throughout it flamed the egg-shaped incandescences, floating furnaces great and small.

Before one of these forges, close to us, stood a Thing. Its body was a twelve-foot column of smaller cubes. Upon the top was a hollow square formed of even lesser blocks—blocks little larger than the Little Ones themselves. In the center of the open rectangle was another shaft, its top a two-foot square area formed of a single cube. From the sides of the hollow square sprang long arms of spheres, each tipped by a tetrahedron. They moved freely, slipping about upon their curved points of contact,

(Continued on page 74)



June

BROADCAST WRNY STATION

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Science and Invention

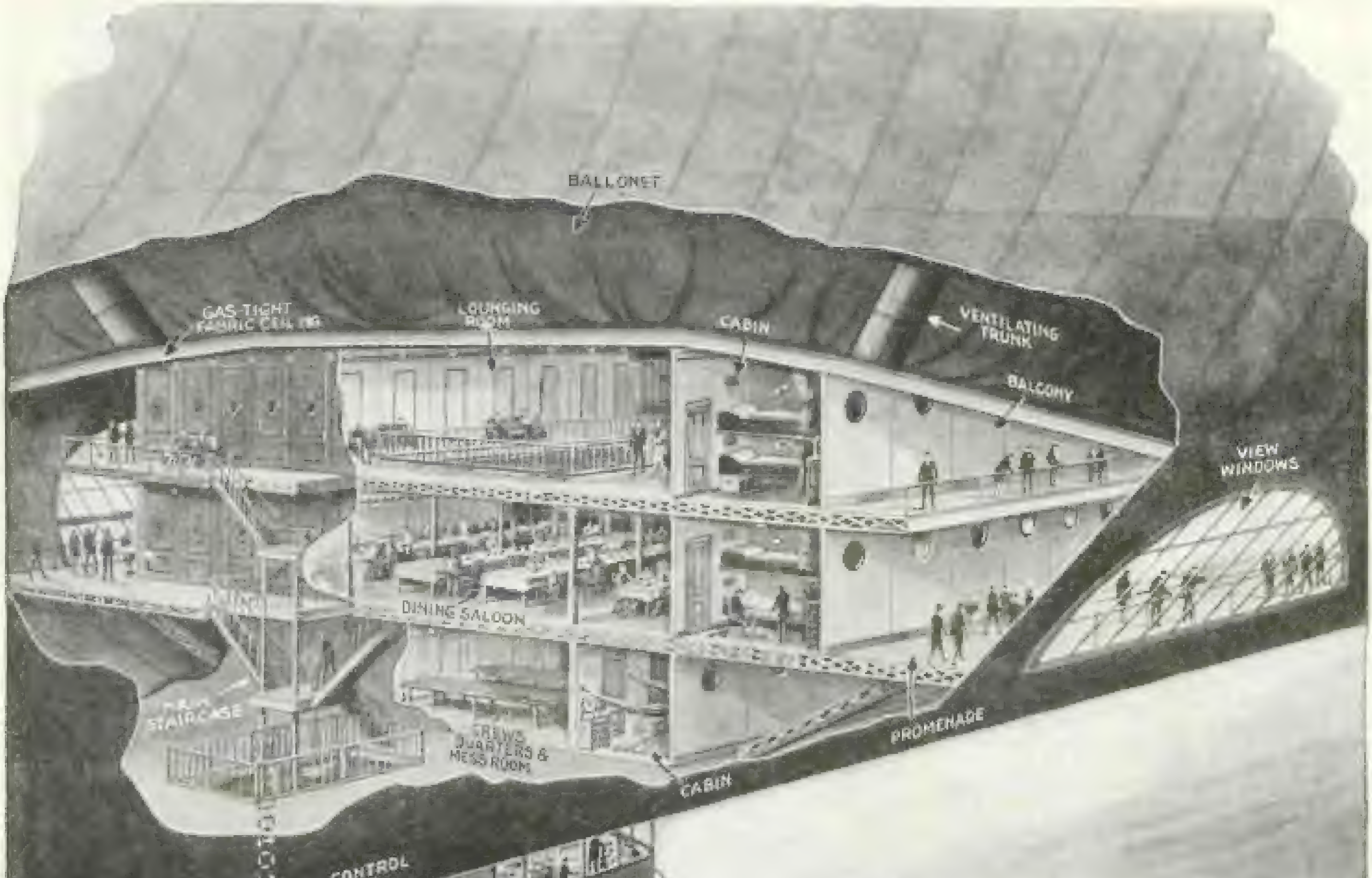
HARNESSING NATURE'S ELECTRICITY

See Page 110

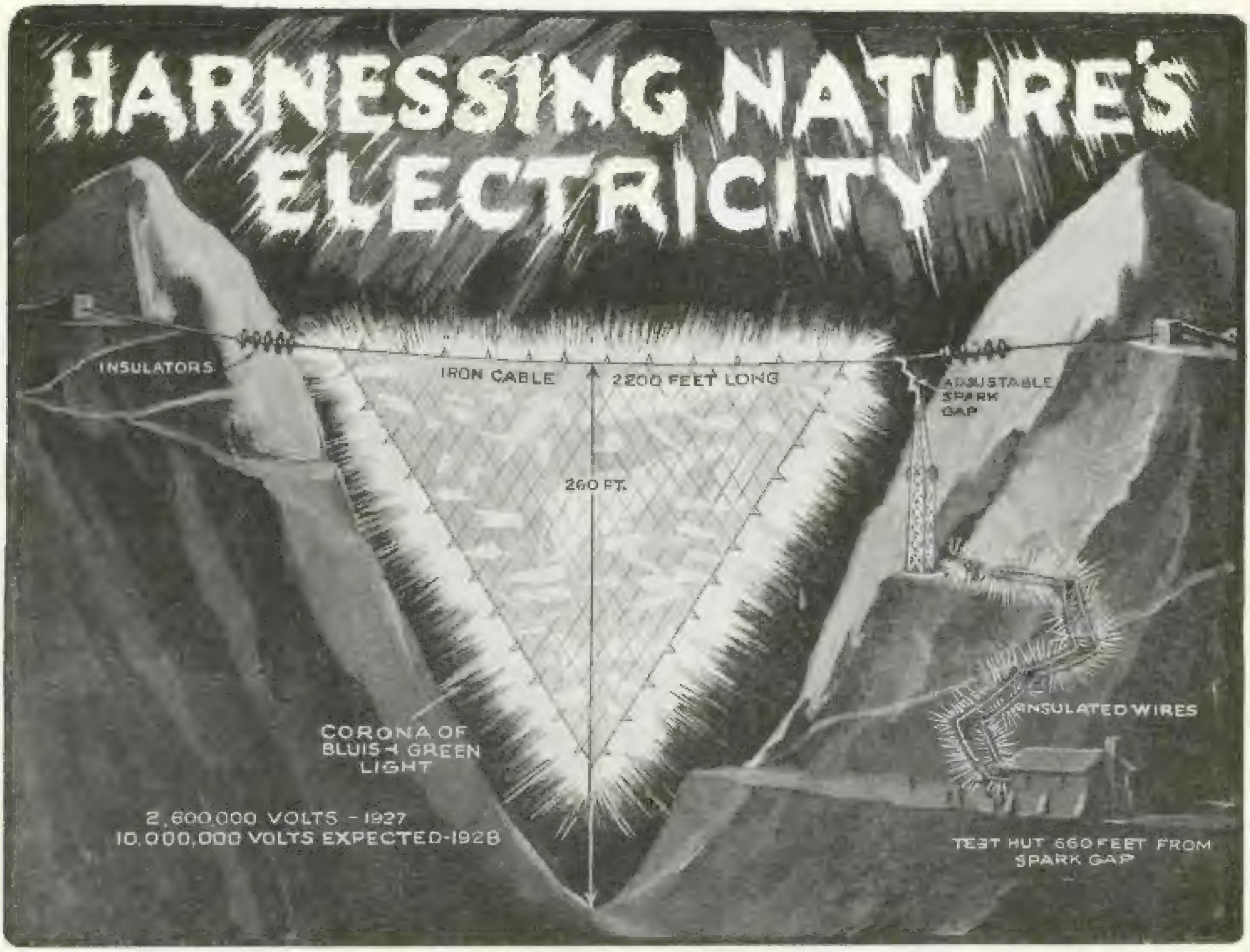
EXPERIMENTER PUBLISHING COMPANY, 230 FIFTH AVENUE, NEW YORK

A Trans-Oceanic Dirigible

Huge English Ship Accommodating 100 Passengers Nearing Completion

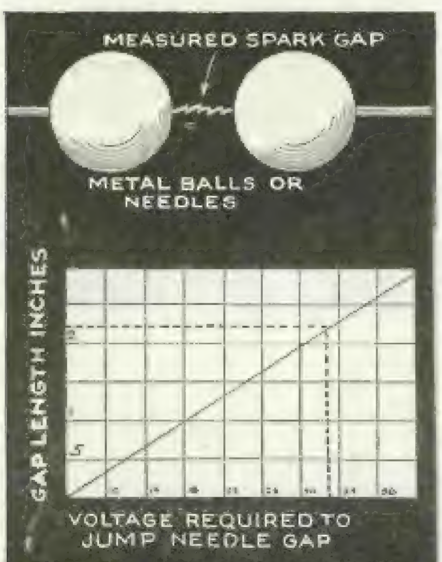


BRITISH engineers are rapidly completing the construction of a new dirigible which will be used in test voyages to demonstrate the feasibility of a regular ocean air line. The ship will be used on a New York, London, Montreal route. The passenger accommodations consist of the equivalent of a three-story house. The crew's quarters are situated on the lower floor, and above this are two promenade decks and a restaurant which will seat fifty persons at one time. The cabins are all equipped with either two or four berths and are fitted with electric light and compartments for baggage. A smoking lounge and two balconies are situated on the top deck. All the heating, lighting and cooking will be done by electricity. In the dirigible there are no engine noises and no vibration or any motion equivalent to that of an ocean liner. It is believed, therefore, that there will be no air sickness amongst the passengers. The R-100 is 709 feet long, and 133 feet wide. In making the outer envelope, 225,000 sq. ft. of fabric was used. This envelope is non-inflammable, thereby eliminating one of the greatest dangers attached to dirigibles. One of the interesting features of this "flying hotel" is the fact that when fully loaded with passengers, crew and supplies, the "pay load" is about 20 tons. Special fuel tanks capable of carrying 50 tons of fuel are being built into the ship. A larger trans-Atlantic vessel than the R-100 is now being planned.



The above scene shows the remarkable electrical effect which frequently occurs in the Alps Mountains, where three young German scientists are endeavoring to extract tremendous electrical discharges from the atmosphere. The idea behind these experiments is that man may find a way to disintegrate the atom, and thus unlock a tremendous new source of energy.

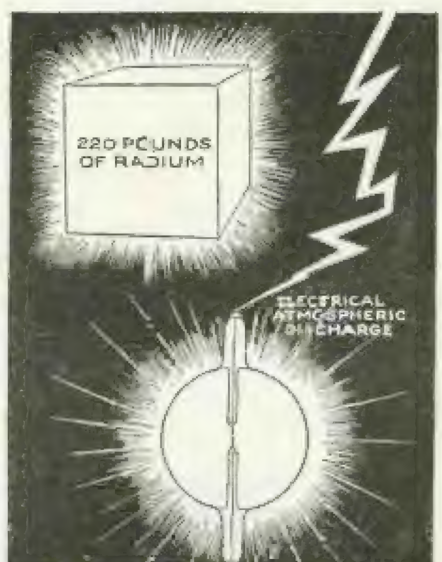
BENJAMIN FRANKLIN, fired the imagination of electrical engineers and experimenters all over the world for a century beyond his time, when on an immortal day he demonstrated by means of his kite, that lightning was a natural electrical phenomenon. Every student of electrical matters has at some time or other dreamed of utilizing the gigantic electrical charges which are ever present in the atmosphere surrounding our earth. Several scientists have lost their lives while trying to harness the tremendous electrical discharges in the form of lightning. Last summer and again this summer, three young German scientists, A. Brasch, F. Lange and C. Urban of the University of Berlin, aided by all the latest scientific information as to how to protect themselves, will attempt to measure and chart the atmospheric electrical discharges high up in the Alps.



Sphere spark gaps, and in some cases needle gaps, of predetermined dimensions are used for measuring high potential discharges. When a discharge jumps a certain length of gap, the voltage is easily read from the calibration chart.

These daring young scientists found in last summer's experiments that electrical sparks of great intensity and accompanied with a roar like that of huge cannon, jumped the gap of their apparatus repeatedly, even when no electrical storms were in the vicinity. On several occasions electrical sparks jumped the large gap on an average of one every second for thirty minutes, and these discharges averaged two million volts. A beautiful corona of bluish-green color played around the cable and wire net at night. The cable and net were suspended across the valley between two peaks in the Alps, as the accompanying pictures show. This corona had all the appearances of the Aurora Borealis, that most magnificent electrical display observable in the arctic regions particularly.

In last year's experiments, the three scientists measured atmospheric discharges having potentials as high as 2,600,000 volts, when the summer electrical storms were practically over; it is hoped this year with the improved apparatus to measure potentials up to ten or more million volts. It is known that potentials of from 5,000,000 up to 30,000,000 volts passes to earth from an



It is hoped by the European investigators that a sufficiently powerful atmospheric electrical discharge can be obtained, which will yield a power equal to the Alpha rays obtained from 220 pounds of radium.

Remarkable European Experiments with Atmospheric Electrical Discharges with Potentials as High as 3,000,000 Volts

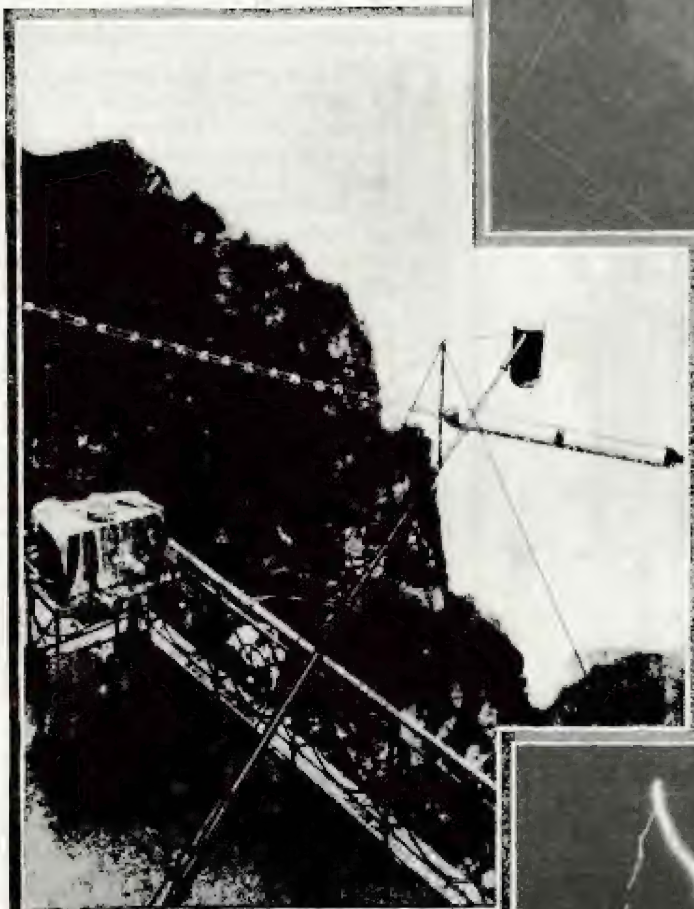
By HENRY TOWNSEND

elevation of 350 ft., and these students of natural electrical phenomena have found a very desirable location in the Alps, where they can suspend between one mountain and an adjacent one, a strong iron cable having a length of about 2,000 ft. This cable is about 250 feet above the intervening valley, and from it these daring engineers have suspended a coarsely woven wire net, which serves as an electrical capacity to gather the electricity from the atmosphere. As shown in the pictures, the wire net is supplied with numerous sharp points to aid in collecting the current from the air.

As the accompanying photographs of the actual apparatus and wire cable used last year clearly show, an adjustable spark gap of considerable length is provided. By adjusting this spark gap to various lengths, it is possible to judge the voltage of the discharge which leaps the gap at any moment. Mr. F. W. Peek, Jr., the well-known American worker in the realm of high voltage measurements, together with other engineers, have provided tabulated data and curves for various lengths of both needle and sphere type spark gaps. As one of the accompanying diagrams shows, it is a simple matter to calculate the voltage when a certain length of gap is used. The engineer first checks the length of the gap on the chart; he then follows a line horizontally from the gap length, to where it intersects with the angular line on the chart; and from the point of intersection he looks in a visual line downward to a place where the voltage is given. For needle spark gap measurements, the characteristic curve on the chart is practically a straight line, while for sphere gaps the characteristic curve on the voltage versus gap length, is a curved line. Those interested in high voltage measurements by means of the spark gap method can find the voltage-gap tables and charts in the *Standardization Rules* of the American Institute of Electrical Engineers. According to Mr. Peek's researches, the voltage per foot of atmospheric electrical discharges is about 100,000, while in laboratory measurements with A.C., transformer high potential discharges, the average voltage per foot of spark was found to be about 150,000 volts. The voltage of a lightning flash may

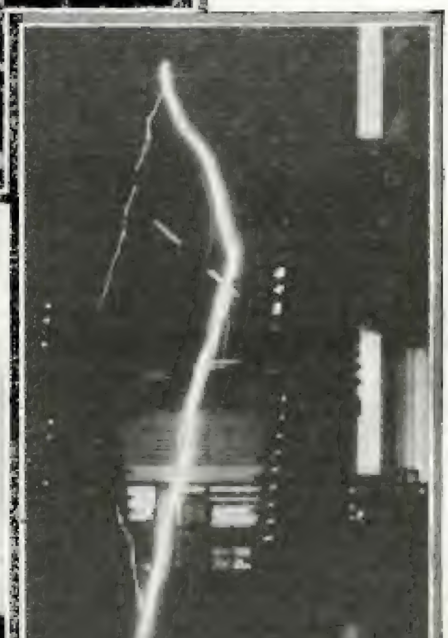
(*Continued on page 156*)

↑ Actual photo above shows 13 ft., heavy spark obtained from the collecting net in the Alps by the German scientists. The voltage is about 2,000,000. The spark occurred once per second for 30 minutes.



Photo, left, shows the adjustable spark gap used in the Alps. Notice the heavy electrode on the end of the adjustable arm to which the spark jumps. ←

Below we see 3,000,000-volt artificial lightning stroke produced in G. E. Laboratory at Pittsfield, Mass. Note man. ↓



Actual photograph of the experimental "kite" used by the German experimenters in the Alps Mountains, for the purpose of accumulating high potential electrical discharges from the atmosphere. Note the size of the insulators.

Helicopters

New Advances in the Field of Aeronautics Relate to

The above illustration shows a new style of proposed helicopter which has a separate engine in each of the vertically acting foils and also an engine and propeller for propulsion.

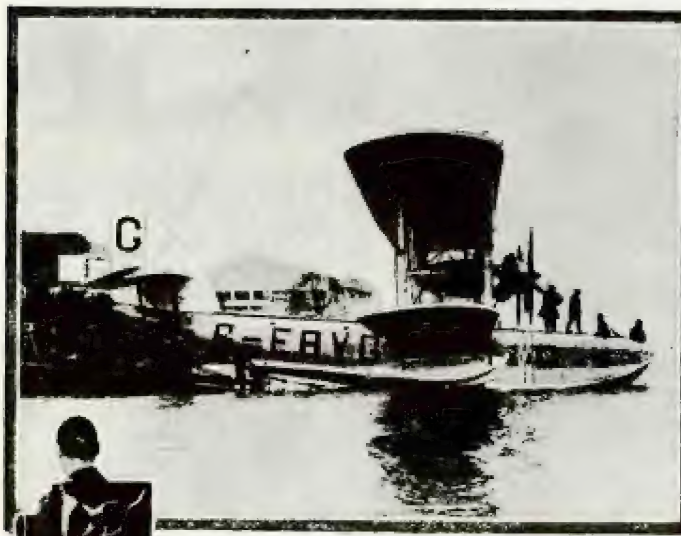
THE world is looking forward to new developments in aircraft, and possibly even getting more than it expects in the way of radical departures from present styles. Aviation enthusiasts believe that the only solution to the problem of popular flying is the development and successful demonstration of vertical flying machines. These machines will have to be able to rise from a limited tract of land and come to rest in the same space. In addition, they will have to proceed at a speed of approximately sixty miles an hour and be absolutely safe, even in the event that the engines should stop.

A prominent eastern aircraft corporation has announced their intention of proceeding to develop the vertical-rising aircraft illustrated on this page. This consists of two air foils or modified propeller blades, mounted at the end of cross arms, and each of the foils is to be provided with its own engine and propeller. These areas are to provide the lift, and they both turn in opposite directions, as the diagram indicates. Instead of tilting the airplane, in the usual method in order to produce a horizontal flight, a propeller and engine for propulsion is provided. The airplane itself will also have a plane surface large enough to permit the craft to glide to the earth, in event of accidental stoppage of any or all of the motors.

The well known electrical wizard, Dr. Nikola Tesla, has invented a new method of aerial transportation, explained in his patent No. 1,655,113. The details of this are also indicated on these pages. Dr. Tesla states that the helicopter type of flying machine is quite unsuitable for speedy aerial transportation because of the large inclination angle of the propeller axis to the horizontal at which the ordinary types are expected to operate. He further holds that these machines are incapable of proceeding horizontally along a straight line under prevailing air conditions, that they are subject to plunges and oscillations, and almost certain to be doomed to destruction in case the motive power gives out. In his own system, the construction is composed of two planes rigidly joined. The tail is omitted for the sake of smallness and compactness, or if used, is retractable by simple means.

As motive power, Dr. Tesla intends to employ the turbines which he invented some years ago and which were fully described in the July 1920 issue of this publication. When the mechanism is at rest, the planes and the driving propeller will be vertical. The operator or passengers are suspended on trunnions which can turn through an angle of about 90 degrees. The usual devices for lateral and directional control are provided to enable the operator to actuate them by foot or hand.

At the start, sufficient power being turned on, the machine will rise vertically in the air to the desired height. When it is gradually tilted by manipulating the elevated devices and proceeds like an airplane, the load being transferred from the propeller to the foils as the angle of inclination diminishes and the speed in the horizontal direction increases. It will thus be seen that with the tilting of the machine, the operator will increase the thrust of the propeller in order to compensate for the reduction of sustaining force which follows as the plane tilts, and before the reaction of the wings can come into full effect. He then gradually cuts down the motive power as the machine gains in velocity. From this point on, the operator can proceed to his destination and on reaching this, the same mode of bringing the machine to a rest is employed. Here the operator causes the machine to again rise in the air and permits it to gradually settle down, as he decreases the thrust of the propeller or the speed of the engine. It will again be observed that at this point the load is being carried primarily by the propeller.



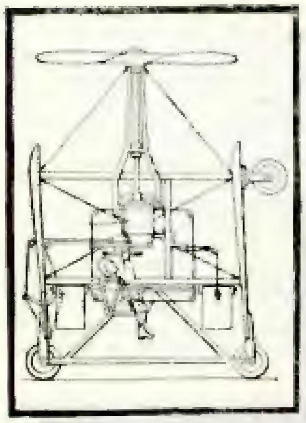
The photograph above shows a new giant all-metal British seaplane which has just been put into service. It will carry fifteen passengers and their baggage, and is fitted with safety appliances.

The interior seating arrangement of the new British seaplane. The seats are so arranged that they house both life preservers and parachutes, both of which can be instantly strapped to the occupant.

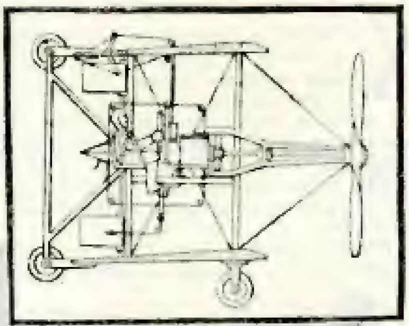
The photographs here show the world's largest seaplane liner. It is equipped with three 485 horsepower Jupiter engines, and is made entirely of metal. It is completely equipped with every convenience for the passengers, including dining and culinary service. The seats are air-filled, and comfortably hold the life belt and parachutes for a forced departure from the plane. The photographs on either side show one of the seats and the equipment strapped to a passenger. The immensity of this plane can be estimated by comparing with the men standing on the vessel.

and Safety Planes

Making Flying Safer and Toward the Development of Vertically Rising Machines.



Below is an artist's conception of the vertically-rising helicopter invented by Dr. Nikola Tesla as it would appear in flight, at rest, and taking off. At the left are the details of the mechanism as it would appear when an aviator attempts to arise or alight. Speeding up the propeller and tilting the plane, he assumes the position indicated at the right and proceeds along his flight.



It will be observed that any type of a gasoline engine could be employed in a helicopter of this nature, but Dr. Tesla recommends the use of his gasoline turbine because of its lightness and because it lends itself to this kind of work, for which the modern types of engines might be unsuited. His own turbine is capable of carrying a great overload and of running without danger at excessive speeds so that during the starting and landing operations, the necessary power can be developed by the motors. At the same time there is always a surplus of power which can be employed if the operator desires to greatly increase his forward speed. The illustrations on this page show the machine as it would appear at rest, with the propeller in a vertical position and the same plane in horizontal flight. No tail is here indicated, but if one were to be employed, it would as mentioned before, be quickly retractable.

And in London, developments along the line of passenger aircraft are rapidly proceeding, with every safety appliance imaginable being included and everything being done to accommodate the passengers. In these large planes the seats are now fully equipped with both parachutes and life preservers, so that in the event the passengers have to leave the plane because of an emergency, they can step out of it, even while it is in flight and negotiate a perfectly safe landing. These planes are all-metal built.

The ability of metal planes in carrying out successful long distance flights is exemplified by the German plane the "Bremen," the first to cross the Atlantic from east to west. The flight was from Dublin, Ireland to Greenely Island, Canada, with Baron von Huenefeld, Herman Koehl, and James Fitzmaurice.

The Metal EMPEROR

by A. Merritt

Author of "THE MOON POOL", "THE FACE IN THE ABYSS" etc.

(Ninth Installment)

Synopsis

Dr. Louis Thornton is traveling through Tibet with his Chinese servant-cook, Chiu Ming, and two ponies that carried the impedimenta. They come upon a white man who introduces himself as Richard Keene Drake. Drake's father had been very friendly with Thornton. The three decide to carry on and come upon Martin Ventnor, a geologist, and Ruth, his daughter. The latter are guarding themselves against hundreds of soldiers who belong to an age at least twenty centuries back. While escaping they are attacked and would have been exterminated, were it not for the timely intervention of Norhala, a tall, beautiful, metallic-haired woman, whose control over lightning and over heavy metallic blocks was phenomenal. These blocks, at her command, would make a bridge for her to walk on or form themselves into battling monsters to protect her or obey her every whim. Chiu Ming is killed in the battle, the survivors leaving with Norhala. Ruth and Norhala get on one of the blocks. The others stand upon a second composed of four smaller ones joined together by their own peculiar super-normal power. The platforms speed through space at a terrific rate, arriving eventually in the court of the Metal Emperor. Angered by the influence of Norhala over Ruth, Ventnor raises his rifle and fires at the red ruby-like object he believes to be the brain of the metal monster. He is struck down by a lance of green flame and rendered unconscious. The metal monster gives Norhala the entire company to serve as her toys. She takes them to her home, where she informs Yuruk, her ape-like eunuch attendant, they are not to be harmed. Ventnor talks, then lapses into unconsciousness again. Ruth, after telling about the strange power that holds her enslaved, goes to sleep. Drake and Thornton discourse on the metal intelligences, and come to the conclusion that they are guided by some sort of group consciousness, and that they move by super-rapid molecular "steps!" Yuruk, because of jealousy, informs Drake of the way back to the city, which Ventnor, in a semi-conscious state, told them was their only hope. Yuruk claims that though the inhabitants of the city were hostile, it is much safer to escape. Leaving Ruth with Ventnor, Thornton and Drake decided to skip away from Norhala. They informed Ruth that Yuruk has learned the meaning of the pistol. After rather spectacular adventures, they come upon the Metal City, where geometrical and intangible forms are seemingly endowed with super-intelligence. The city saw and was alive. Norhala appears unexpectedly and is just as quickly blotted out from sight. They observe the metal hoards and make the acquaintance of the Metal Emperor, to be subsequently brushed out of his presence, after which they glide away rapidly.

Thornton and Drake finally come upon the birth chamber of the Metal Horde, a surprising sight. The corridor closed and pushed the adventurers off a precipitous cliff. Falling fast, they see Norhala appear. The metal cubes save the two men from destruction. Norhala tells Thornton and Drake that Ruth and Ventnor have been take captive by Cherki's men. Norhala causes the Horde to form a mighty metal dragon, which moves forward to Ruszark, the City of Cherkis. Norhala demands the surrender of the maid and the man.

CHAPTER XXV
CHERKIS

THERE was stark amazement on Kulun's face now, and fear enough. He dropped from the parapet among his men. There came one loud trumpet blast. What was to happen next?

From the battlements poured a storm of arrows, a cloud of javelins. The catapults leaped forward. From them came a hail of stones. Before that onrushing tempest

Quick as a serpent's tongue, a pyramid tipped tentacle flicked out beneath us. It darted through the broken circle of the bowmen. It licked up Ruth and Ventnor and—Kulun!

of death I flinched and cowered.

I heard Norhala's laughter—and before arrow and javelin and boulder could reach us they were checked as though myriads of hands had reached and caught them.

Forth from the great spindle shot a gigantic arm, hammer tipped with cubes. It struck the wall close where Kulun had dropped. The stones crumbled and fell crashing. With the fragments fell soldiers who were buried beneath them. A breach a hundred feet wide gaped in the battlements.

Out shot the arm again. It hooked its hammer tip over the parapet, and tore away a stretch of its breastwork as though it had been cardboard. Beside the breach an expanse of the broad flat top lay open like a wide platform. That arm withdrew.

From the length of the spindle thrust other arms, hammer tipped, held aloft, menacing.

From all the length of the wall arose outcry. The storm of arrows ended, the catapults were still. Again the trumpets sounded, and the crying ceased. Down fell a silence, terrified and stifling.

Kulun stepped forth, both hands held high, arrogance gone.

"A parley," he cried. "A parley, Norhala. If we give you the maid and man will you go?"

"Go get them," she answered. "And take with you my command to Cherkis—that he return with them."

For an instant Kulun hesitated. Up thrust the dreadful arms, and poised themselves to strike.

"It shall be so!" he shouted. "I carry your command!"

He leaped back, and his red mail flashed toward a turret. He was lost to sight. In silence we waited.

On the further side of the city I glimpsed movement. Little troops of mounted men, pony drawn wains, knots of running figures, were fleeing from the city through the opposite gates. Norhala saw them too, and with that incomprehensible, instant obedience to her thought a mass of the Horde whirled up into a dozen of those obelisked forms I had seen march from the cat eyes of the City.

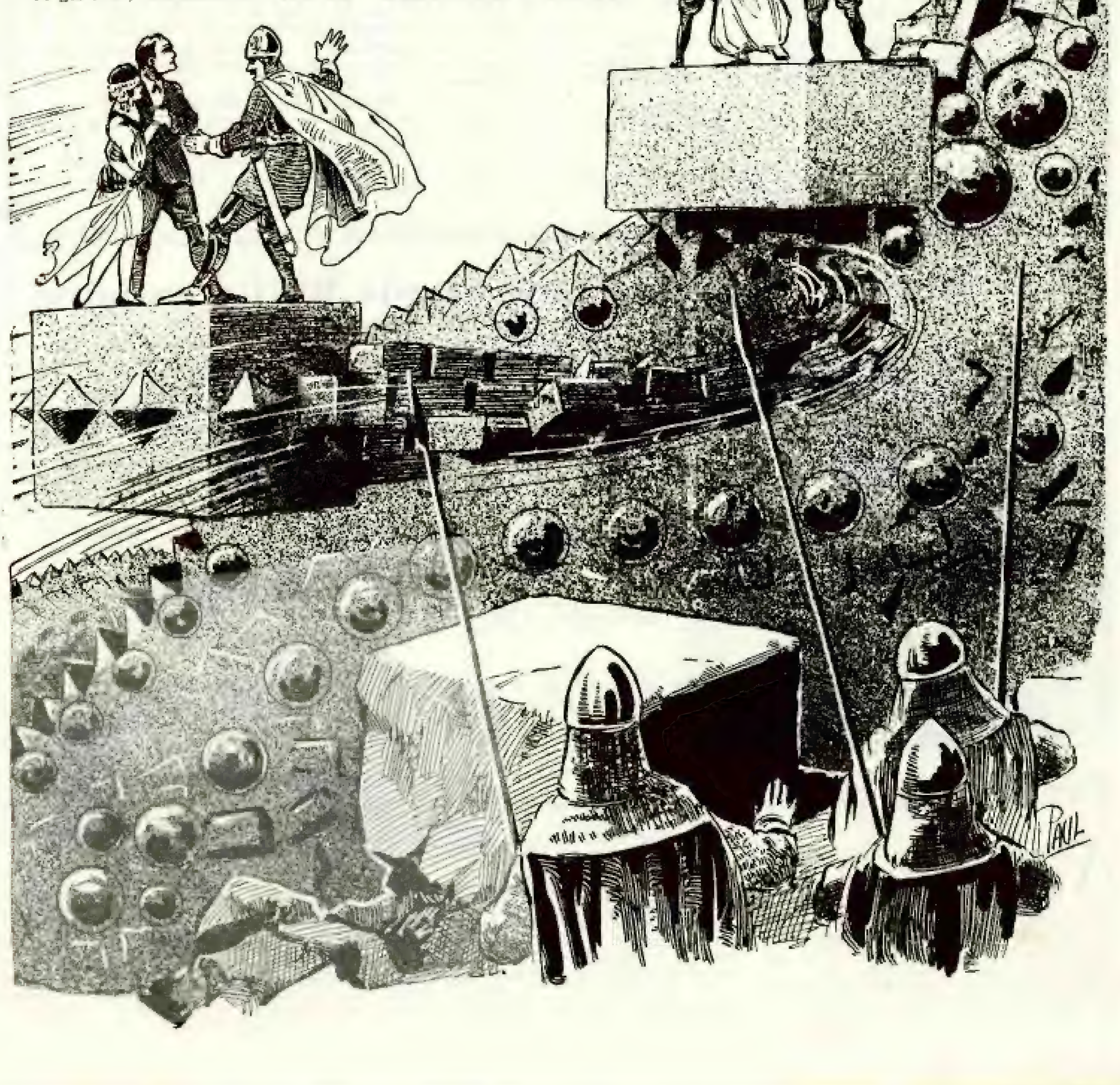
In an instant, their columns were far off, herding back the fugitives.

They did not touch them, nor offer to harm them only, grotesquely like dogs heading off frightened sheep, they circled and darted about them. Back rushed the people they herded.

From the watching terraces and from watchful walls arose shrill cries of terror and wailings. The obelisks met, pirouetted, and melted into one thick column. Towering, motionless as we, that pillar stood, guarding the further gates.

There was a stir upon the outer battlements, a flashing of spears and drawn blades. Two curtained litters appeared, surrounded by triple rows of swordsmen fully

(*Continued on Page* 181)



July

BROADCAST WRNY STATION

Science and Invention

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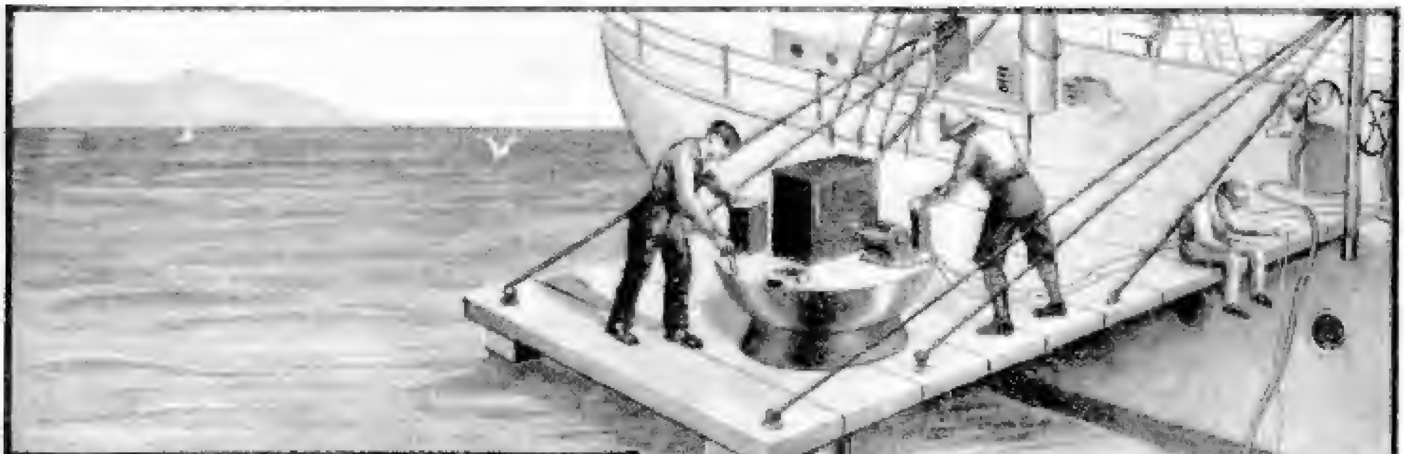
EXPERIMENTER PUBLISHING COMPANY, 230 FIFTH AVENUE, NEW YORK

Deep-Sea Motion Picture Camera

The Film Boxes Are at the Surface, But a Tube Carries the Film to the Lens Located Near the Bottom

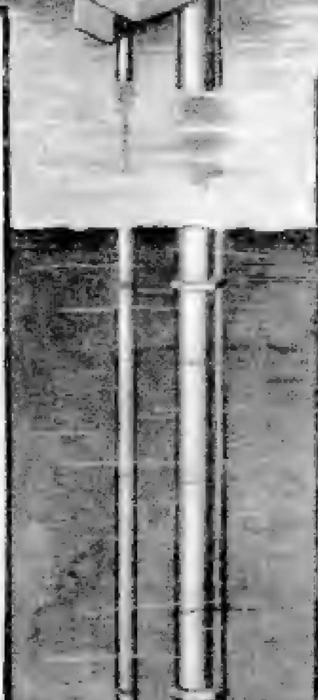
By H. WINFIELD SECOR



This illustration shows how the new submarine motion picture camera could be applied to a yacht for the taking of deep-sea pictures. The semi-spherical face plate can be rotated or moved to any angle to follow the actors.

A CALIFORNIA movie concern has recently become the possessor of the unique invention of Paul Guerin, by the aid of which we can expect some very unique motion pictures from this famous company, which has specialized in "bathing beauty" productions. This invention relates to motion pictures cameras for taking "movies" beneath the surface of a body of water. The same device can also be used for taking photographs from an airplane or a boat. Thus, if the cameraman wants to take a picture of a speeding boat as though he were directly behind that boat, he could do so even if fifteen or twenty feet to one side thereof.. As will be observed, the system consists of a long, tubular barrel of any length, regulated by inserting extra sections. There are gaskets between the fittings to prevent possible seepage of water into the barrel itself, and at the bottom, a weight is located to maintain the tube in a substantially upright position. This tube connects at its upper end with a semi-spherical face plate, movably mounted in a semi-spherical socket, thus making a ball and socket form of universal joint. Paralleling the tube there is another tube which serves as the finder. At the bottom of this second tube a lens and mirror are located for the purpose of projecting up to a ground glass, any scene which may take place at the distant end of the tube. It will be further seen by examining the drawing, that the film boxes are mounted upon the face plate which in turn is supported by a platform projecting from a yacht. The film-driving mechanism is operated by an electric motor.

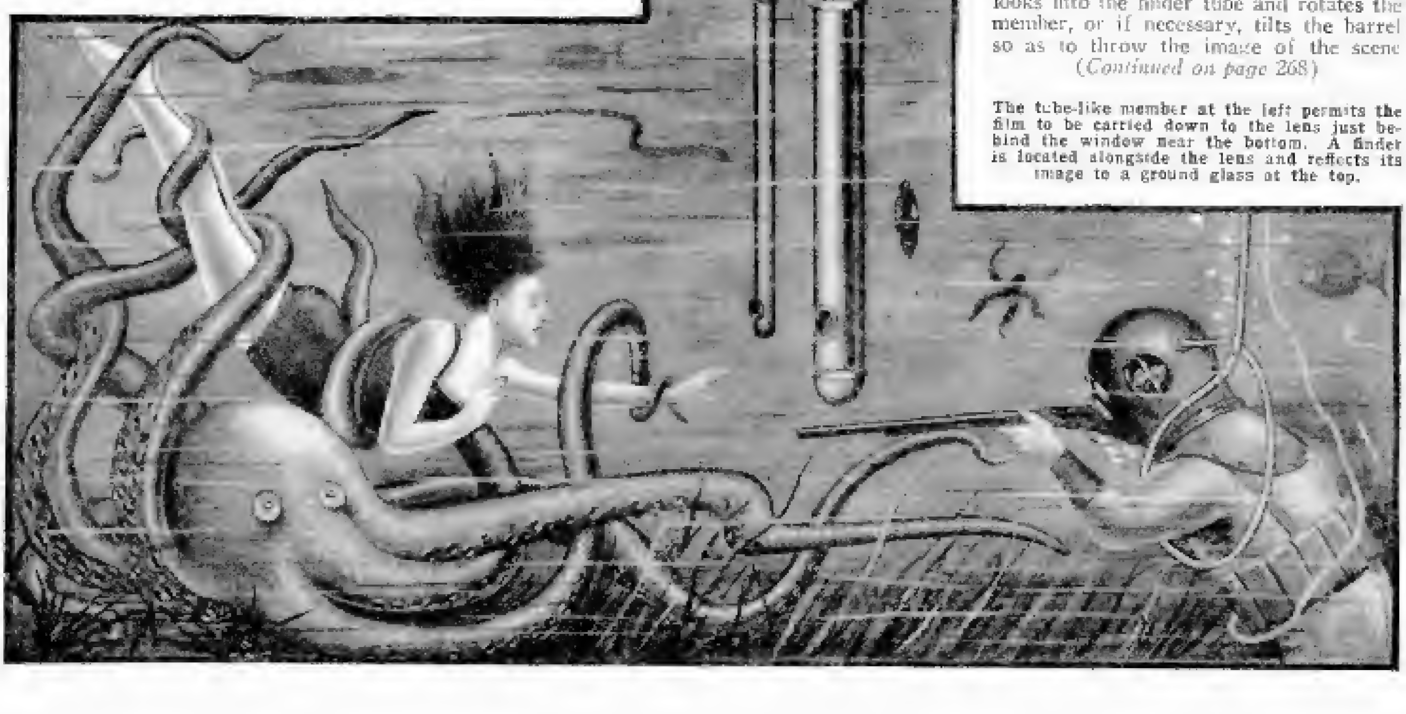
Here is a view of the mechanism at the bottom.



Thus, the cameraman needs but turn on the current and photograph whatever appears below, because the lens of the camera is mounted just in back of a window provided in the first mentioned tube. Any focusing which the cameraman has to do is done at the surface where the cameraman turns a shaft to register a finger with the proper distance marking on a scale. The operator also looks into the finder tube and rotates the member, or if necessary, tilts the barrel so as to throw the image of the scene

(*Continued on page 268*)

The tube-like member at the left permits the film to be carried down to the lens just behind the window near the bottom. A finder is located alongside the lens and reflects its image to a ground glass at the top.



The Metal EMPEROR

by A. Merritt
Author of "THE MOON POOL", "THE FACE IN THE ABYSS" etc.

(Tenth Installment)

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By means of the long metal tentacles at Norhala's command, Ruth and Ventnor are snatched off the ground, after Cherkis had allowed them to appear. Kulun was also licked up by the tentacle, but he was killed a moment later. Norhala has her vengeance and destroys Ruszark and all its people. Later she destroys Cherkis—the scene closes with the dead body of Cherkis being consumed by birds of prey.

CHAPTER XXVII

THE DRUMS OF DESTINY

SLOWLY we withdrew, lingeringly, as though the brooding eyes of Norhala were not yet sated with destruction.

Of human life, of green life, of life of any kind there was none. Man and tree, woman and flower, babe and bud, palace, temple and home—Norhala had stamped them flat. She had crushed them within the rock even as she had promised.

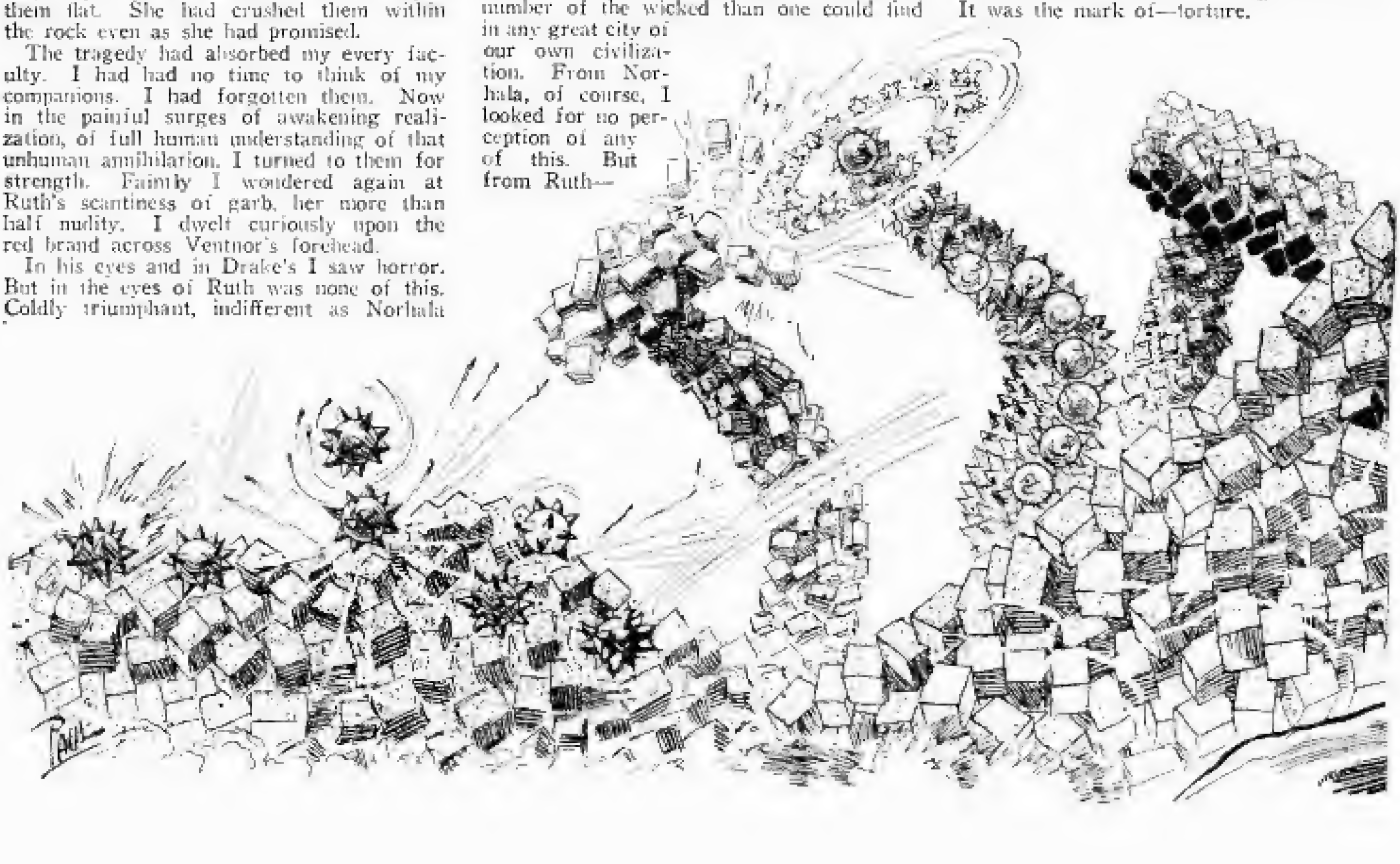
The tragedy had absorbed my every faculty. I had had no time to think of my companions. I had forgotten them. Now in the painful surges of awakening realization, of full human understanding of that unhuman annihilation, I turned to them for strength. Faintly I wondered again at Ruth's scantiness of garb, her more than half nudity. I dwelt curiously upon the red brand across Ventnor's forehead.

In his eyes and in Drake's I saw horror. But in the eyes of Ruth was none of this. Coldly triumphant, indifferent as Norhala herself, she scanned the waste that less than an hour since had been a place of beauty.

I felt a shock of revulsion. After all, those who had been destroyed so ruthlessly could not all have been evil. Yet mother and blossoming maid, youth and oldster, all the pageant of humanity within the great walls were now but stains within the stone. According to their different lights, it came to me, there had been in Ruszark no greater number of the wicked than one could find in any great city of our own civilization. From Norhala, of course, I looked for no perception of any of this. But from Ruth—

My reaction grew. The pity long withheld linked with a burning anger against this woman who had been the directing soul of that catastrophe.

My gaze fell again upon the red brand on Ventnor's forehead. I saw that it was a deep indentation as though a thong had been twisted there, biting to the bone. There was dried blood on the edges, a double ring of swollen white flesh rimming the cincture. It was the mark of—torture.



"Martin!" I cried. "That ring? What did they do to you?"

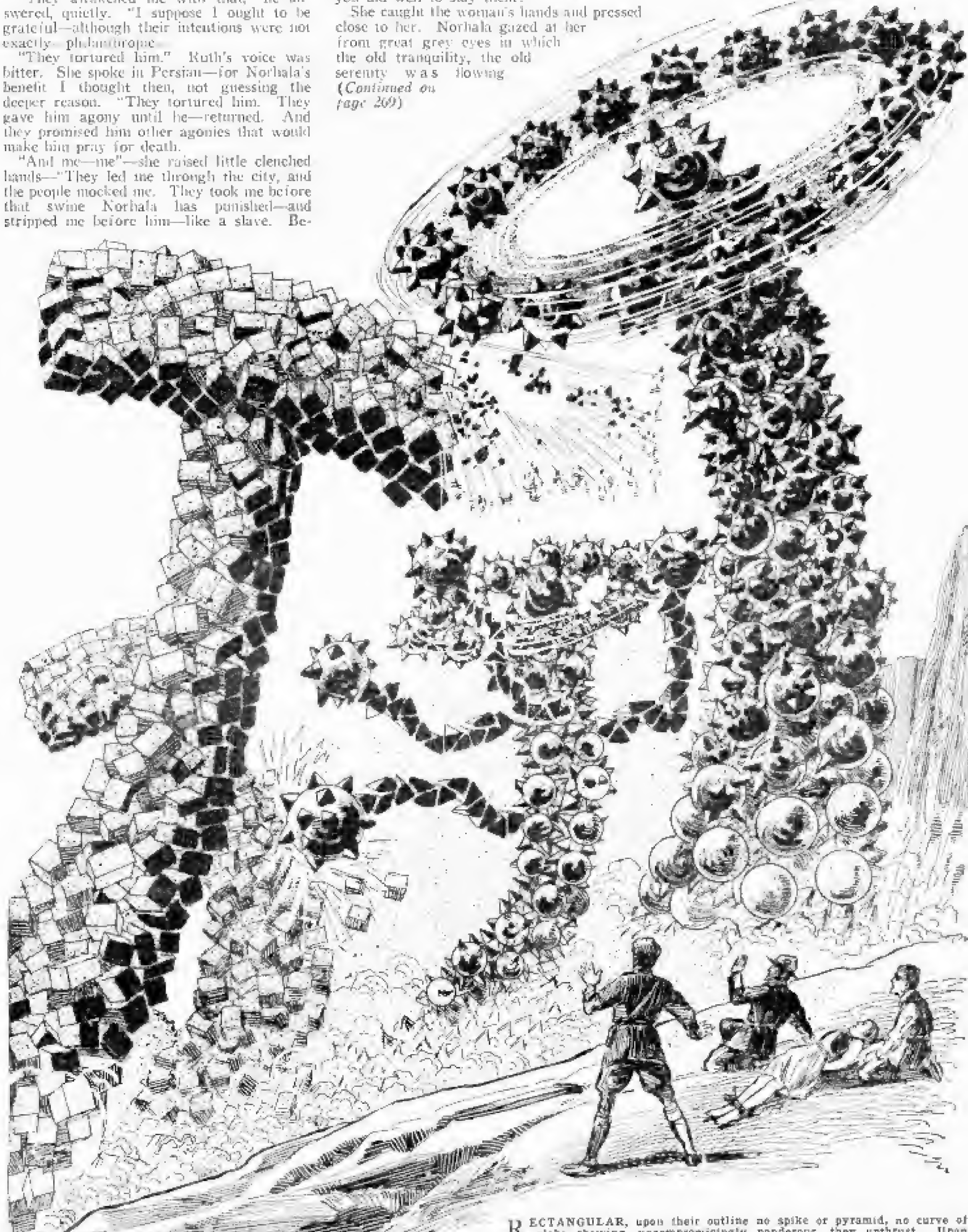
"They awakened me with that," he answered, quietly. "I suppose I ought to be grateful—although their intentions were not exactly philanthropic."

"They tortured him." Ruth's voice was bitter. She spoke in Persian—for Norhala's benefit I thought then, not guessing the deeper reason. "They tortured him. They gave him agony until he—returned. And they promised him other agonies that would make him pray for death.

"And me—me"—she raised little clenched hands—"They led me through the city, and the people mocked me. They took me before that swine Norhala has punished—and stripped me before him—like a slave. Before my eyes they tortured my brother. Norhala—they were evil, all evil. Norhala—you did well to slay them!"

She caught the woman's hands and pressed close to her. Norhala gazed at her from great grey eyes in which the old tranquility, the old serenity was flowing

(Continued on page 269)



RECTANGULAR, upon their outline no spike or pyramid, no curve of globe showing, uncompromisingly ponderous, they upthrust. Upon the tops of the first rank were enormous masses, sledge-shaped—like those metal fists that had battered down the walls of Cherkis's city but to them as the human hand is to the paw of the dinosaur. As though the tower of Woolworth Building in New York should be drawn up to twice its height, be widened by a half, be multiplied by hundreds, and then upon their tops be set horizontally, as hammer-heads, towers a third as great. Animate, flexible, they beat down with their prodigious mallets, smashing them from side to side.

Aug

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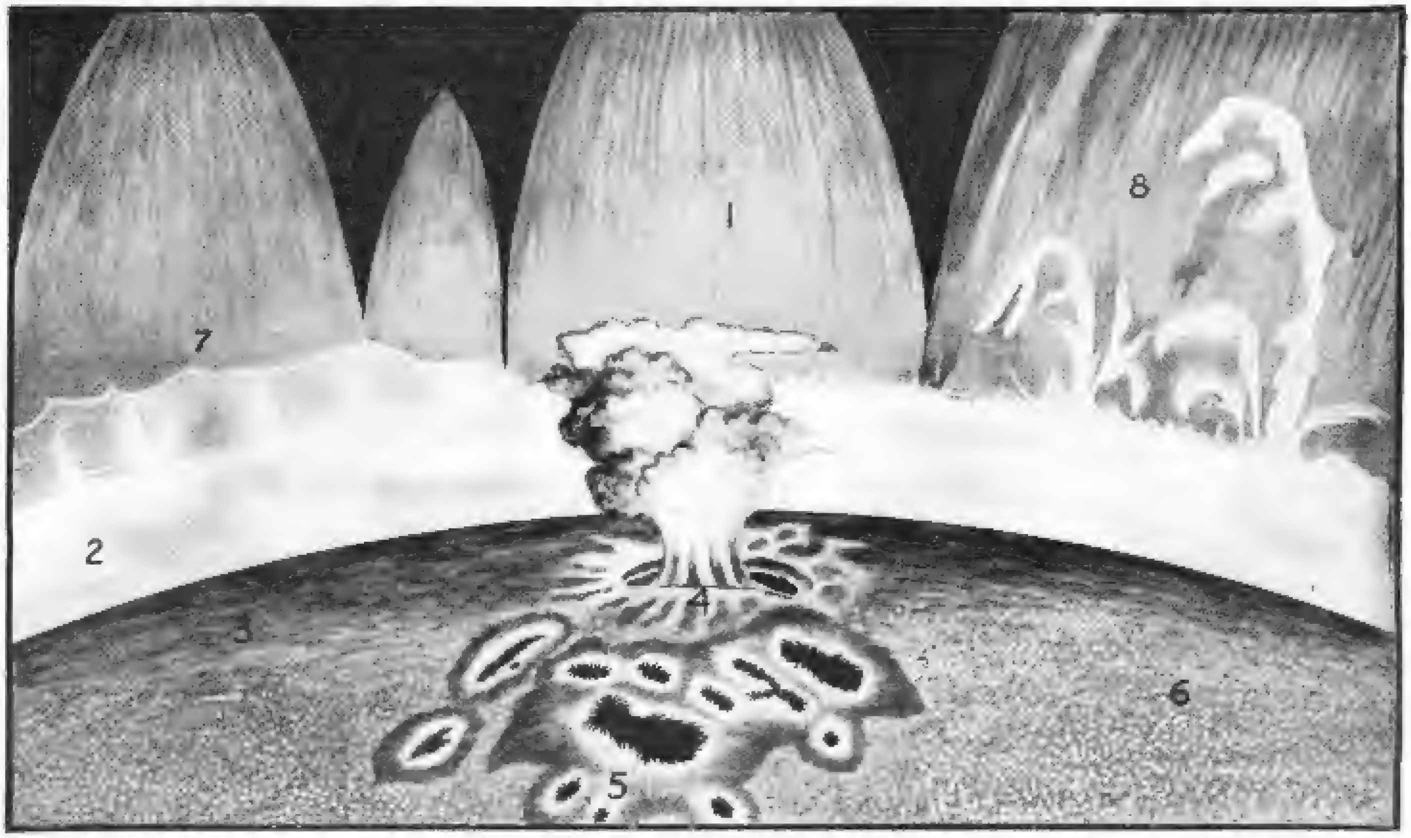
DO ANIMALS THINK?

See Page 302

EXPERIMENTER PUBLISHING COMPANY, 230 FIFTH AVENUE, NEW YORK

The Sun's Characteristics

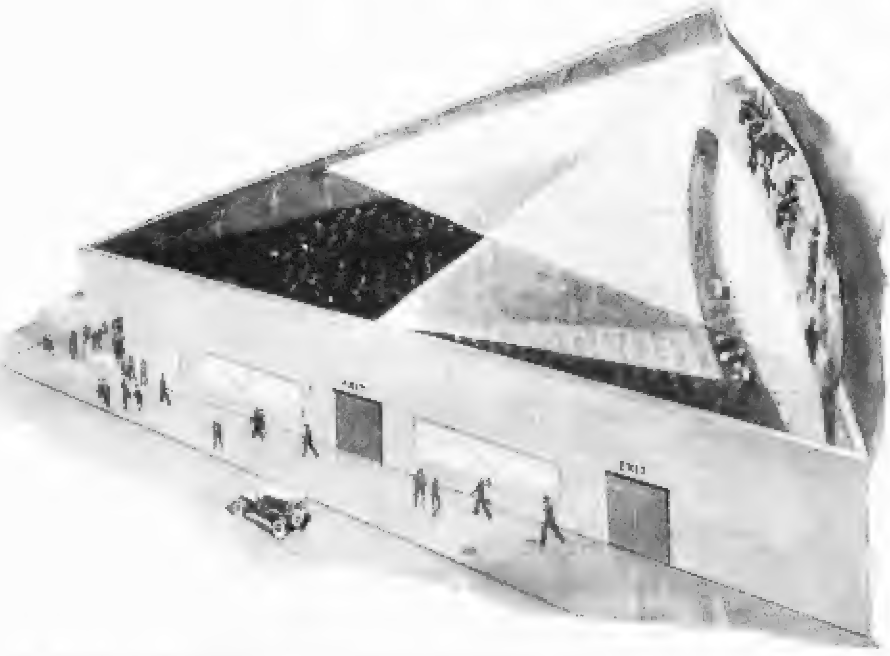


The above drawing is a representation of the upper surface of the sun. This is a reproduction of the original sketch of A. Zieberg, of Germany.

IF the upper surface of the sun were magnified or enlarged, it would look something like the illustration shown here, which was originally made by Prof. A. Zieberg, of Germany. A corona ray shot out by sun-matter at more than 375 miles per second is shown at 1. The cloud protuberances, which reach a height of 1,500 to 2,000 miles, may also be seen at 7. The chromosphere of the sun is shown at 2. The photosphere, surface layer of cloudlike condensed vapors, is shown at 3. 4 indicates an electrically charged gas cyclone which emits powerful cathode radiations. 5 indicates sunspots. A temperature of 5,900 degrees Centigrade exists at 6, and eruptive protuberances which reach a height of 248,000 miles are indicated at 8.—*Kosmos.*

The Movie Theater of the Future

THE theater of the future will be built in the form of a triangle, with the screen covering one whole side, as shown here. In a recent issue of the *Los Angeles Times,* Douglas Fairbanks predicts the advent of stereoscopic movies, possibly by using two synchronized projectors shooting upon a curved screen. Modern motion pictures are handicapped because they cannot bring the drama close enough to the spectator. How much more dramatic would be a cavalry charge, if it were shown in full panorama, keeping the close perspective. The screen of today is small and one has to look directly at it in order to see the action. The actors are jammed into the small frame, and it seems as though one were looking at a specimen viewed in a microscope. The future theater will have a curved screen large enough for the eye to rove about and then come back to the main action without being distracted. A member of the audience wouldn't know he was in a theater at all. With the music, voices and figures standing out lifelike, he would feel as if he were a part of the picture. Another change is also predicted in the studio regarding the camera. The camera of the future will reach out and bring action nearer to the eye. Reinhardt's Theater, in Berlin, is the reverse of the theater of tomorrow, shown here, as he puts the audience around the stage, instead of trying to put the stage around the audience.



The theater of the future is envisoned above. It will use a large curved screen, big enough for the eye to rove about and come back to the main picture without distraction.

DO ANIMALS

Are Snakes Useful? Could Monkeys be Trained as Servants? Can Horned Toad Live in Sealed Rock?

At the left we have a picture of a very intelligent chimpanzee, who is seen smoking a cigarette. This is one of the most humanlike of the animal family.

THIS talk may possibly be rated as a bit unkind—because the intention is to undermine and explode a series of pet theories regarding animals. This shattering of unnatural history, however, forms a clearing in the mind, in which to build a simple, practical knowledge of actual *natural* history.

Interest in animal life in this country is increasing. There is a developing, humane and sympathetic interest that is clearly indicated by the increasing mail received at the Zoological Park. It is the character of this correspondence that prompts the talk this evening—for we have to answer every kind of a query, from elephants being afraid of mice, through the mazes of hoop snake myths, to toads producing warts. Some day, I think, we will prepare a book citing the character of a generous part of our correspondence and illustrating the immense amount of unnatural history that exists in the minds of good Americans.

But in the meantime, let us consider a few of these superstitions:

DID YOU EVER SEE A HOOP SNAKE?

THE first to be cited is that of the hoop snake, alleged to take its tail in its mouth and roll downhill—or *propel* itself along a road. There is no serpent in the world that in its habits even indicates a basis for the story. When alarmed or excited, some snakes may thrash around, and it is quite possible that they might accidentally grasp their tail in their mouth, but never with an idea of rolling away to safer regions. Nor has any snake in the world a sting in the tail. When correspondents have become insistent about the hoop snake and the power to sting with its tail, we have offered to pay a thousand dollars for even a young specimen that would perform. Twenty-five years of repetition of this offer have produced no hoop snakes. In a similar fashion we dispose of the enthusiastic correspondent who insists he has records of 75-foot boa constrictors in the tropics. But in this instance the prize being of alleged noble size, we are willing to increase the offer—even offering a thousand dollars for a dried, rolled skin.

The kangaroo is one of the most peculiar animals and it comes of a very hardy type, which breeds in captivity, according to Mr. Ditmars, the author of the present article.

WELL! WELL! MEET THE MILK SNAKE?

NEXT in order of the snake myths, is that of the *milk snake*. Many farmers firmly believe there is a specific kind of snake that lurks around the barns and steals milk from the cows by actually milking the stock. Some blame the black snake for this pernicious habit. The allegation is that the cows are so robbed of milk there is a considerable loss to the farmer—hence the milk stealing snake is a distinct enemy.

Now to put a little truthful dynamite under the milk snake myth:—There is no doubt that certain snakes may warrant suspicion by their persistent lurking around barns and dairies. A knowledge of their habits, however, immediately explains their presence there. They are rodent-destroying species and gather near human habitations owing to the abundance of rats and mice around the farms. Thus they are friendly, or economic types. As to their stealing milk from the cows, let us clear up this foolish supposition with a few words of anatomical detail. A fair-sized serpent, if it were to crave milk, would be limited to contain not more than half a pint of fluid within its stomach. As serpents feed, it would not repeat the meal before a week. An amount like this would produce no effect upon even a scrawny cow. So you see, our milk snake is anatomically incapable of causing serious loss to the farmers.

HORSE HAIRS CHANGING INTO SNAKES

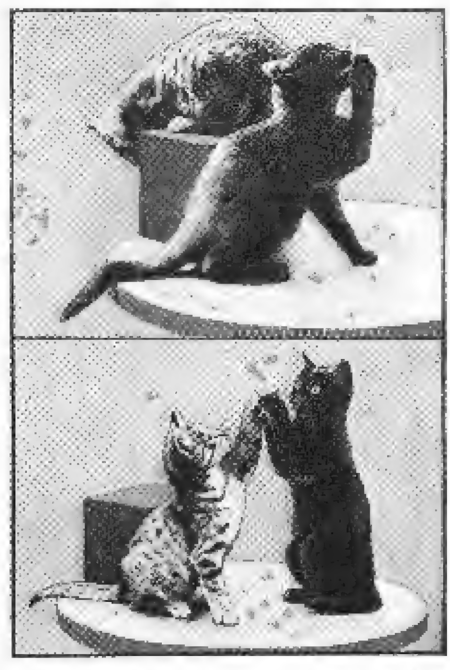
ANOTHER query we receive is about horse hairs falling into a well and turning into snakes. This is explained by a singularly slender aquatic worm, technically known as *Gordius,* quite active, sometimes over a foot long and appearing like an animated horse hair.

A common query is about rattlesnakes committing suicide when cornered. There is a story to the effect that if a horse-hair lariat is thrown in a circle and a rattler placed inside that it will not cross the rope, but, striking its fangs deeply into its body, quickly dies from the deadly venom. All venomous serpents are immune to their respective poisons. In the excitement of capture they often strike this way and that, and wound themselves with the poisonous fangs, but there is no bad effect from such injuries.

I have tried the horse-hair lariat experiment a number of times and have seen rattlers calmly crawl over the rope—in fact have not noted that they even hesitated. This also eliminates the myth about the sleeping cowboy on the plains, seeking protection from prowling rattlers by sleeping within a large ring of his lariat.

THINGS MOTHER SNAKES DON'T DO

WE still have a few pet theories about snakes. One is that the mother serpent, accompanied by her litter of young, will "call" them and quickly swallow the litter when threatened with danger. I have



The household cat often shows very intelligen actions and reactions. Here we see two interesting pictures of cats playing with and capturing a butterfly.

not an atom of belief in this persistently alleged habit. In the first place the young serpents do not "accompany" the mother. They are fully provided to look out for themselves and immediately scatter into the world, each for itself. It happens sometimes that the mother serpent, lured from the rocks by a genial sun, may be incidentally surrounded by some of her offspring which have remained near the sheltering crevices. During many years of reconnoitering in wild places I have seen such serpent families, but as the observer approaches, in every instance I have ever noted, there is a general gliding of each member of the group for respective shelter—every reptile for itself, which is certainly the quickest way. If the mother were to hesitate and "call" her brood, the time consumed in getting a parade of snakelets down her throat would be fatal.

Incidentally, snakes do not "call." They

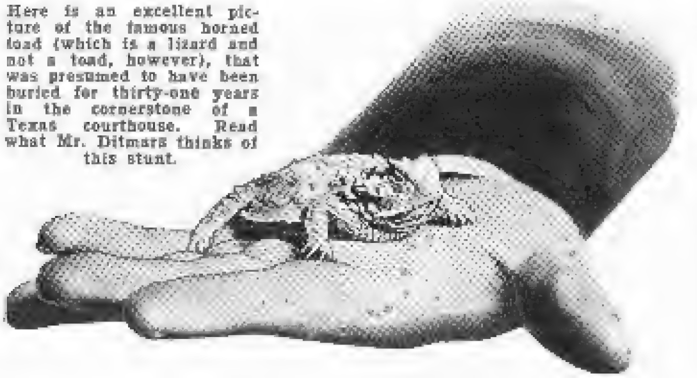
THINK?

Subject of a lecture given at WRNY in their "Home Science University" series.

BY RAYMOND L. DITMARS

Curator of Department of Mammals and Reptiles, at New York Zoological Park

have no power of hearing, as ordinary sounds go. I have never noted affection among parent serpents, either wild or in captivity, and am quite convinced that if young serpents ever reached the parent's stomach they would be immediately smothered in the powerful gastric juices.



Here is an excellent picture of the famous horned toad (which is a lizard and not a toad, however), that was presumed to have been buried for thirty-one years in the cornerstone of a Texas courthouse. Read what Mr. Ditmars thinks of this stunt.

DO SERPENTS CHARM BIRDS?

EQUALLY fallacious is the idea that a serpent charms a bird. Observations of an apparently benumbed bird near a serpent relate merely to a keenly alert, parent bird luring a snake from the nest. Many of us have noted an apparently wounded bird in the grass, dragging a wing, keeping a short distance ahead. Try to pick her up and observe how alert and *quick* she is, but she has accomplished her object in trailing you away from a litter of helpless young—as she does the snake.

Another supposition is to the effect that if a snake is killed the mate will soon appear—and if it is poisonous, will seek vengeance upon the slayer. It seems a shame to explode this romantic theory and also to shatter the strength of a perfectly good poem which we hear recited nowadays, concerning the dreaded Dukite snake. The truth of the matter is that snakes do not travel in pairs, and where one is killed there is every indication that the victim has selected good ground to prowl for food and other serpents may have scented prey and are covering the same ground.

CONCERNING WARTS FROM TOADS

A VERY common belief is that toads, if handled, will produce warts. This is a myth. While there is an irritating poison in the skin of the toad which produces a burning pain in cuts and an inflammation that may last a few hours, no warts ever result from handling toads. This story probably originated in the warty appearance of the toad's skin.

ELEPHANT TALES

AND now for a few fallacies regarding the larger animals. There is the old-time story about the elephant's fear of a mouse. I have never noted any indication of this, but have, on the contrary seen mice and rats running through the hay in the elephant paddocks and the big animals paying no attention to them. I remember one illustration relating to a whole herd of elephants, when I was spending one vacation traveling with a circus. A storm had damaged the animal tent and the whole troop of elephants—fifteen of them—was led across the fields to a big cattle shed and hastily staked in the usual row. They were *uneasy*, away from the canvas and the cars, so four of us, with equally spaced lanterns sat up with them all night to keep them company—and there were *rats* in that barn, lured out by the seeds in our sweet, fresh hay. So far as I could see, the human members of the group were the only ones that took exception to the rats—for we literally kicked them away from us.

THE HYDROPHOBIA SKUNK

FROM Arizona we have stories of a so-called hydrophobia skunk. The allegation is that if one of these animals bites you, rabies will positively result. This strange allegation cannot positively be denied. The condition appears highly improbable, yet only recently the speaker talked with several men, one of them a bacteriologist, who declared it possible that several species of small mammals might harbor the organisms of the dreaded disease, yet themselves be immune to it. It is of course well known that the so-called virus (probably specific germs) of hydrophobia produce a deadly effect with most animals and that wounds produced by the teeth of such animals when developing the malady, pass the disease along to others. However, we should remember that the organism producing sleeping lives harmlessly in the blood of the crocodile.

DON'T FAIL TO TURN THE PAGE AND READ THE OPINIONS OF EMINENT EXPERTS ON THE QUESTION

DO ANIMALS THINK?

An interesting little animal—the Koala—formerly supposed to be very delicate in captivity, but which lives quite well as a captive, now that it is more thoroughly understood.

Bears are always interesting—here is "Ranjah," one of the trained bears owned by Mr. E. Pallenberg of California, riding on his hobby horse.

ANENT SINGING MICE

THERE is a query that we get by 'phone sometimes that sounds weird and creepy. This relates to singing mice. I put the question just as we receive it: Can a mouse *sing?* Many claim they have heard them, set a trap, caught the mouse, and it sang while in the trap! Here is a myth that isn't a myth. A mouse cannot sing voluntarily, but certain mice become afflicted with a curious bronchial trouble that appears to become chronic, yet not serious enough to weaken the animal. The trouble in a way is similar to asthma, as it occurs *at times*—and during these periods the mouse wheezes, whistles, even appears to trill in a way that is quite musical.

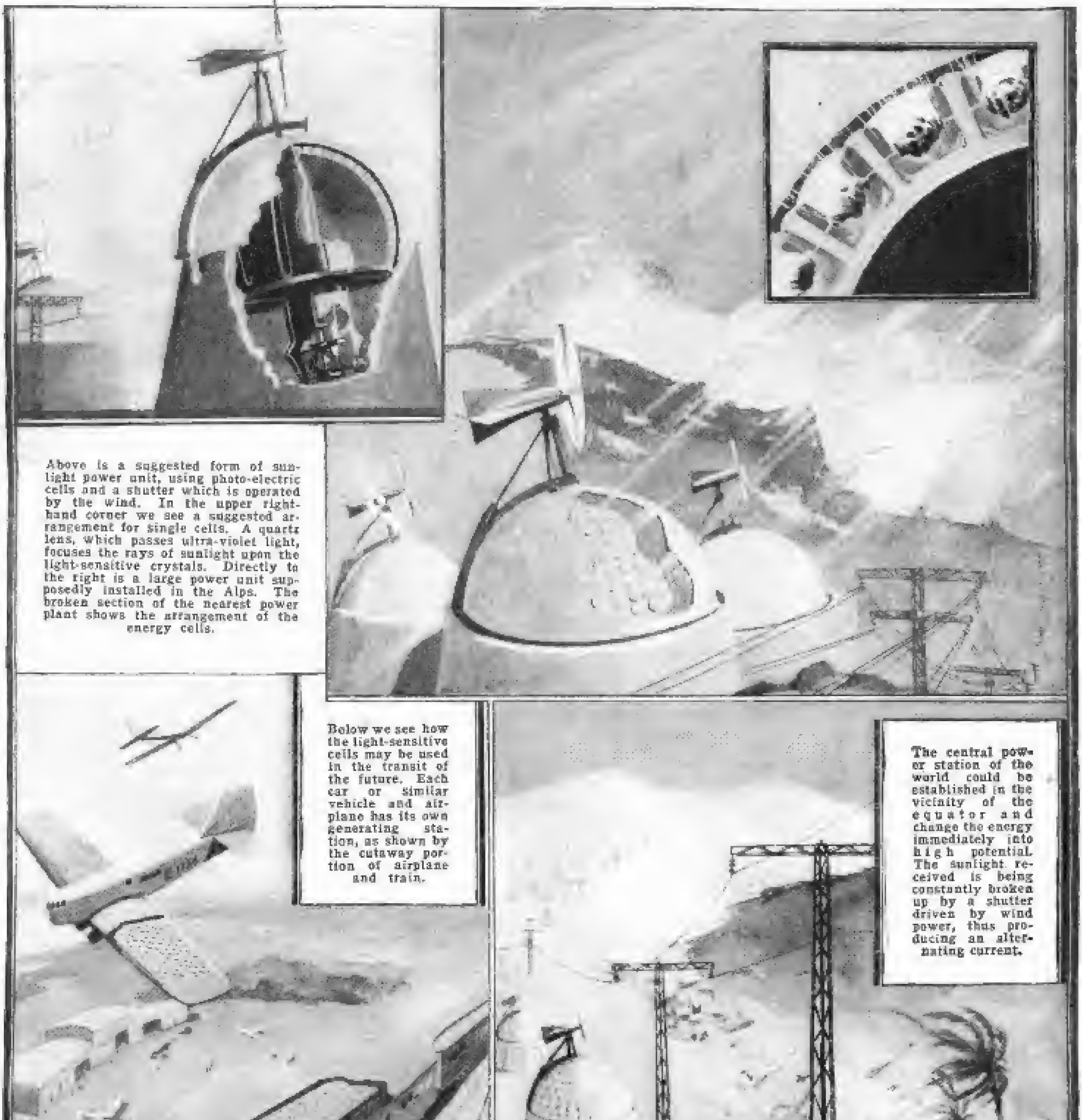
TRUE ANIMAL STORIES STRANGER THAN FICTION

IF we go deeply into the records of remote places we will find many things that are far stranger than these myths about wild creatures. For instance—there is a *Flying Snake* in Java that makes long, floating journeys from tree to tree. In South America there is a beetle with lobes on the sides giving off a light so bright that one can read fine print in a dark room with a specimen held several feet away. Africa has a

(Continued on page 377)

Electricity from the Sun

"Light Energy Converters" Generate Electrical Energy



Above is a suggested form of sunlight power unit, using photo-electric cells and a shutter which is operated by the wind. In the upper right-hand corner we see a suggested arrangement for single cells. A quartz lens, which passes ultra-violet light, focuses the rays of sunlight upon the light-sensitive crystals. Directly to the right is a large power unit supposedly installed in the Alps. The broken section of the nearest power plant shows the arrangement of the energy cells.

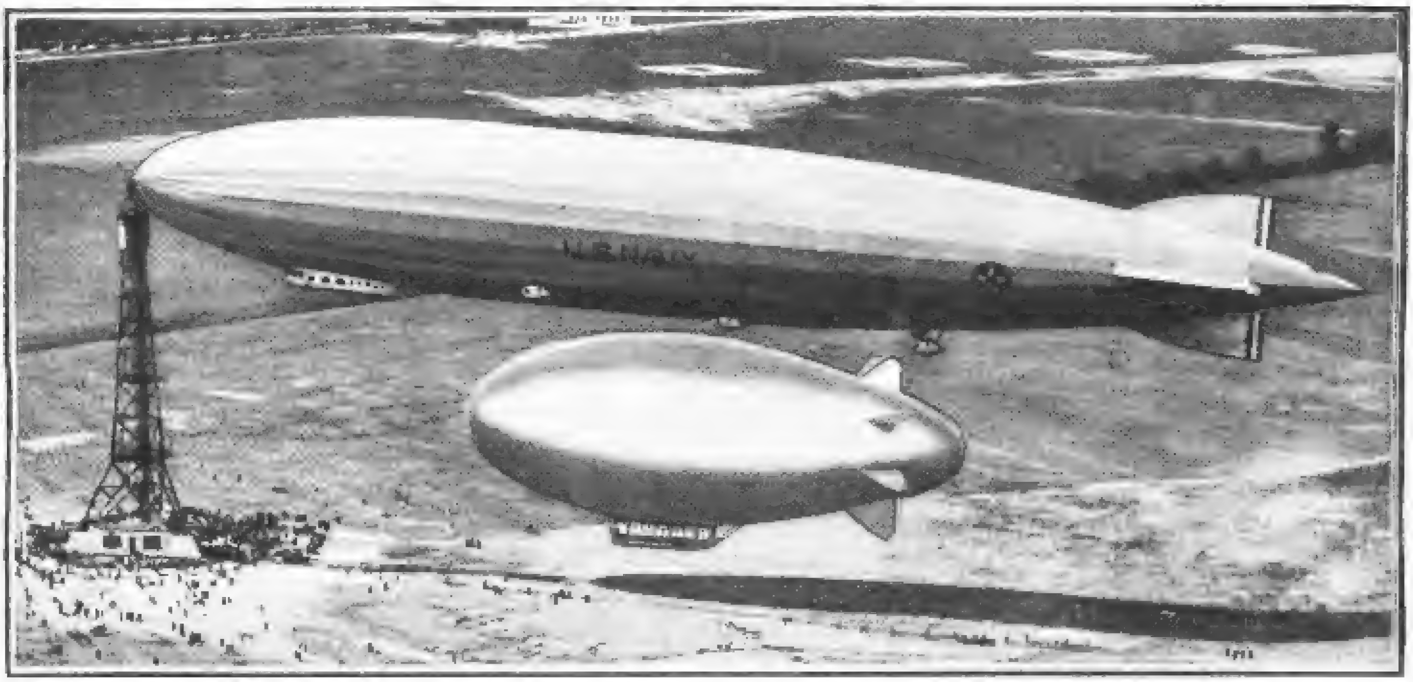
Below we see how the light-sensitive cells may be used in the transit of the future. Each car or similar vehicle and airplane has its own generating station, as shown by the cutaway portion of airplane and train.

The central power station of the world could be established in the vicinity of the equator and change the energy immediately into high potential. The sunlight received is being constantly broken up by a shutter driven by wind power, thus producing an alternating current.

Suggestions for a sunlight-power generating system of the future are given in the above illustration, through the courtesy of *Die Woche*

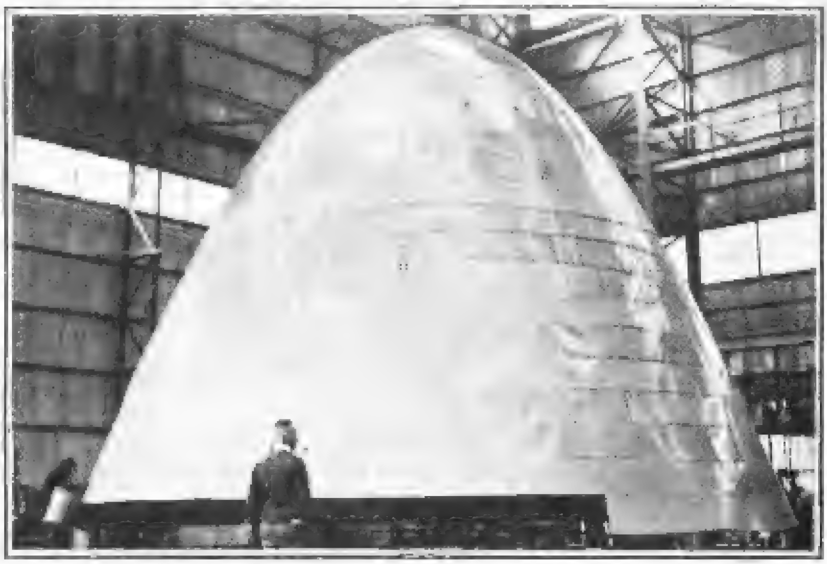
ALL-METAL DIRIGIBLES

Metallic Ship Guided by Steering Fins



Above is a view of the U. S. Navy's huge dirigible "Los Angeles," tied up to the mooring mast, at the Ford Airport in Detroit.

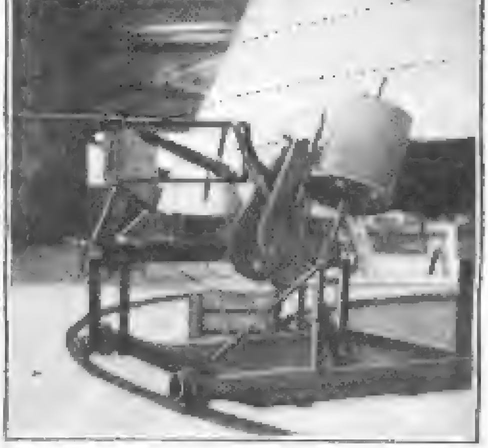
A designer's visualization of the new all-metal airship has been superimposed below the "Los Angeles." The new ship is known as the MC-2.



The above photo shows how the stern of the metal aircraft is fashioned out of lightweight metal ribbons, which are riveted together by a special process recently developed.

THE U. S. Navy is now building an all-metal dirigible, which will make it a pioneer of this type of craft and will open the way to the construction of huge air liners which might well exceed the size of the present-day Los Angeles, which is 656 ft. long. The new craft, which is known as the MC-2, will be 150 ft. long when completed and 50 ft. in diameter. Two 200-horsepower motors will furnish the motive power and give a speed of 70 miles per hour. In comparison with the fabric dirigibles of a similar class, the new metal ones are expected to have twice the stability and four times the durability, because they will have about half the air resistance and only about 5 per cent of the gas leakage of a blimp ship. The development of duralumin, an alloy of aluminum and copper, which is almost as strong as steel, has made the building of this type of aircraft possible. This same metal is used in all metal airplanes because of its lightness, uniformity of strength, and its high resistance to rust and corrosion of any kind. The gas cells will have a total capacity of 200,000 cu. ft. of gas and will give a total lift of 12,000 pounds. The design of the ship itself is the result of more than seven years of study, from the time of the Zeppelin to the present-day aircraft. The first step in the construction was to devise a method of building the ship in sections and then assembling them as they were completed. This method enabled the mechanics to fit every piece of frame into place while standing on the floor of the hangar and with the greatest ease. To build the metal "skin," the engineers in charge spent considerable time and money in fashioning a riveting machine mounted on circular tracks, so that it could be wheeled around the sections of the airship while they were being built. This riveter carries a reel of duraluminum .008-inch in thickness, which is gradually unrolled and, at the same time, is riveted to the "skin," which has been previously attached to the frame. It is estimated that this machine will accomplish the work of more than forty men a day. The metal ship of the air will not be affected by weather changes and will last at least ten years.—*Photos courtesy New York Sunday American.*

HOME MOVIES!
A New Monthly Department
Don't Miss It!
See Page 320



Above is a view of the special riveting machine which is being used in the construction of the MC-2. It cost $30,000.00 to perfect and build this device.

THE RIDDL

Did the Earth's Capture of the *Moon*

By HANNS

(Opinion of well-known Astronomical Authority)

HARVARD COLLEGE OBSERVATORY

CAMBRIDGE, MASSACHUSETTS

Dear Mr. Secor:

The article on Atlantis, by Hanns Fischer, which you sent me a few days ago, has interested me very much. The story of this lost continent, the sunken bridge between Europe, Africa, on the one hand and the American continent on the other, is one of the most fascinating subjects, upon which history, science, and imagination unite. Its study has occupied the minds of scientists, historians and linguists alike for centuries past, and will doubtless continue to do so for many centuries to come, particularly since such study will enable us to push back further the origin of man's civilization on earth.

Mr. Fischer has approached the subject in a novel way, and has proposed a theory which appeals to the imagination. As an astronomer, however, I am afraid that I cannot agree with him in some rather essential details.

For one thing, I do not think that astronomers in general are bold enough to try to guarantee perpetuity for the conditions at present existing on the earth, though some may have done so in the past.

Also, I take issue with him on the question of the origin of

The people of Atlantis were surprised by a huge tidal wave accompanied by earthquakes and electric storms, it is believed by the author of the present logical narrative.

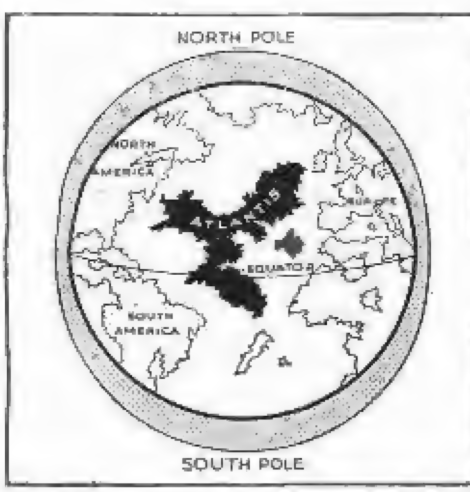
SIX hundred years before Christ, Egyptian priests at Saïs told the philosopher Solon that once upon a time, according to ancient traditions of the land of the Nile, beyond the pillars of Hercules, that is beyond the straits of Gibraltar, a great island kingdom, Atlantis lay; it not only had a large populace, but was also rich in gold, fruit trees and harvests, and was very highly cultivated, but was so extended that one could get at it readily from the nearest points of the European continent.

THE STORY OF ATLANTIS

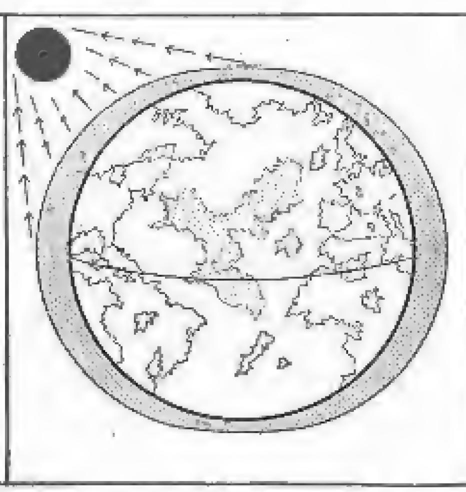
ASTONISHING as it may seem, the old Egyptians seem to have known that on the other side of the straits of Gibraltar far to the west, there existed a continent that was known to the old ancient people long before it was discovered by Columbus; formerly, it was easy to reach because this island of Atlañtis lay between Europe, Africa and America, and it was one of the greatest riddles of earthly history, and in an unhappy day and a frightful night, as these priests tell us, nine thousand years before the birth of Christ, it sank into the sea. This was the end of the Atlantis so rich in traditions; it became a troublesome question, that for centuries was investigated in vain for an answer by geologists and biologists, by sea navigators, ethnographers, geographers, antiquaries and astronomers. A few years ago the question came up whether the picturing of Atlantis in the works of Plato was a fable or actual history. Many have left the question to such authorities as illustrious linguists, who claim that there was no doubt that it was only a poetical invention, but others have gone further in their researches. Today we hardly credit the idea that Plato was romancing in his story.

ARGUMENT FOR LOST CONTINENT PLAUSIBLE

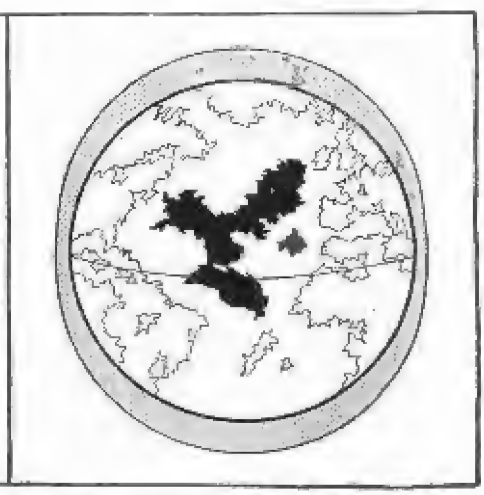
NOW if we can accept Plato's description as a depiction of facts, then we hear that once the highly cultivated and powerful inhabitants of Atlantis carried on strong attacks to the east in the Mediterranean Sea. If we believe in the truth of this narration, then it seems no longer wonderful when among one hundred similar words in American Indian language, the word "malko" means the prince; in Arabic "malka" has the same meaning, and in Hebrew "melek" means the king. We are no longer astonished if we can establish between middle American languages and the ancient Greek the closest relations, or if we find well-known myths from Grecian history repeated in American traditions. It seems to us that, with regard to the attacks of the Atlantis armies upon the Mediterranean coasts, and in the intercourse with the new world, these are almost to be taken for granted, that the famous step pyramid at Sakkara in Egypt, considered the most an-



The picture above shows how Atlantis appeared before the earth captured the moon; the ocean water was shallow at the equator.



Here we see how Atlantis was covered by the ocean waters due to the moon's gravitational pull. The earth is here pictured with the moon (present condition).



The future—many scientists believe that when the earth loses the moon, the land comprising the lost continent of Atlantis will reappear.

OF ATLANTIS

Destroy Atlantis—the Lost Continent?
FISCHER

the moon, and its subsequent or rather ultimate return to the earth. The present day theory of the origin of the planetary system, the theory of dynamic encounter, made the earth come out of the sun, and, while the earth was still in a somewhat liquid state, made the moon come out of the earth as a result of the disruptive effect of the sun's tidal force. The moon originally revolved around the earth in a shorter time than it does now, and while it was wandering outward, along a spiral so to speak, and while it too, was still syrupy in consistency; the tremendous attraction of the earth raised huge tides on the moon, which ultimately succeeded in making the moon rotate on its axis in the same time that it revolves around the earth. Mr. Fischer, by his theory would have considerable difficulty explaining that on the capture theory. Finally, though it is not impossible that the earth may have had other moons in the past, it appears entirely impossible, from our present day knowledge of such processes, that an adjustment necessary for Mr. Fischer's theory should have completed itself in such an astronomical instant as 13,000 years. On the other hand, some astronomers now hold the view that the earth will slow down, due to the sun's disturbing tide, and this slowing down of the earth's rotation may eventually break up the moon, which will thus ultimately return to mother earth.

(*Signed*) W. J. Luyten.

One of the best maps showing how the islands comprising Atlantis are considered to have bridged the gap between Africa and the Americas. From—"The Problem of Atlantis" by Lewis Spence.

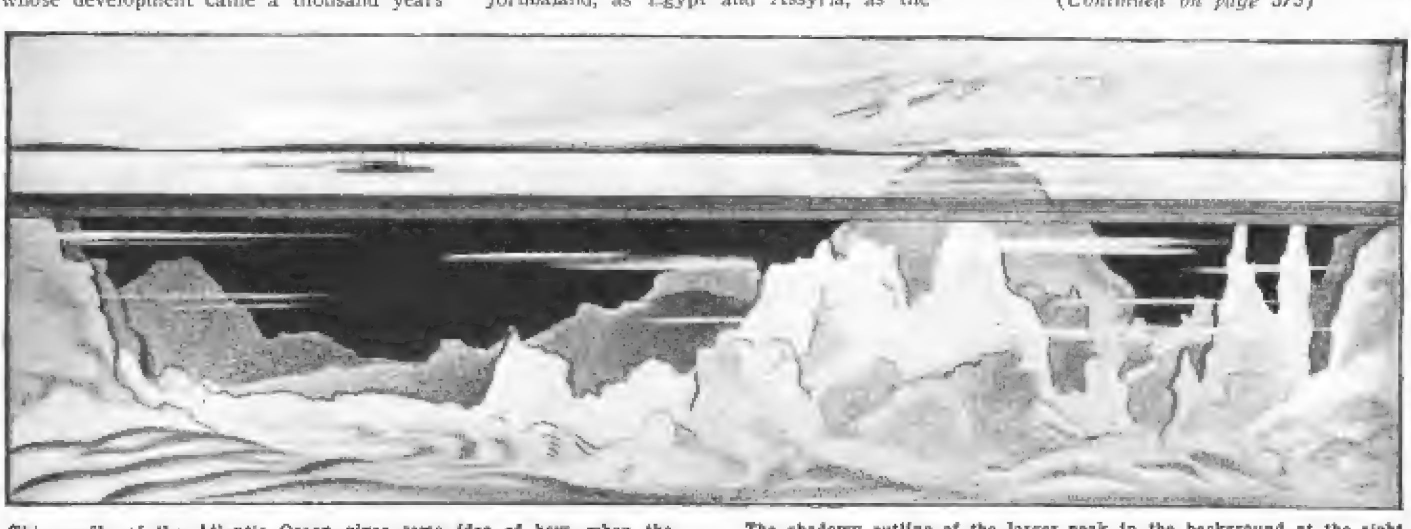
cient building in the world, has its companion pieces in the ancient Mexican step pyramids. Also the discoveries of Frobenius on the African gold coast in Jorubaland in the neighborhood of the mouth of the Niger lose their mystery if we admit the former existence of Atlantis and keep before our eyes the connection of Atlantis with the west coast of Africa. Frobenius found here the bronze head of the God of the Sea, Neptune, the God, who, according to tradition, was the first governor of Atlantis. The same investigator could form similarities between the topography of the region of the lower Niger mentioned above, and the resemblances to each other, of the former inhabitants of Italy, the Etruscans, and of the Pueblo Indians in America, people who today are separated by thousands of years, by stretches of land, and by the ocean. Dr. Noetling shows that the pyramid of Cheops expresses in stone a reduced picture of the distance of the sun from the earth (the height of the pyramid), and the path of the earth around the sun (the ground circuit of the pyramid) in the proportion of one to one thousand millions, undoubtedly therefore representing the result of prehistoric ancient astronomy, whose development came a thousand years later. It appears also as self-understood why Paul Porchardt in North Africa found again the Atlantis name left us by Plato as the remains of the peaceful or warlike travels of the inhabitants of Atlantis. Also a further secret is explained: that of the Egyptians, whose culture seems without any root, who then without any development would have jumped into an astonishing development, out of primitive culture, which if an Atlantis colony existed would cease to be a mystery.

All this is in accord with Plato's story. Even the fantastic figure that Plato gives for the sudden sinking of Atlantis must part with its apparent incredibility. From calculations of the age of the wonderful culture on Crete investigations go back from ten or twelve thousand years. And Crete just as Jorubaland, as Egypt and Assyria, as the northwest coast of Europe, were colonized by Atlantis. Also in the land of the Nile, investigations of the relics of ancient culture, which the Nile has given to us, indicate an age of at least twelve thousand years.

COINCIDENCE OF IMPORTANT DATES

NOW let us take examples which can be grasped for a reliable estimation of the length of the period in question. If we compare for instance, a calendar of ancient inhabitants of the Euphrates and Tigris regions, and of the Egyptians, we find the Egyptian solar year and the Assyrian lunar year coincide, and if we go further back we find it surprisingly well established, that the two of them in the year eleven thousand, five hundred and forty-two B. C., came in accordance so that probably both had their

(*Continued on page 375*)



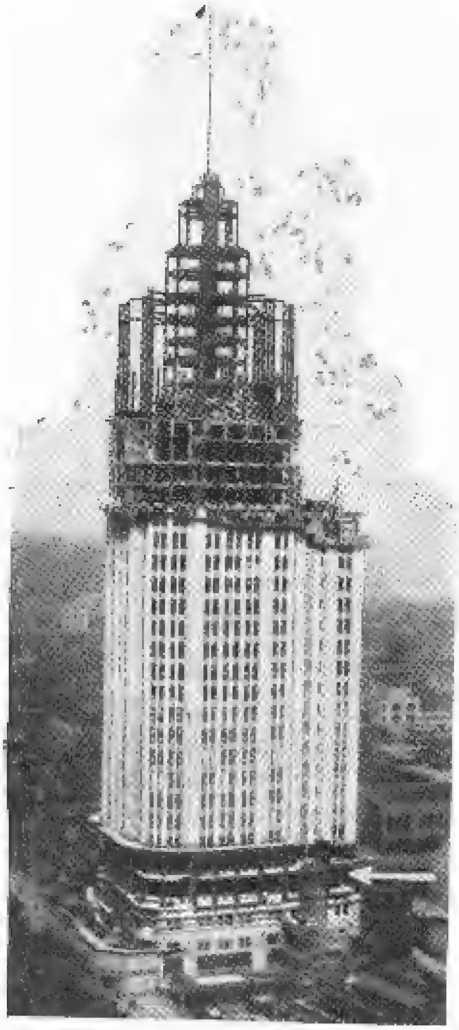
This profile of the Atlantic Ocean gives some idea of how, when the waters were more shallow before the earth had a moon, the fabled land of Atlantis could have readily been formed from the elevations observed rising from the ocean bed, above the present sea level, in some instances.

The shadowy outline of the larger peak in the background at the right, shows how the Azores are formed. If the waters should subside again, Atlantis would be exposed to view. Explorers may find evidence of the lost race before that time however.

WHY IS A

In the Accompanying Article the Various Factors ... Details of Skyscrapers Are

By H. WINFIELD



In this picture of the Tribune Tower during its construction in Chicago, one of the remarkable facts concerning skyscrapers is brought out vividly. The white arrow shows two lower floors on which the stone work has not been placed. With the old style masonry construction, where the walls support the weight above them, this would be impossible; here the steel frame supports all the weight.

SKYSCRAPERS mark one of the outstanding achievements of the present age of wonderful engineering and architectural development. The peculiar thing about these forty and fifty-story buildings that we find in such large cities as New York, Philadelphia, Chicago, not to mention many of the smaller cities, is that the average city dweller passes the building every day, perhaps, and never stops to think how these remarkable monuments to modern business and technical acumen have been made possible. Two generations ago city office or other buildings were limited to six stories or less, as no one would think of renting an office situated on a floor higher than six stories when there were no elevators and they had to walk upstairs to their place of business. A little later the first elevator was installed and this marked an epoch in tall building construction. Without our modern high-speed passenger elevators, the skyscraper would be useless. As soon as the elevators began to make their appearance, ten to twelve-story office buildings came into prominence in such cities as Chicago, where the first skyscrapers were built, as well as in New York and other cities.

THICK WALLS OF OLD TALL BUILDINGS

IT must be remembered that, thirty to forty years ago, when these buildings of six, eight and ten stories were erected, the use of steel or iron was practically unknown, and the upper floors were supported by the stone or *brick masonry walls* and columns. As one of the accompanying pictures shows, a forty-story skyscraper erected by the old method, would be too ridiculous to even think about. To build a forty-story building would necessitate masonry walls about forty feet thick at the base, these huge walls being required to support the tremendous load of the floors above the street level. There are today some buildings to be found in many of our large cities, which show how the far thicker walls and consequent small windows, with poor lighting and ventilation arrangements were forced upon the architects of a generation or two ago.

In many examples of the older architecture as followed and required for buildings of ten to fourteen stories, huge columns occupied a goodly portion of the space on the lower floors, these columns, of course, becoming smaller as the upper floors were reached and the load became less. There was practically no basement space left by this older design before the age of steel construction, most all of the space being occupied by huge columns and foundation piers. As one of the accompanying diagrams shows graphically, the vast improvement in tall building construction has been brought about by the marvelous characteristics of steel as compared to stone, brick and cement. Using the old masonry wall construction to support the building load, each square inch could support only about two hundred pounds. Today the steel columns in a modern skyscraper support 18,000 pounds per square inch, or ninety times the old working pressure.

STEEL FRAME CARRIES THE WEIGHT

THE writer had a very interesting talk recently with one of the foremost architects and designers of skyscrapers in America, Mr. Harvey Wiley Corbett. From the windows of Mr. Corbett's office, situated in a breezy position atop the Bush Terminal Building in New York City, we could look at skyscrapers both completed and uncompleted, as they lay spread out on the scene.

One of the most interesting things that Mr. Corbett had to say was that the average person has a false conception of the skyscraper, when they think that the weight of the upper floors is carried, at least to quite a large extent, by the stone or masonry walls. Mr. Corbett drew a very interesting analogy at this point and stated that a skyscraper could be compared to the human body. "Did you ever stop to think," he said, "that it is not the muscles or flesh covering of the body which supports it; instead it is the bony structure." The writer said that he had never stopped to think about that particularly, but on second thought it brought out vividly the basic law regarding skyscrapers and how they carry the tremendous load of forty or fifty stories of cement and steel very beautifully.

In other words, the skyscraper is like the human body—the steel frame you see being rushed up so rapidly by the iron-workers, accompanied by the rat-tat-tat of the pneumatic riveting hammers, is to be eventually the hidden skeleton which supports the whole weight of the skyscraper. Remarkable as it may seem, the stone, brick or other masonry covering, which fills in the steel frame, does not support the weight of the great towering structure. One of the accompanying photographs will prove this to your satisfaction if you happen to be a "doubting Thomas." As this photograph shows, it frequently happens that the masonry work may be put in place on the upper stories, before it is erected on the lower floors. If the old method of constructing tall buildings was in force, and the steel framework did not support the whole weight of the building, then it would be impossible, of course, to have the masons put stone or other masonry covering (not to mention the heavy fireproof floors) in place on ten, fifteen or twenty stories situated above the first few floors, which did not have any stone or other masonry work in place.

DO you know that it would be practically impossible to build 40- or 50-story skyscrapers, as the tall modern office buildings are called, if it were not for the fact that an enterprising engineer conceived the idea of placing a steel frame or skeleton inside the brick and stone structure? Without the steel skeleton the base walls of a skyscraper would be 30 to 40 feet thick.

In other words, each *window* or opening in the steel work measuring, say 12 feet by 20 feet, is, to all practical intents and purposes, a separate unit to be filled in with masonry and window frames where desired. This unit, when filled, so far as its weight is concerned, is carried by the steel beams and columns of the skyscraper skeleton.

MASONRY WALLS ALTERABLE AFTER COMPLETION

EACH *window* in the steel work is treated as a unit all the way through. At any

An unusual skyscraper photograph, the camera lens having been pointed skyward—showing the famous Woolworth Building on the right, and a new fifty story neighbor being erected next to it. This photo gives a good idea of the skyscraper's steel frame.

SKYSCRAPER?

Regarding the Desirability as Well as the Constructional Explained in Everyday Terms

SECOR, E.E.

time one of these sections of stone or brick work can be removed without in any way endangering the building, or causing a collapse or sudden strain in the general building structure. This could not be done, of course, with the old method of construction before the era of steel. Changes in the walls of the building could be effected to a certain extent with the old style building

IF it were not for the modern high-speed passenger elevators, the skyscraper would be out of the question. For years the limit of office buildings was six floors—people would walk up no further than this. Did you know that the steel frame of a skyscraper carries the whole weight of the building, and that the masonry work is merely a filling or "dress" for the steel frame?

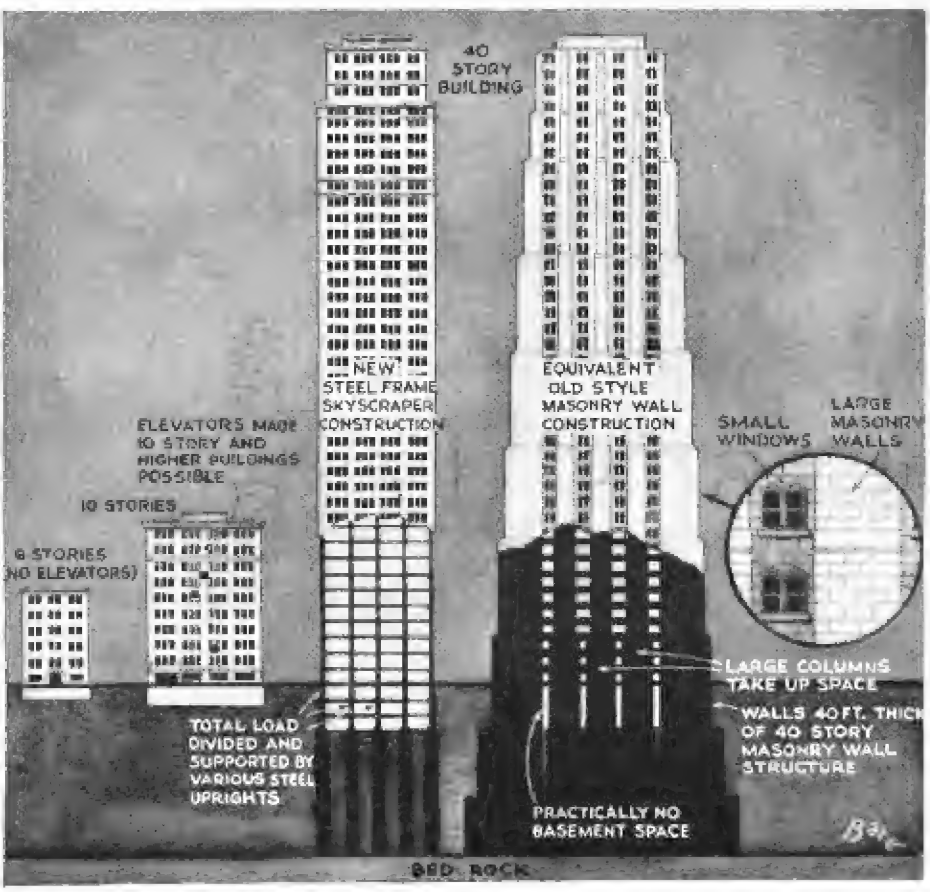
methods, by suitably shoring up the wall with a mass of heavy timbers, but operations of this kind were seldom carried on and only in a limited way. As Mr. Corbett pointed out, so long as the steel work is left intact and not interfered with, you can tear out as much masonry work as you care to, and on any floors desired. It seems almost impossible to a layman, perhaps, that the stone wall "filling" or "curtain" surrounding the first floors of the building, like the Woolworth Building, for example, could be torn away for the sake of a change in design or the addition of larger windows, with forty stories of stone, cement and brick above it, supported only by the relatively thin steel columns, which you would see exposed when the stone work was removed.

EXPANSION AND CONTRACTION CARED FOR

THERE are several very interesting aspects of the modern skyscraper design with regard to the outer (curtain) wall covering which the layman probably never thinks about. One of these factors is that with a large wall, such as that on the inside of a modern tall office building, there is a large amount of contraction and expansion due to temperature changes. In small buildings this expansion and contraction, continually taking place in summer and winter, is absorbed and distributed easily, owing to the small size of the walls.

Contraction and expansion in the outer masonry walls of the skyscraper is taken care of in two ways, as Mr. Corbett pointed out in a recent interview with the writer. In the first place, the brick or stone wall is divided up into a large number of sections, by virtue of the steel skeleton construction, each section measuring not far from 12 feet high by 20 feet long; and secondly, special flexible cement is used at each floor line, where the floor support girders join the upright steel columns. One of the accompanying sketches shows this feature and also how water-proofing, such as tar paper and tar, is used around the steel girders to prevent water reaching the steel work, becoming pocketed there and eventually weakening the steel frame. Although the casual passerby would probably never notice it, there is always more or less pointing up or filling in with cement required on skyscraper brick and stone work, caused primarily in most cases by the strains of contraction and expansion which result in cracks between sections of the wall.

Beautiful appearance of flood lighted modern design of skyscraper. This building was designed for the Pennsylvania Power and Light company, and was recently completed in Allentown, Penn. The architects were Helmle, Corbett and Harrison.



The illustration at the left shows vividly and graphically the evolution of the modern skyscraper from the six story elevator-less office building of forty years ago, to the modern steel frame, forty or more story structure of today. Note that if a forty story skyscraper had to be built with masonry walls, without the steel supporting frame that the walls, particularly at the base, would have to be so thick that the construction would be impracticable. There would be practically no basement space, the windows would be very small, and the huge masonry supporting columns on all the lower floors would occupy most of the floor space.

FOUNDATIONS

PEOPLE who have stood and looked at a skyscraper for a time have frequently been puzzled as to how a sufficiently strong and permanent foundation for such a tremendous mass of steel and concrete could ever have been built. Some idea of the weight of a skyscraper, such as the Woolworth Building, will be obtained when it is considered that this magnificent structure of stone, concrete and steel weighs 100,000 tons, or 200,000,000 pounds; if you are familiar with ocean steamships to some extent, and are used to employing a ship like the *Leviathan* as your mental yardstick, it is interesting to remember that the weight of the Woolworth Building is equivalent to nearly twice the total displacement of a ship the size of the *Leviathan*, whose displacement is approximately 60,000 tons.

When the first tall buildings of ten to fourteen stories were built, the foundations represented one of the weakest points. In a great many cases the architects designed the buildings with the idea and provision in

(*Continued on page* 348)

$500.00 PRIZE CONTEST

Sept

BROADCAST WRNY STATION

25 Cents

Science and Invention

CAN YOU FIND ALL SCIENTIFIC MISTAKES IN THIS PICTURE?

See Page 398

EXPERIMENTER PUBLISHING COMPANY, 230 FIFTH AVENUE, NEW YORK

$500.00 SCIENCE CONTEST

YOU ARE INVITED TO JUDGE WHAT IS WRONG WITH THE COVER. IF YOUR CONCLUSIONS ARE GOOD YOU MAY WIN A CASH AWARD.

By HUGO GERNSBACK
Member American Physical Society

THIS month we are pleased to present to our readers an entirely new kind of a contest; a contest such as, we believe, has not been presented heretofore anywhere.

It is true, that "What's Wrong" contests are no novelty, and have previously appeared in many publications, but it is believed that this particular contest is new, because *it is strictly scientific* throughout.

In short, you are asked to find the scientific mistakes which have been purposely incorporated in the front cover picture of this magazine. A reproduction of the cover appears on this page, but for many reasons, you are asked to work from the cover only and not from this picture.

At first glance, there seems to be nothing much wrong with the picture, but it actually contains 48 scientific errors, most of which the average layman will not be able to detect unless he knows something about science in general.

Here, then, is an excellent educational pastime, and this particular contest is the first one of a series that we hope to present to our readers in the near future.

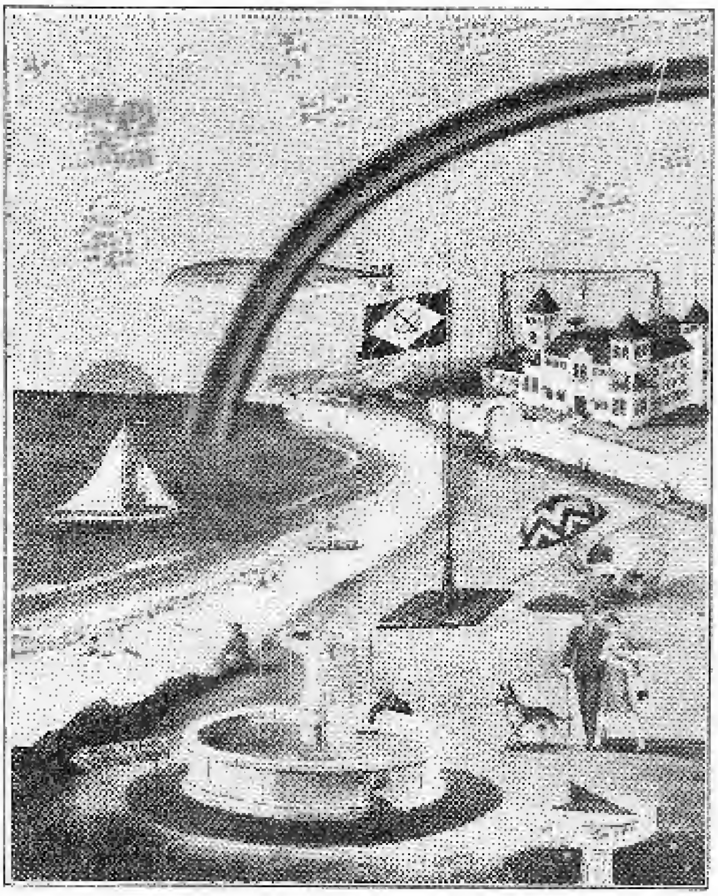
We strongly wish to stress the point that ALL mistakes are of a purely scientific nature. You must know something about science, and you must use your reasoning powers, if you wish to correctly list the scientific mistakes.

Practically every branch of science is represented in the mistakes on this cover. The following are represented: Astronomy, Meteorology, Hydraulics, Optics, Gravitation, Electricity, Radio, Mechanics, Aeronautics, etc.

You must know something about these branches of science in order to correctly find the mistakes purposely made.

Aside from being highly educational, the feature should be of great interest to all artists, amateur artists and draughtsmen. Very frequently, even in famous paintings, artists have made grevious scientific errors. While to the ordinary layman, such a drawing or picture may appear to be perfect, to the scientist it looks absurd, because there could be no such circumstances, such as we see pictured frequently, it being a physical impossibility to have them thus. This, the front cover illustration, brings vividly home.

It appears at first, like an ordinary seashore scene, and it would seem impossible to the layman that there could actually be 48 mistakes in this particular picture. Nevertheless, they are all there, and it is up to you to find them.



Aside from the prizes which we are going to award, the contest is most interesting and you will find a great deal of amusement for yourself as well as your friends.

PLEASE DO NOT LOOK FOR TRICKS. There are no tricks in this contest. DO NOT LOOK FOR MISTAKES THAT ARE NOT OF A SCIENTIFIC NATURE. Thus, for instance, the color of the sun is correct, as shown on the cover drawing. Do not look for a mistake in the color, as very frequently the sun can be seen with such a color. Remember, that the mistakes are ALL of a scientific nature. Just to give you a hint, we name one mistake: The man sitting at the beach is smoking a cigar. The smoke could not possibly go straight up, for reasons that will be clear if you study the picture. *This is a meteorological mistake.*

If you wish to qualify as a prize contestant, be sure to read the following rules carefully. In most prize contests, it is found that people jump at conclusions, and do not read the rules and, frequently, someone who would be entitled to a high prize, does not earn any money at all, because he or she disregarded the essential ruling, so please follow the rules carefully:

1—In making your answer to this prize contest, use a white sheet of paper, letter size, 9 x 12 inches, using nothing else.

2—On the left-hand margin, write the figures from 1 to 48. Write your answers alongside each number. Remember, there are only 48 scientific mistakes, and that you will not find any more. Do not look for trick mistakes, of a non-scientific nature, as these are ruled out.

3—Make answers as short as possible. Thus: "Cigar smoke of man wrong due to breeze."

4—All answers must be written in pen and ink or else typewritten. No penciled matter can or will be considered. Write legibly and neatly.

5—As there will be duplications in correct answers, the higher prizes will go to those whose description is judged best from a scientific viewpoint; as well as the nature of the letter in being concise, brief, neat and correct at the same time.

6—In case of a tie, a prize identical with that scheduled for the award tied for will be paid each contestant so tying. This contest closes at midnight, October 5th, 1928, and the prize-winning answers will appear in the December issue.

$500.00 IN PRIZES
—73 Cash Awards—

1st Prize	$100.00
2nd Prize	50.00
3rd Prize	35.00
4th Prize	20.00
5th Prize	15.00
Eight 6th Prizes of $10.00 each	80.00
Twenty 7th Prizes of $5.00 each	100.00
Forty 8th Prizes of $2.50 each	100.00
Total	$500.00

FREEZES MAN IN ICE

MASTER WONDER OF MODERN MAGIC PERFECTED BY LATE HARRY HOUDINI

By H. WINFIELD SECOR

The above photograph shows Mrs. Harry Houdini presenting the "man frozen in ice" trick.

This explanation of how the illusion of freezing a man in ice is accomplished has been given to this magazine by Mrs. Beatrice Houdini, with whose permission it is herewith published. Mrs. Houdini has granted SCIENCE & INVENTION Magazine this privilege as a courtesy to Mr. Joseph Dunninger, the magic editor of this publication, and Chairman of our Psychic Investigation Committee.

The ice is broken away and the man lifted out with ropes, as illustrated above.

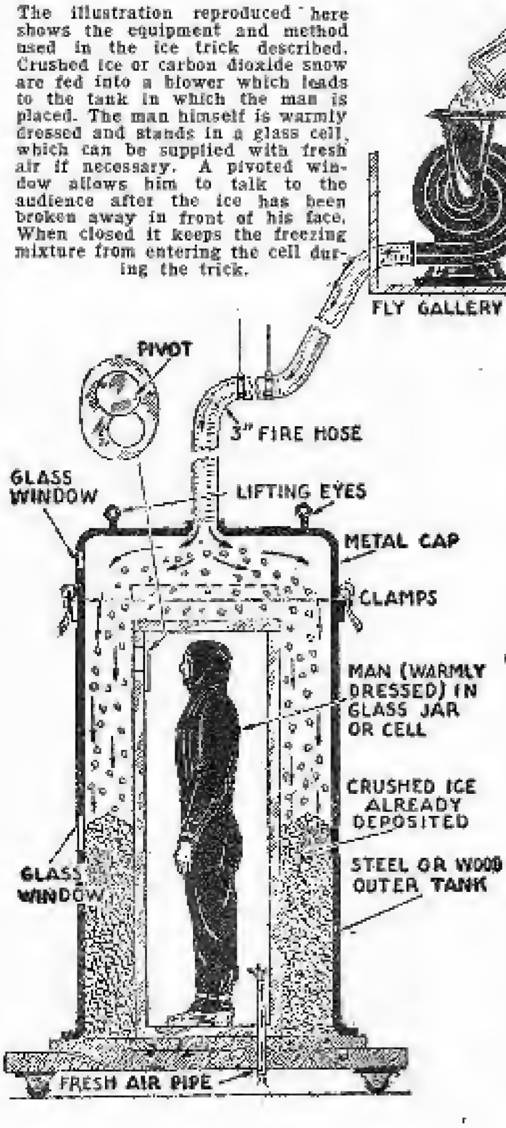
FREEZING a man alive is one of the newest of modern stage illusions. It is one of the most sensational tricks ever conceived and executed in the theatre. The subject is clad in an insulated suit and lowered into a tank. Water apparently freezes around his body and he is tightly imprisoned in the frozen mass. In order to free the subject, the ice has to be chopped away where it is seemingly frozen tightly around his body. The effect produced is that the man was placed in a tank of water which froze solidly around his body.

In the stage presentation of this scientific illusion, an appropriate back drop is used, with the rest of the stage bare, except for a small raised platform or dais placed in the center. Assistants, entering upon the stage from each side, stand ready to hoist the subject up and then lower him into the steel tank on the dais. The subject, clad in an insulated suit resembling that used in Arctic expeditions, is lowered into the tank, in which, as we shall see, a glass cell has been concealed in order to protect the man during the freezing process. Naturally, it appears to the audience that he is directly lowered into the tank and is apparently exposed to the water, which is introduced through the top by a hose. In manipulating the hose the water is turned off when the end is dipped over the edge of the tank and again turned on when the hose is to be removed. The cap is now lowered onto the tank and clamped in place. The man is visible at all times to the audience, due to the provision of a glass window fitted in one of the sides of the tank. Ice can be seen gradually forming behind the window, and it is apparent that the man is to be frozen solidly in an ice cake. After a short time, the cap and sides of the tank are removed and a hole is chopped in the ice and the subject speaks to the audience. The ice on top is then chopped away and the man hoisted out, apparently none the worse after being frozen alive.

In the trick as presented by Mrs. Houdini this was claimed to be a feat of suspended animation. The subject used was a Sioux Indian who was in the first presentation hypnotized before being placed in the tank.

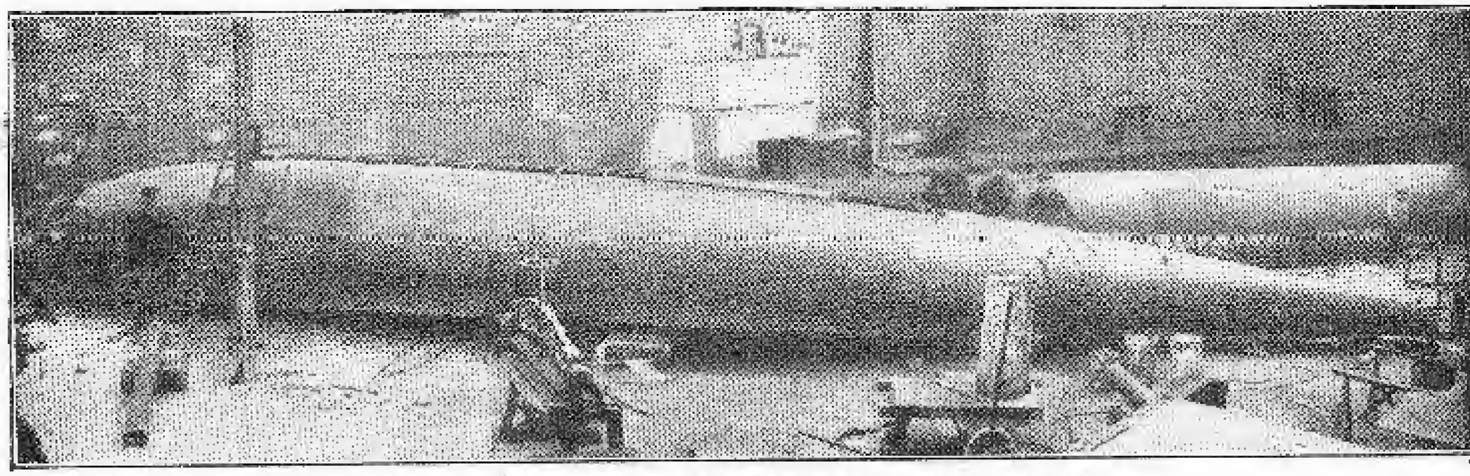
The reader himself might care to duplicate this trick and therefore we are describing one method which is perfectly harmless to the subject chosen. Details will, of course, vary with the individual magician and the mode of presentation. If dry ice is not available, scraped ice can be used in its stead. The average person will not want to make the freezing tank from metal, but there is no reason why it cannot be built with wood and provided with suitable clamps.

The illustration reproduced here shows the equipment and method used in the ice trick described. Crushed ice or carbon dioxide snow are fed into a blower which leads to the tank in which the man is placed. The man himself is warmly dressed and stands in a glass cell, which can be supplied with fresh air if necessary. A pivoted window allows him to talk to the audience after the ice has been broken away in front of his face. When closed it keeps the freezing mixture from entering the cell during the trick.



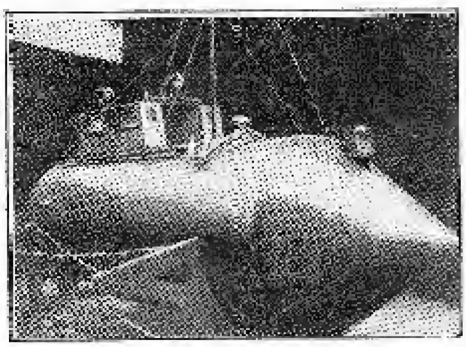
This startling illusion was performed on the stage by using carbon dioxide snow, scraped ice, or preferably a mixture of both. The man is lowered by block and fall into an opaque tank of steel or wood. Concealed in this tank is a glass jar or cell. Of course, the effect produced upon the audience is that the man is actually placed within the freezing or outer tank. Glass windows in the outer tank permit him to be clearly visible to the audience. A pipe supplying fresh air is introduced into the bottom of the protecting glass cell. A specially constructed cap is lowered down onto the tank within, in which is concealed a small top to close the inner glass cell so as to keep the ice away from the man. This cap fits tightly and is clamped in position, as illustrated. From the top of the cap, a large hose about 2 or 3 inches in diameter leads to the fly gallery. Here it is connected to a blower into which pieces of dry ice or carbon dioxide snow and pieces of ice are fed. These are then forced down into the freezing tank. The ice particles pile around the glass cell and by means of a peep hole covered with glass in the tank, the magician or the assistant can tell when the ice has completely filled the enclosure around the glass. When using dry ice, the whole mass freezes almost instantly, as this solidified carbon dioxide gas has an average temperature of about 114 degrees below zero on a Fahrenheit scale. With the perfected method described here, it was found possible to produce a cake of ice within a short time. After a short talk by the magician or after the execution of several other tricks, the cap on the freezing tank is removed with due ceremony. The four sides of the tank are then unclamped and lifted away, showing to the astounded audience, a huge block of white ice. A hole is then chopped through the ice in order to expose the man's face, which, it will be remembered, was covered by a small window placed upon a pivot. This protected him during the freezing operation, but now, as he sees the ice being chopped away, he pushes the window up and speaks to the audience. Later, some of the ice is chopped away at the top and the man hoisted out by means of a block and fall. Of course, the trick is subject to variations both in procedure and equipment, but in any case a startling effect is always produced.

A Trans-Oceanic Pontoon Boat

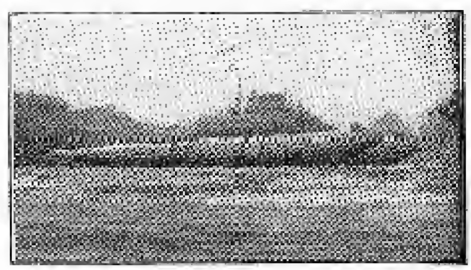


Above we see the interior of the factory where the two pontoons were made.

A PONTOON glider which skims over the surface of the water (driven by water propellors) and attains a tremendous speed has been constructed in France for a trip across the Atlantic to the United States. It consists essentially of two floats of the shape shown in the photograph, between which is suspended a cabin. It is constructed entirely of steel. In the interior of each float are two groups of thirteen reservoirs which are used for the storage of gas and oil. The cabin of sheet steel is perfectly cylindrical except for two extremities, where it is cone-shaped. It is divided into two parts by a horizontal floor, the lower portion housing the motors and the mechanics' quarters. A complete radio transmitter and receiver is placed in the rear cone. The pilot and navigator take their place in the upper portion of the cabin. Surface resistance between the pontoons and the water has been reduced to a minimum by their peculiar construction. If the projected voyage proves successful, the inventor intends to build another ocean glider of larger size in order to carry a number of passengers. This will be propelled by an airplane engine and will attain a speed of 60 knots an hour if the expectations of the builder are to be realized.—*Lucien Fournier, our Paris correspondent.*



The main portion or cabin of the boat is shown above. This is placed between two pontoons.



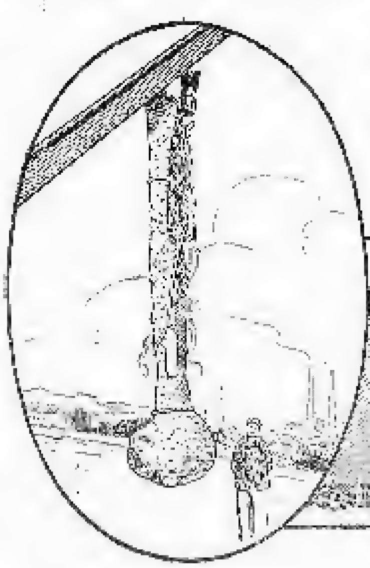
The complete boat afloat on the water appears in the above photograph.

Explosive Concrete Piles

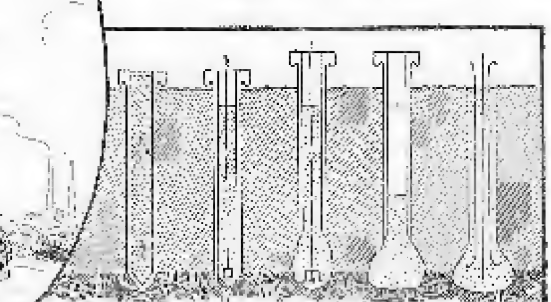
THE foundation is of importance for everything, but specially in building constructions. The fact that so much is said of foundations, of bases and the like, shows how deeply the feeling of importance of things of this order has penetrated our flesh and blood. The usual way of carrying out foundation work is the laying down of a flat foundation, which carries the weight of the building in conjunction with the natural ground below it. But when the firmness of the natural soil is slight, the above is not sufficient. We have to try to support the building better, and the usual method is to drive piling for the foundation. The method is to drive down a series of long beams with a heavy ram or weight operated by the pile-driver, keeping them vertical, so as to avoid all side strain. In the first place, it must be accurately known what load each pile has to carry eventually. By the distance which the pile traverses in a definite number of blows, say from 20 to 30, it can be calculated how many kilograms of resistance the earth offers to its further penetration. The weight of the ram used and the proposed load to be carried when the building is erected, gives simple factors from which we can calculate the greatest amount of penetration determined by the last series of blows, in order to get the necessary sustaining power. We must not be satisfied if the lower end of the pile strikes some small solid surface area, such as a big stone, which seems for the moment to give a good bearing; such will not last long. Consideration of how the whole series of piles are driven gives a far better estimate for the supporting power of the soil.

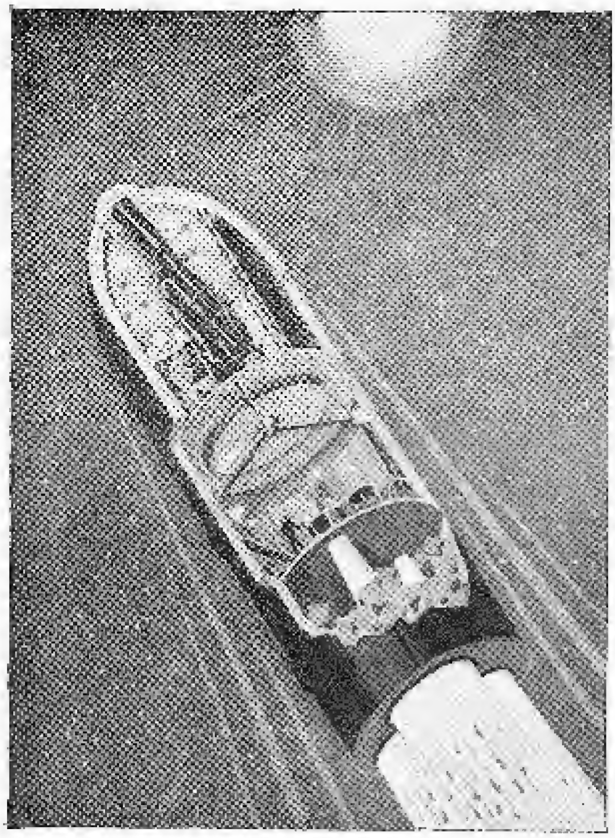
But in many cases, it is very difficult to get a sufficient sustaining power for the pile in soil of low resistance. Often it will seem to be quite secure enough, but when a sufficiently intense series of testing blows are given, the pile goes down still further. In such cases, it is often necessary to put another pile on top of the one driven down to its full length, so as to virtually lengthen it by some meters, but such additional piece has never half the reliability of the original pile, and often more than one of these extra pieces are required. It often wants more, and it is quite expensive in the end. In swampy soil in which sustaining stratum of ground cannot be reached, some relief is obtained if a very large number of piles are driven down, one beside the other, which increases the specific pressure of the soil so greatly that the bearing power of the ground reaches a reliable minimum. But to be very sure, the upper ends of the pilings are joined by a sort of platform of beams or else by a great layer of concrete, so that the whole building eventually will rest almost floating on a spongy sub-stratum, all of which must be well studied out. In the case of Dutch railroad viaducts, which are partly carried by such

(*Continued on page* 447)



The illustration at the left shows an experimental concrete pile being drawn out of the earth. In the illustration below, a is an iron sleeve, b shows charge of explosive being introduced, c shows the mushroom-shaped foot after the explosion, d the mushroom-shaped end is spread equally in all directions by driving down the wooden pile, e, the iron tube is drawn up to the surface.





From the Earth to the

The Problem of Interplanetary Navigation

At the left is an illustration of the rocket car intended for interplanetary flying. It is divided into three compartments, the upper of which contains a telescope and oxygen producing apparatus, the middle compartment contains an electric motor and disintegration chambers, the rear compartment contains the ejection cones.

SHADES of Jules Verne! A space flyer propelled by rockets attains a tremendous speed and solves the problem of inter-planetary navigation (?) The rocket car has proved feasible and attained the surprising speed of nearly three miles per minute on tracks. Further developments are being made by an aviation company in Germany, which is now building the first

IF interplanetary voyages are realized some time in the future, it will be in a vehicle far more developed than the projectile-car fired from a cannon 300 meters in length, which Jule Verne brings into his famous voyage, "From the Earth to the Moon."

These voyages across the heavens, several learned spirits and very serious ones, have had no fear in prophesying. Captain Ferber bases his view on the opinion of Mr. H. G. Wells, Rev. Archdeacon, Quinton, and M. Esnault-Pelterie, to predict the fatal exodus of humanity, which had attained a civilization far superior to ours, and who quitted the exhausted earth in search of more interesting planets.

If we wish to follow these amusing but scientific dreams they will lead us straight to special problems, which are very curious and which present some practical interest, because they touch upon almost all the branches of natural science. It follows that astronautic science (this is the epithet with which Mr. J. H. Rosny has endowed the future interplanetary navigation) can bring before us a whole series of investigations theoretical or practical, and extremely serious.

TRUE CONDITIONS FOR AN INTERPLANETARY CANNON SHOT

THE ballisticians, for example, can take up again the problem of the projectile vehicle and correct the calculations of Jules Verne, which were manifestly insufficient.

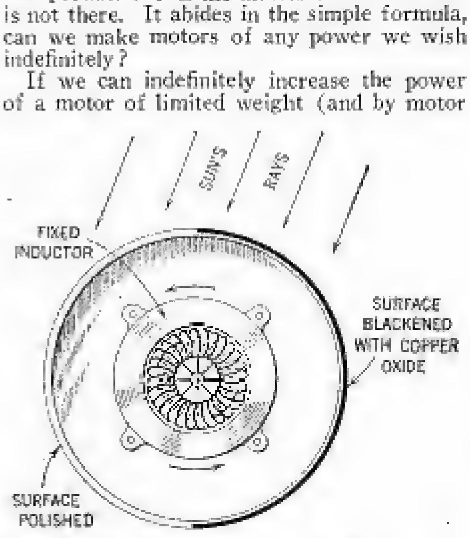
After having shown, without difficulty, that the necessary velocity to enable a projectile to escape definitely from the earth's influence could not be given by any cannon, even if it were 300 meters long, and that there is no way of cushioning the shot within the projectile, at the moment that the discharge takes place, the ballisticians are naturally brought face to face with the real conditions of the problem, and there arises an interesting theoretical discussion in which the most eminent artillerists are not in accord as yet with each other.

The projectile would receive, in any case, on leaving the mouth of the gun, a second shock, coming from the resistance of the air, so that the traveler already driven down against the base of the shell, would be driven back against its head section a second time. Finally, the heat due to the adiabatic compression of the air in front of the projectile would soon make it volatilize. The object of theoretical controversies are the determination of the critical moments when such accidents would be produced, whose practical interest is recalled to us by the too celebrated Big Bertha. In a word, in reference to the projectile car labeled "Earth-Moon," we are always face to face with this question: what is the longest range which can be realized by the methods of present artillery or by that which may be conceived in the future?

FROM JULES VERNE'S CANNON TO THE REACTION MOTOR

BUT the real problem, and the only important one in the matter of astronautics is not there. It abides in the simple formula, can we make motors of any power we wish indefinitely?

If we can indefinitely increase the power of a motor of limited weight (and by motor



The rotation stabilizer is illustrated above. To control rotation around its axis the projectile would be fitted with an electric motor placed on its side, on the floor of the rocket.

I mean the machine supplied with its combustible), then there is no doubt that astronautics is not a Utopia. It would be possible on some day, more or less remote, to leave the earth. It will be enough, using such a motor, to keep constant for several hours the acceleration of any vehicle, so as to attain a certain "critical velocity," which, directed toward the zenith, will bring us outside of the zone of attraction of the earth. At this moment the heavens belong to the travelers. They were conquered by the velocity the machine has developed.

THE SPEED LIMIT REQUIRED

WE now come to the essential point of the problem, the astronomical point of view. Let us then determine what is this "critical velocity" capable of overcoming gravity. It is quite simple to understand its nature, and to verify mathematically its dimensions, if we only keep in mind this theorem of celestial mechanics: "A body coming from the infinite and falling on any planet whatever reaches such planet with a velocity which is finite."

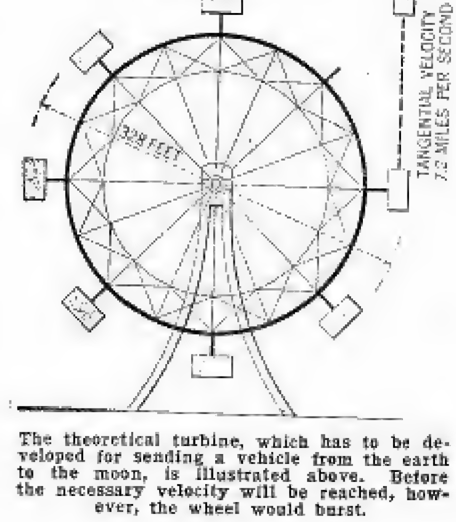
It is well to insist on this, because many educated people are encountered who have no scientific education and who think: "The greater the height from which one falls, the greater is the velocity with which one reaches the ground. If then, a body left the heights of the heavens and fell without meeting any obstacle upon the earth, it would reach there with a velocity of several millions of kilometers per second, perhaps faster than the speed of light—which would contradict very nicely Mr. Einstein."

To this simple idea the theory of gravity potentials gives us definite denial: No! Such a projectile in free falling would never reach the earth at any other speed than 11,180 meters per second. This is not very great, if we realize that some nebulæ go at the rate of 600 meters per second, and that the earth in its orbit far exceeds these few 11 kilometers, which would be enough to leave it.

Now you will have perceived that the reciprocal is true: For, if in leaving the infinite, the earth is reached at 11,180 meter-seconds only, it would suffice to reacquire this velocity in the opposite sense to return to the infinite, whence theoretically you have departed.

PASSING FROM TERRESTRIAL TO LUNAR GRAVITATION

ALL this is precise, but if one is not going to the infinite of space, if one desires only to reach the moon, a far less velocity will suffice.



The theoretical turbine, which has to be developed for sending a vehicle from the earth to the moon, is illustrated above. Before the necessary velocity will be reached, however, the wheel would burst.

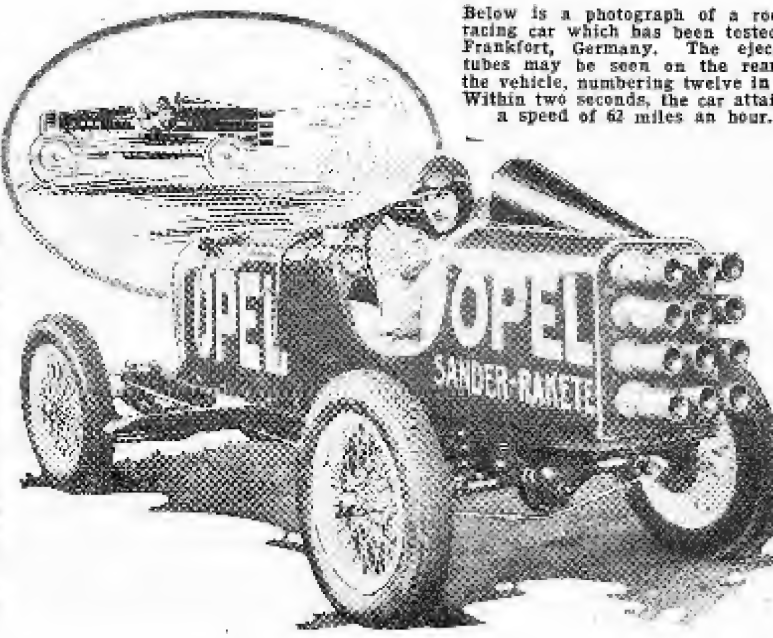
Moon via Rocket

Is of Real Scientific Interest

Suppose one manages to impart to a vehicle of the weight of a ton, an acceleration only one-tenth that of terrestrial gravity (in other words, if you succeed in applying to it a constant force of 1,100 kilograms), this vehicle will acquire an ascension so greatly accelerated, that at a distance of 5,780 meters, its speed will have risen to 8,180 meters per second. This result will have been obtained in twenty-four minutes and nine seconds and will be enough in itself, so that the propelling force can be shut off. The voyage will continue by the velocity acquired (inertia).

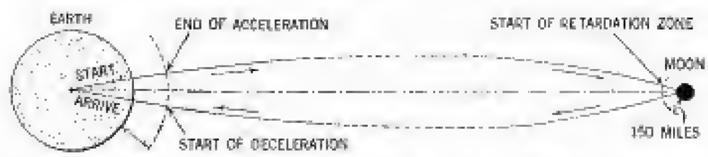
rocket planes, which may revolutionize aviation. At a conservative estimate, these planes will attain a speed of more than 350 miles an hour. If we could but utilize the partial intra-molecular energy of radium, or the total intra-molecular energy of disintegrated matter, we would undoubtedly be able to construct a rocket attaining unheard of velocities.

Below is a photograph of a rocket racing car which has been tested at Frankfort, Germany. The ejection tubes may be seen on the rear of the vehicle, numbering twelve in all. Within two seconds, the car attained a speed of 62 miles an hour.

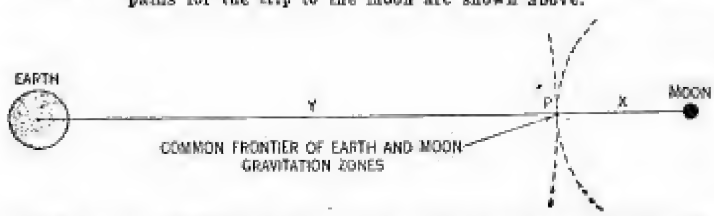


Twenty-four rockets were carried in the car, which eventually attained a speed of over two miles per minute. The owner, Fritz Von Opel, predicted that within a short time, a flight around the earth would be made in twelve hours by an airplane propelled with rockets.

Nevertheless, the terrestrial weight will play a part, acting as a brake. The velocity will then diminish, but at that it will be 2,300 meters when the vehicle reaches the zone of equal attraction, separating the respective domains of terrestrial gravity and lunar gravity. This last now coming into play will appear in a new positive acceleration, and the velocity will rise to 3,060 meters. At this instant the vehicle will reach the lunar surface. This would be a "lunar collision," absolutely annihilating. It then is necessary to have a parachute. This parachute, in the absence of all atmosphere, would be useless, and in any case even in an atmosphere would be quite inefficacious, so the motor would have to be called upon at the proper moment to operate against the acquired velocity. This would be nothing difficult for it, if by a positive acceleration maintained for twenty-four minutes and nine seconds it could overcome terrestrial gravity, the same motor *a fortiori* could oppose the lunar attraction which is seven times less intense. The braking action would only need to last three minutes and forty-six seconds, and it would be sufficient to start the operation only two hundred and fifty kilometers before reaching the moon.

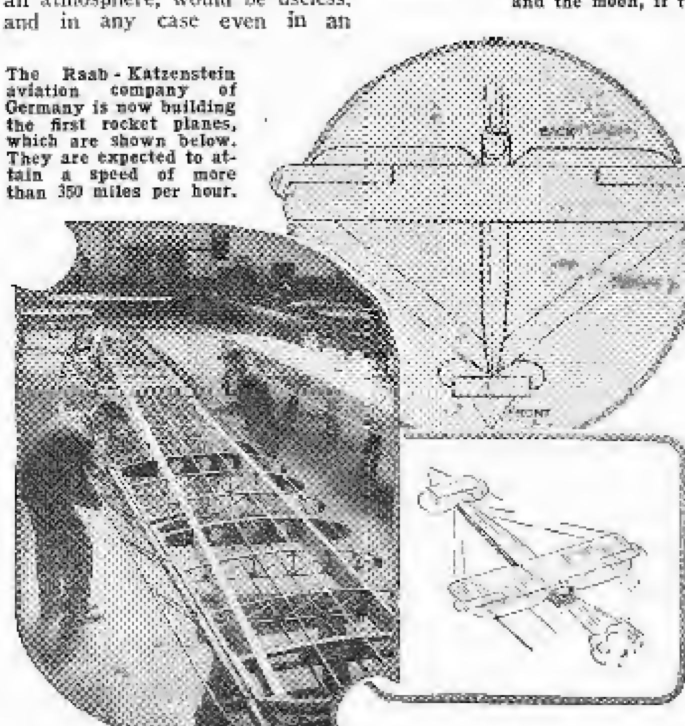


The mean distance from the earth to the moon is 30 terrestrial diameters. The atmosphere of the earth, however, offers an obstacle. The various paths for the trip to the moon are shown above.



Above is a representation of the point of equal attraction, marking the common frontier between the respective fields of gravitation of the earth and the moon, if the two were alone in space.

The Raab-Katzenstein aviation company of Germany is now building the first rocket planes, which are shown below. They are expected to attain a speed of more than 350 miles per hour.



THE REACTION MOTOR, ITS FORMS AND RELATIONS WITH THE ATMOSPHERE

It is now time to examine if there is a motor in existence capable of such power, or if it can exist, and what kind it would be.

It exists exactly represented (naturally of reduced power) in the modest fireworks, as in rockets and pin wheels.

Such are reaction motors and indeed the reaction motors *par excellence.*

The rocket does not act by pushing against the air, as so many people believe by mistaken intuition; it progresses in the manner of a machine gun, which mounted on wheels on a perfectly smooth surface, such as a frozen lake, will constantly recoil if it burns up its cartridges in sufficient amount to maintain the recoil motion. Recoil, which is a great trouble for artillerists, is precisely the reaction effect which drives the rocket. This it is which M. Robert-Pelterie specially studied with a view of carrying out interplanetary travel.

The work of Mr. Esnault-Pelterie covers all possible hypothesis relating to existing explosives, and its calculation covers all forms of the theoretical rocket.

There are certainly rockets and rockets.

Let us construct a cylindrical rocket exactly like those we find in commerce, its orifice for the escape of gases is unchanged over its entire course. Calculation shows that this form of rocket, independent of the explosive employed and of whether it works in the air or in a vacuum, is the best form for raising to the greatest possible height, a certain dead weight calculated for it in advance. The same form is also adapted to raise to a certain height, the largest useful load, but that does not say that a cylindrical rocket is best for interplanetary travel.

For the rocket, as for the projectile-car of Jules Verne, the atmospheric layer gives a difficult road. If the velocity of any projectile exceeds for instance, a certain amount, the heat due to the resistance of air on its face rapidly raises the temperature of the projectile itself.

As long as the rocket is passing through terrestrial atmosphere, it will have to be kept below a certain velocity. This is somewhat annoying. After having done everything to acquire velocity, we have now to sacrifice it!

And this is what aggravates the matter. The density of the air does not enter into the heating question, which is contrary to what we might believe. To put it otherwise in rarefied air, at very high altitudes the projectile will be heated on the average as much as on lower altitude. This is the result of accurate theoretical calculations. Therefore, the obstacle of heating by the resistance of the air is prolonged far above that which we might believe.

On the other hand, at the extreme limit of the atmosphere, the projectile will attain

(*Continued on page* 440)

Oct.

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Science and Invention

THERMITING
ICEBERGS
See Page 494

EXPERIMENTER PUBLISHING COMPANY, 230 FIFTH AVENUE, NEW YORK

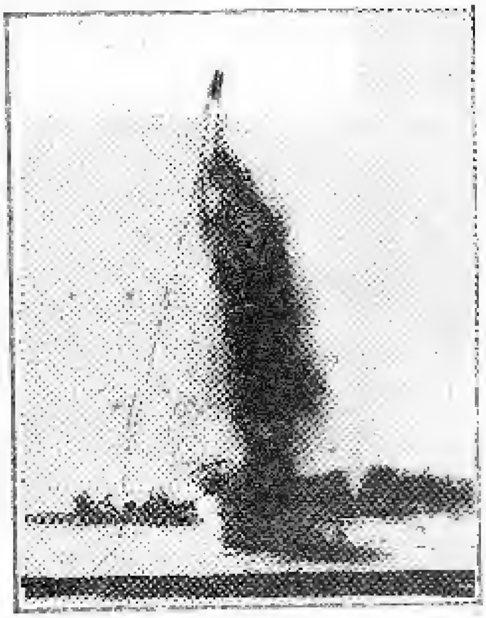
THERMITING ICEBERGS

Ice Jams Cost Millions of Dollars Yearly; Prof. Barnes Tells How to Break Up Ice Formations Cheaply and Simply *

By HOWARD T. BARNES
Professor of Physics, McGill University, Montreal, Canada

INTRODUCTION

IN giving this little account of Ice Fighting, I have in mind always a time when mankind will wake up to the fact that we are masters of our destiny, and that with modern engineering skill anything in reason is possible. The children of to-day will be the men of affairs to-morrow, and therefore I am always glad to address the younger audience, hoping that their receptive minds will become interested in the facts of Nature, and will thus realize what can be accomplished even under a generation grown up with the idea fixed in their mind that ice and snow is a visitation of the Almighty like the weather, and therefore incapable of being modified.



A charge of ninety pounds of thermit reacting in ice on the St. Lawrence River. This charge lifted up a mass of ice 8,500 feet square and 9 feet thick, broke it and the pieces floated down the river in a few minutes. The metal container of the charge is seen shot up in the air to a height of 100 feet.

It is wonderful in retrospect to look back to the progress during the past 30 years in handling ice and snow, and it is a conservative mind indeed which cannot look forward to the next 30 years with assurance of the tremendous progress which will be made.

COST OF ICE AND SNOW TO THIS COUNTRY

THE annual tax imposed on us by Jack Frost is enormous. In our waterways we find the navigation ceasing with the advent of winter, and where means are found for breaking ice the expense must be borne by the Government so great is the cost.

In the great Port of Montreal, closed for five months of the year, the weekly loss runs to $15,000,000. In the operation of automobiles, no estimate of the millions lost has been made. All our Taxi Companies report thousands of dollars spent in damage done every winter.

In the operation of the railroads, the clearing of snow from the tracks and the thawing of switches represents much money. In delays to traffic, no estimate has ever been made. Every snow storm costs the City of New York about one million dollars for snow-removal alone.

The great water power plants situated on northern rivers are seriously affected by ice, and many of them are reduced to half their summer capacity.

The loss to telephone and telegraph lines due to sleet is very serious.

All this represents loss, and is therefore never considered as money made when saved. To this I ascribe the apathy and the reluctance displayed by the big interests and the Governments in directing concertive study to the problem of fighting ice and snow.

This is why I want all the boys and girls of this country to think over this matter seriously and to realize the need for careful study of remedial work in saving the vast fortune which is slipping annually through our hands.

MILLIONS of dollars worth of business, not to mention many lives, is lost every year in the United States, Canada and other parts of the world, due to great masses of ice which pile up and prevent navigation of rivers and harbors. Also great masses of ice in lakes and rivers are frequent causes of disastrous floods, representing another huge monetary loss.

Professor Howard T. Barnes, of McGill University, Montreal, Canada, is probably the greatest expert in North America on the problem of how to rid harbors, rivers and lakes of dangerous ice formations. Prof. Barnes has also developed a remarkable method of attacking and destroying icebergs, those dangerous menaces of sea voyages. Prof. Barnes has perfected a remarkably simple method of applying thermit to the destruction of huge quantities of ice, such as icebergs.

NEED OF MILITARY PREPAREDNESS

IN all respects the coming of winter brings the enemy ice and snow with regular recurrence. Ice must be regarded as an enemy to mankind, for since the earliest dawn of history man has been fighting the encroachment of ice for his very life. No one fact of Nature has influenced so fundamentally the whole course of human history as ice, for the great ice ages of the past have driven men from their homes and modified the mode of life just as they will in the future.

But what is done in the case of the approach of the enemy must be done in the case of the approach of winter. Preparations must be made, and forces organized to meet the on-coming of ice and snow in time to temper its effects and prevent its gaining the hold and paralyzing the industries of the country.

You may ask how can this be done? All I can do is to try to explain to you how it has been done so far, and what can be done with wonderful results in the future.

METHODS OF ICE FIGHTING

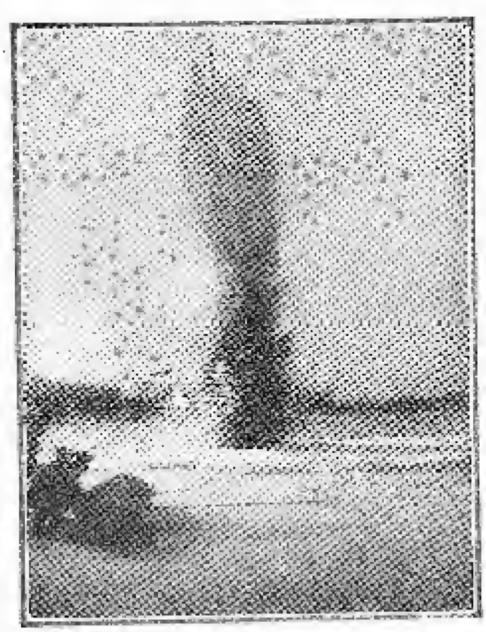
IN our rivers and lakes one great barrier is the copious formation of ice on the surface. Every year many grain vessels are caught on the great lakes by a sudden drop of temperature. With a low temperature ice thickens rapidly and resists all efforts but that of special ships called ice breakers to move it.

Navigation is impeded and ships are injured by the sharp edges of the ice as they are forced through the solid pack. The new ice on a cold day is like a sharp knife, and cuts or ruptures wooden or steel plates, causing leaks to start.

In many rivers other serious conditions arise owing to the channels remaining open after the bays and shallow areas have frozen over. Great fields of ice move out and block the channel, into which the broken pieces of shore ice become packed and the whole cemented by snow blown into the water and fine ice crystals called frazil and anchor ice which forms in the open water on the bottom and is carried by the current into the pack. Thus an ice jam is produced which dams back the water and causes the river to overflow its banks and flood the surrounding country. So severe are these winter floods that many farmers have to resort to their upper stories every year and go about from one farm building to another in boats. This results in great loss and suffering to man and beast.

The Canadian Government has three ice breakers on the St. Lawrence River, which are stationed at Quebec City and operate all winter through Cap Rouge where the great Quebec Bridge is situated, in order to protect the river bank from the flooding. These boats have been working since 1908, and have

(*Continued on page* 540)



A terrific explosion takes place when thermit is used to crack and break up ice jams. In this case the thermit can was shot high in the air, and the whole ice sheet was lifted and ruptured.

* Subject of a lecture given by Prof. Barnes in WRNY's "University of the Air" Series.

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Science and Invention

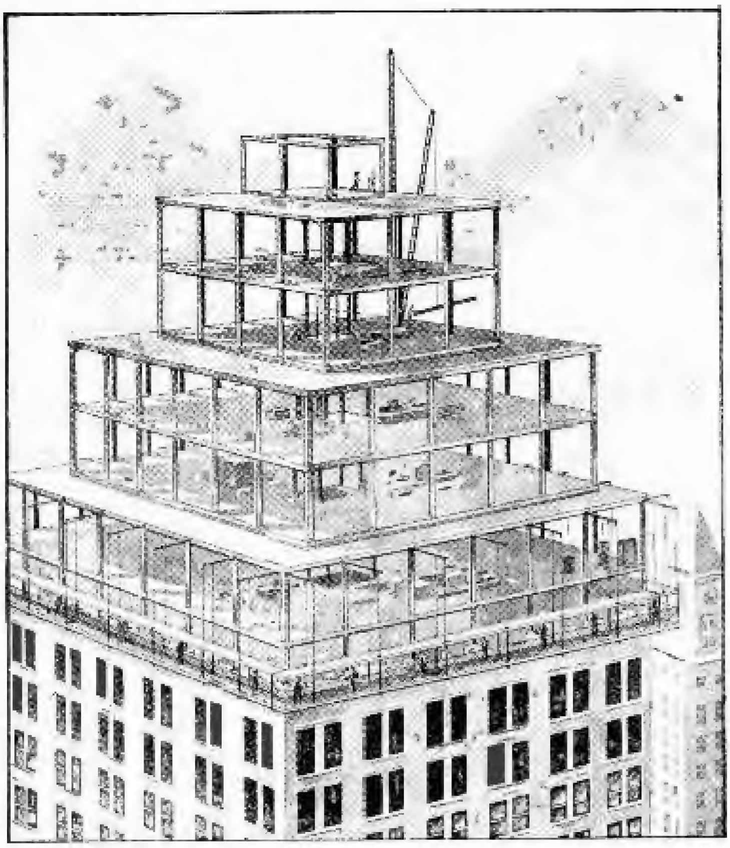
BUILD YOUR OWN
TELEVISION
RECEIVER

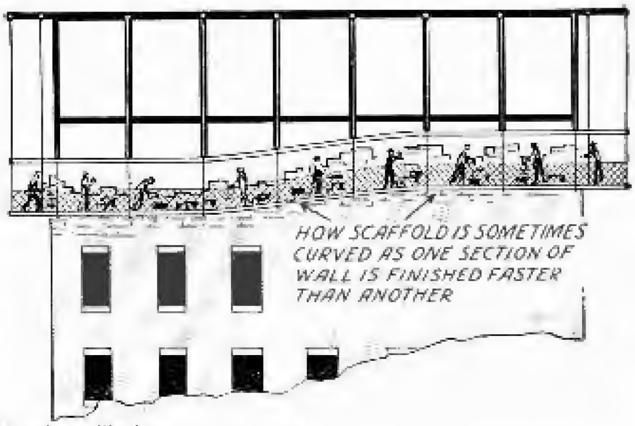
See Page 618

EXPERIMENTER PUBLISHING COMPANY, 230 FIFTH AVENUE, NEW YORK

Moving Scaffolds Aid Masons

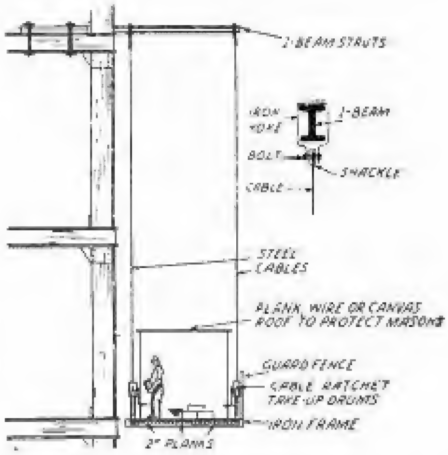
Stone and Brick Work Placed on Skyscrapers in Record Time; Masons Follow Iron-Workers





The above illustration shows how the scaffolds can be curved as one section of the building is finished faster than another. The drawing at the right shows how the platforms are moved by means of hand winches.

The scaffolds are placed entirely around the walls of the building, and are cleverly joined to each corner. The illustration at the left shows these moving platforms being used in the construction of a large skyscraper. A roof is provided to protect the workers.



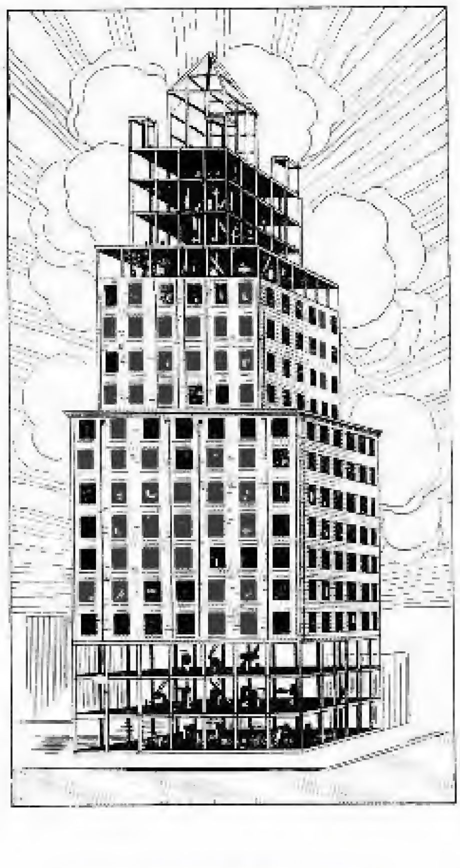
IN our present-day Machine Age, engineering and architectural development is rapidly advancing. In all big cities skyscrapers are springing up like veritable mushrooms. As each day passes, new construction methods are invented to keep in step with the modern building design. Recently, moving safety scaffolds have been put to use in the erection of the large buildings and have greatly aided the masons in applying the stonework. The new scaffolds are made of planks supported by an iron frame and are roofed over with boards, wire or canvas to protect the workmen from objects falling from above. A heavy wire frame around the edge of the scaffold assures protection to the pedestrian and safety for the workmen. To further insure

The illustration at the right shows how the steel skeleton of a building is filled in with the stonework at any desired floor. With the old type of masonry construction, where the walls supported the weight above them, this would be impossible, and the masonry would have to begin from the bottom.

the pedestrian's safety, the sidewalks are roofed over.

The scaffolds are suspended with steel cables from I-beam struts from a portion of the building framework. A series of winches placed at the front and back edges of the mason's platform permits it to be raised or lowered by the workmen. As one portion of the wall is finished, the scaffold is raised by simply operating the lever on the hand winch. Sometimes one portion of the wall is finished faster than another. This condition is illustrated here, and it will be seen that the scaffold can be bent or curved at will. On one large building which the editors watched from the window, the scaffolds assumed a double curve frequently during the construction. The moving platform or scaffold permits eight or ten floors to be finished without changing the position of the cables. When the stonework has been put on the maximum number of floors, the cables are removed and placed higher up on the building.

Another interesting point in the erection of a skyscraper, is the placement of the construction elevators which lift the bricks and materials, which cannot be carried from the street level. These elevators are built just as soon as a steel skeleton has been started, and keep pace with the growth of the structure. The heavy elevator motors, water tanks, and other materials, are raised to the upper floors of the building by a steel boom derrick before the masonry is put on.

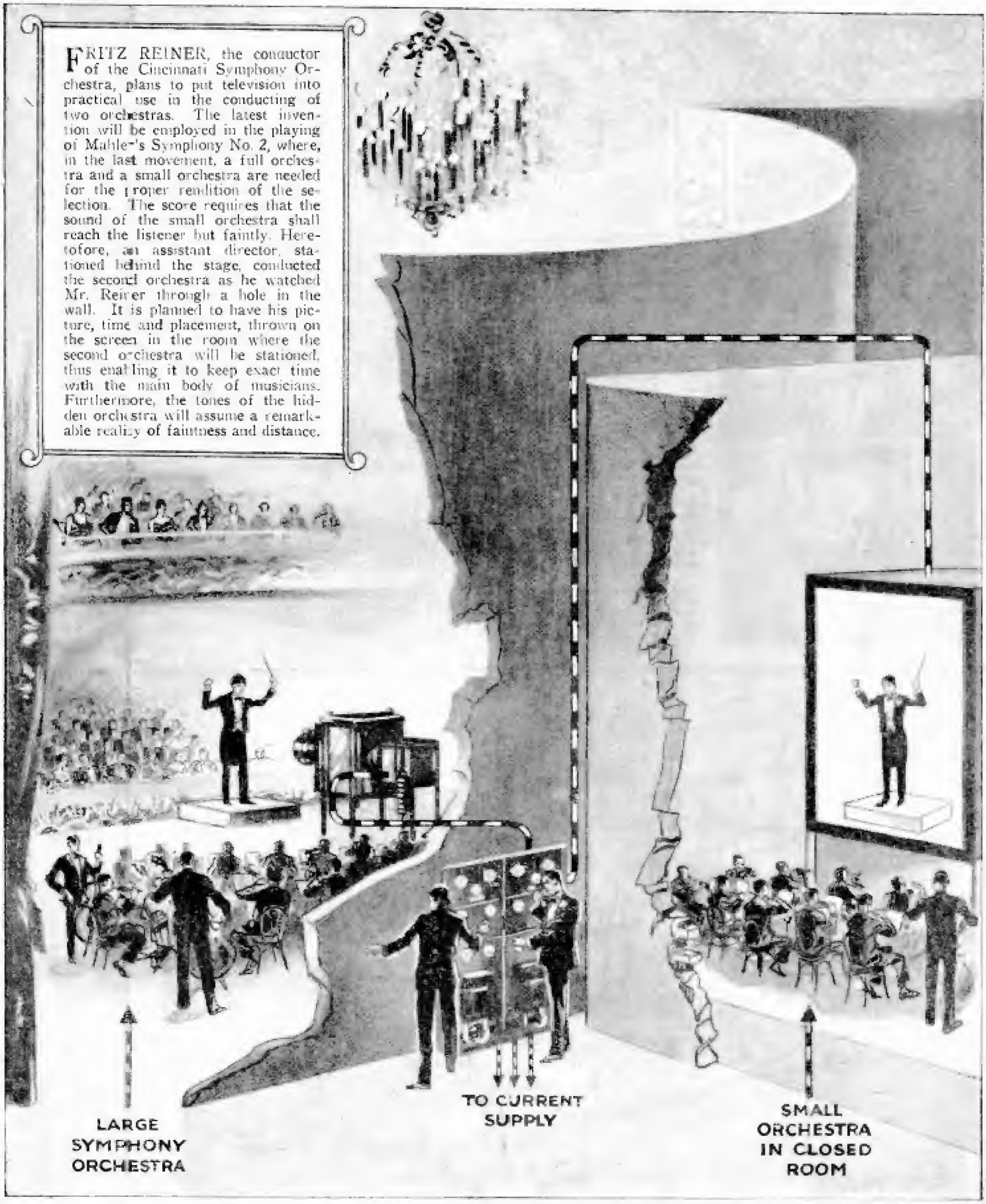


The contraction and expansion in the outer masonry walls of the building is taken care of in two ways. The brick or stone wall is divided up into a number of sections by the steel skeleton construction. Besides this, flexible cement is used at each floor line where the floor girders join the uprights. Before the masonry is put in place, tar paper and tar are used to waterproof the steel work and prevent water from reaching it and becoming pocketed. It is interesting to note that any section of the outer brick or stonework can be removed without causing a collapse of the building. This is made possible by the steel construction of our modern buildings. Forty years ago the floors above the street level were supported by brick or stone walls and towers. In the older buildings, which had from ten to twelve stories, the huge supporting walls took up an enormous amount of space on the lower floors. The present-day steel skeleton supports the whole weight of a skyscraper, and the stone or brick masonry simply covers it, but does not bear any part of the weight. The illustration at the bottom of the page will show this and illustrates how the masonry work is frequently put in place on the upper stories before it is applied to the lower floors. Detailed information on modern skyscraper erection will be found in an article entitled, "Why is a Skyscraper?" by H. W. Secor, in the August, 1928 issue of this magazine.

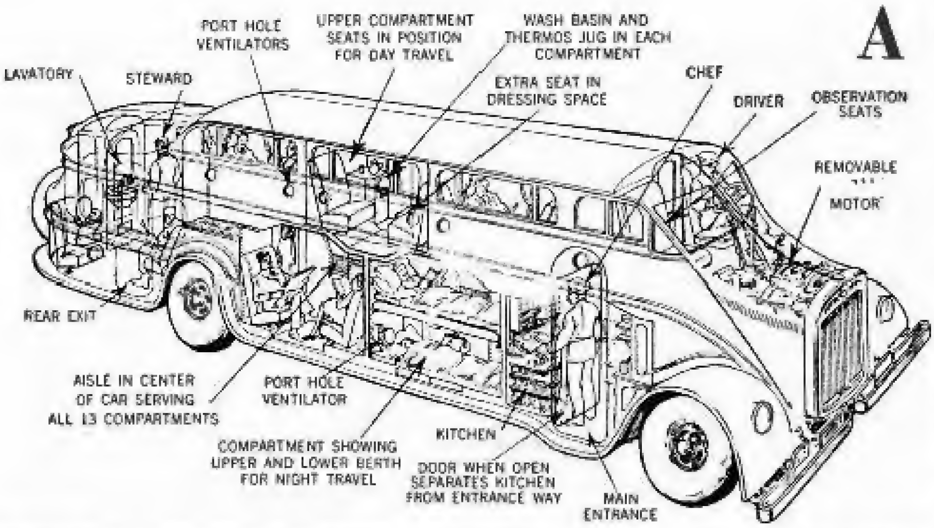
Television Directs Two Orchestras

Leader's Picture on Screen Keeps Two Bands in Time

FRITZ REINER, the conductor of the Cincinnati Symphony Orchestra, plans to put television into practical use in the conducting of two orchestras. The latest invention will be employed in the playing of Mahler's Symphony No. 2, where, in the last movement, a full orchestra and a small orchestra are needed for the proper rendition of the selection. The score requires that the sound of the small orchestra shall reach the listener but faintly. Heretofore, an assistant director, stationed behind the stage, conducted the second orchestra as he watched Mr. Reiner through a hole in the wall. It is planned to have his picture, time and placement, thrown on the screen in the room where the second orchestra will be stationed, thus enabling it to keep exact time with the main body of musicians. Furthermore, the tones of the hidden orchestra will assume a remarkable reality of faintness and distance.

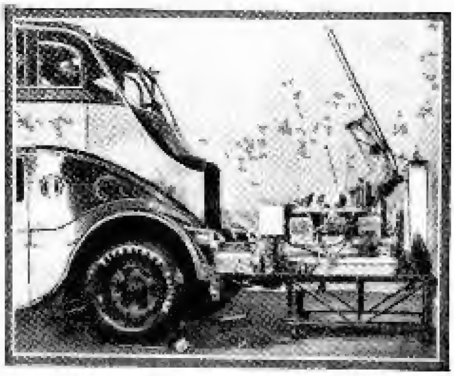


The above drawing shows how a hidden orchestra will be kept in time with the main symphony orchestra by means of television. The conductor's movements will be thrown upon a screen in front of the hidden orchestra. The leader of the orchestra will be televised and his picture thrown upon a screen, keeping both bands of musicians in the same tempo. This is to be put into effect during a concert given by the Cincinnati Symphony Orchestra.



A MOTOR BUS SLEEPER

Now Possible to Travel Across United States at last on Buses Carrying Sleeper Berths and French Chefs

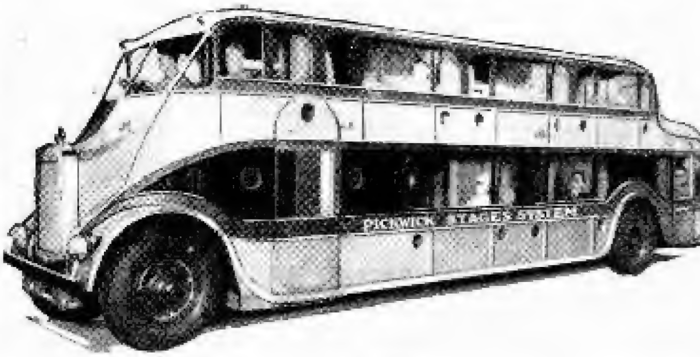


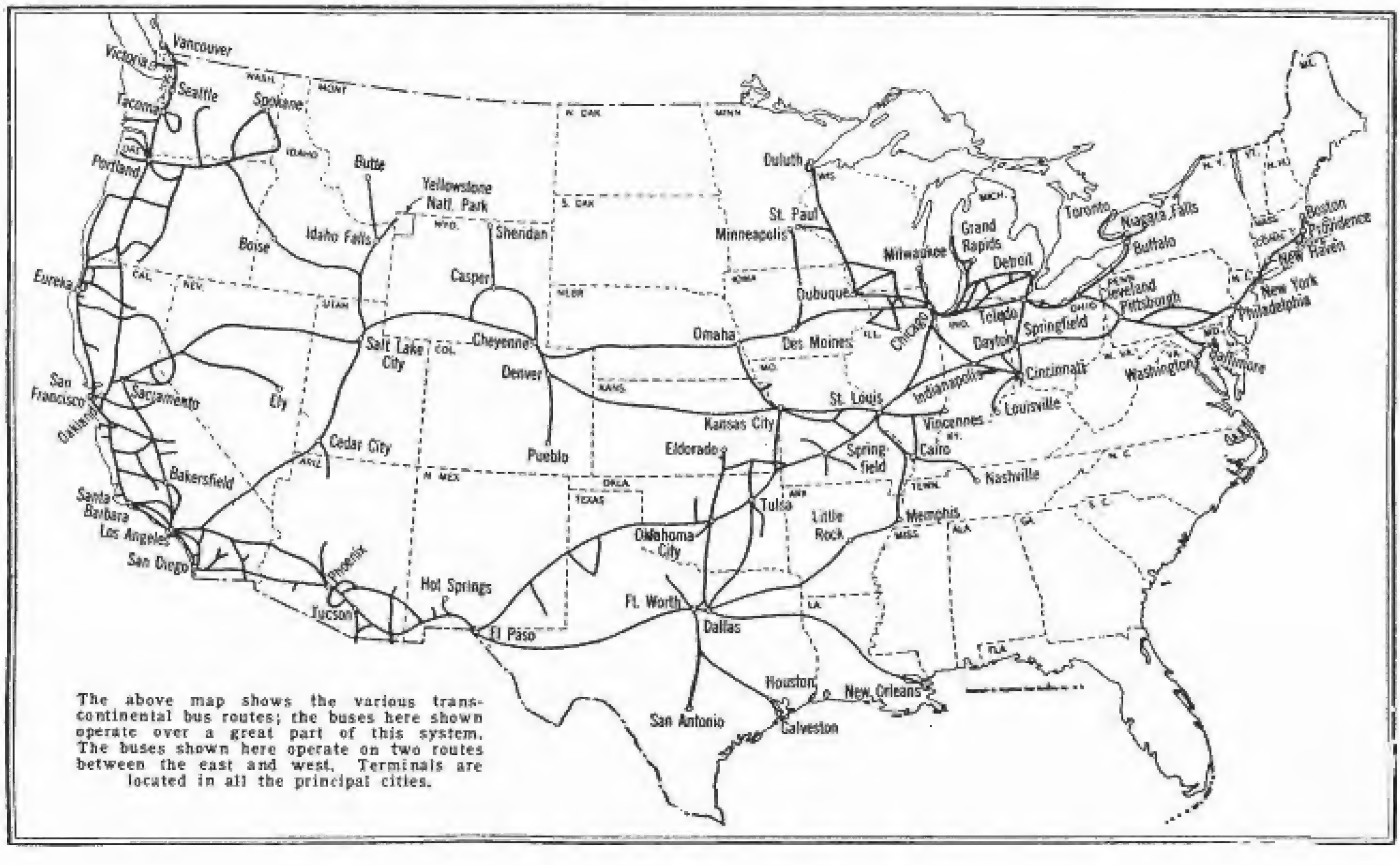
A remarkable new feature of the bus lies in the fact that the motor can easily be removed for repair, as shown above.

THE ultimate idea in motor bus construction has been reached with the introduction of a night coach, which provides sleeping quarters for twenty-six passengers. The compartments are arranged in upper and lower decks, and each accommodates two people. At night the cushions of the seats are used to form the berths. The bus is 34 ft. 6 in. long, 8 ft. wide, and 10 ft. 3 in. high. It weighs 14,000 lbs. and was built at a cost of $30,000. The coach is constructed entirely of metal and has no chassis. A heavy frame of steel around the car just below the lower berth windows serves as a chassis.—*Photos courtesy Pickwick Stages System.*

The photographs at the left show the passenger seats in normal use and when the berths are made up. At the right is a photo of the new motor stage.

The illustration at the top of the page shows the internal construction and how greatest comfort is provided in a minimum of space by clever engineering design.





The above map shows the various transcontinental bus routes; the buses here shown operate over a great part of this system. The buses shown here operate on two routes between the east and west. Terminals are located in all the principal cities.

The Month's Scientific News Illustrated

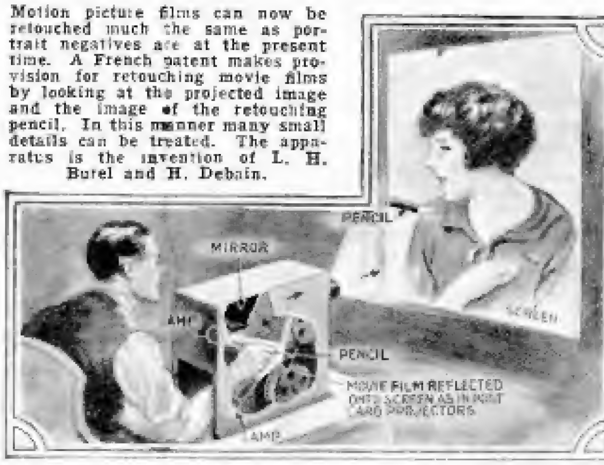
By GEORGE WALL

Jean A. Lussier recently went over the Horseshoe Falls at Niagara Falls in a huge rubber ball. He is the third man in history to accomplish this death-defying feat. The ball was of special design and was made according to his own design and weighed seven hundred pounds. Lussier started his trip three miles up the river and traveled that distance, including the drop of the falls, in 50 minutes. When the ball was reached after the trip, it was right side up, and only a few minutes time was required to open it, because of the specially constructed lid. The passenger suffered only minor bruises in his perilous journey and all were received in the terrific bouncing which was experienced while going over the rapids. The above illustration shows the construction of the ball which was fitted with a ballast and an air vent.

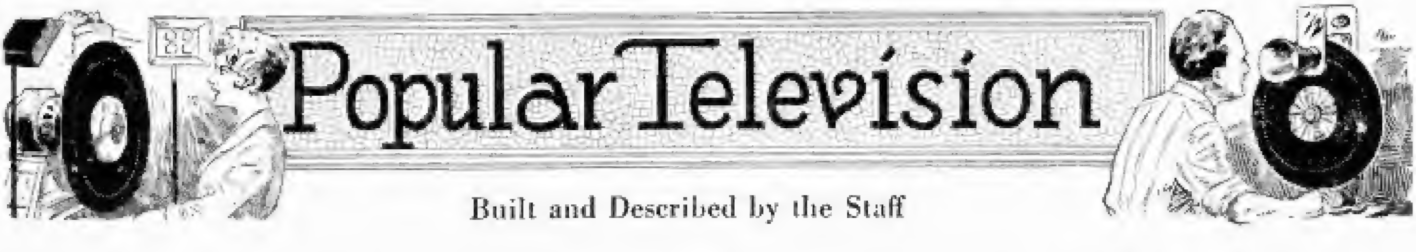
Two buildings in Washington, D. C. were burned to the ground in order to obtain scientific data. The unusual fire was part of a series of tests being made by the Bureau of Standards in order to obtain accurate information of fire prevention. Observations were taken from a dug-out in a boiler room nearby, and by means of thermo-couples the temperatures were measured. Estimated temperatures of 3,500 degrees Fahrenheit were obtained. Thirty-five safes in different parts of the building, numbered for identification, held thermometers and useless records so as to determine the degree of protection afforded.

Recently, at Tracy, California, an airplane was brought to earth with a huge parachute, as illustrated above. Only slight damage was done to the plane, which was allowed to fall from a height of 2,000 feet. The pilot released a small parachute, which in turn unfolded a larger one. Failure of the smaller parachute to open quickly nearly ruined the experiment. The plane began to spin and the pilot was prepared to leave it when the ropes untangled.

Motion picture films can now be retouched much the same as portrait negatives are at the present time. A French patent makes provision for retouching movie films by looking at the projected image and the image of the retouching pencil. In this manner many small details can be treated. The apparatus is the invention of L. H. Burel and H. Debain.



For the first time in aviation history an army dirigible successfully landed mail on the roof of a speeding train. Army officers maneuvered a 200-ft. non-rigid ship down on top of a mail car roof after a chase of thirty-five miles. In spite of the speed of the train, the dirigible maintained its position long enough to permit the transfer of a sack of mail, and to demonstrate the possibility of air-to-land transfer. Cameras were carried in both dirigibles and moving pictures were taken while the stunt was carried out. During the chase the dirigible traveled at a high rate of speed directly above the train tracks. On one side of the tracks were strung telephone wires, while on the other, ran high tension power lines. The airship traveled between these electric walls and almost came to grief when one of the trailing cables swept a high tension line. In spite of the air currents set up by the train, the dirigible finally managed to catch the train and drift above it.



Built and Described by the Staff

How To Build The S & I TELEVISION RECEIVER

A slight adjustment of the rheostats and the picture comes in clearly. This photo shows a complete television receiver connected to an ordinary radio set. The picture is seen in the cone.

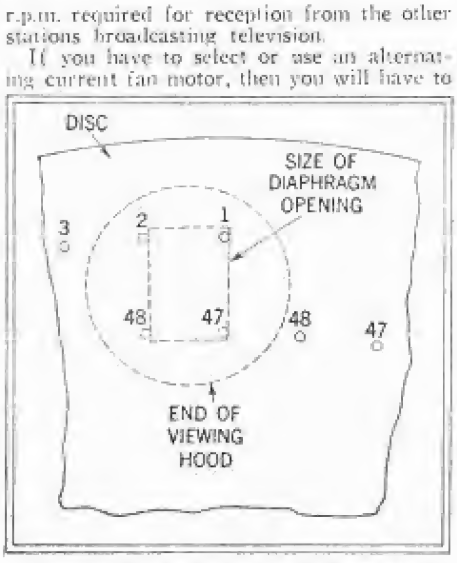
A Television Receiver of Simple Design, Built Around an Ordinary 16-inch Electric Fan Motor

THE front cover illustration shows the simple television receiver designed and built by the editorial staff. The accompanying photographs and drawings show the appearance and the construction details of the television receiver, the apparatus pictured having, of course, to be connected to the output of a suitable radio receiving set. The ideal set for receiving television images from WRNY or other stations, is, for the broadcast wavelength of 326 meters, one comprising two or three stages of tuned radio frequency, a detector and at least three stages of resistance-coupled amplification. When a resistance-coupled amplifier is used, it will be found best to use above 250 volts at least on the last stage from either storage or dry "B" batteries. A good "B" eliminator may be used, but a special filter is usually necessary, to prevent "motor-boating" with a resistance-coupled amplifier.

PROPER MOTOR FIRST ESSENTIAL

THE first requisite for building this television receiver is a good 16-inch fan motor. If the television disc to be used (it should have 48 holes for reception from WRNY and 3XK; also 1XAY and WLEX of Boston; and 24 holes for reception from WGY, 2XAD, and 2XAF, G. E. Co., Schenectady), is quite light, a 12-inch fan motor may do the work. If you have direct current in your laboratory or other location where the apparatus is to be operated, then you will have no trouble in controlling the speed of the motor down to the 450 r.p.m. required for WRNY reception or the 900 r.p.m. required for reception from the other stations broadcasting television.

If you have to select or use an alternating current fan motor, then you will have to find out whether the motor can be slowed down to a steady speed of 450 r.p.m. If the A.C. motor happens to be of the type that has throw-out contact brushes, which open the starting winding after the motor has attained fairly high speed, you will probably find this sort of motor unit for television purposes. If the motor is of the universal A.C.-D.C. type, with commutator and brushes, the armature being connected in series with the field, then you will find that this motor can be regulated as to speed very nicely by means of the series resistances shown in the accompany diagram. We strongly recommend a universal type motor if you are going to purchase one, as these have been found to regulate well with regard to the speed.



The method of laying out the diaphragm opening is shown clearly by the above drawing.

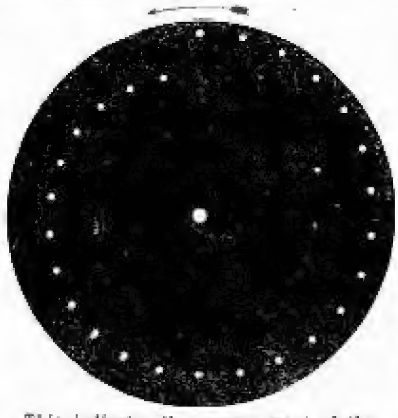
MOUNTING THE DISC

THE disc used in the television receiver here illustrated was a 48-hole 16-inch diameter bakelite disc of standard manufacture. This disc may be mounted and secured on a regular bushing provided with lock nuts supplied by the people who make the disc. In the present case, however, the perforated disc was mounted on the brass spider and hub which had originally carried the fan blades. The blades were removed from the legs of the spider and these were then flattened out in a vise and checked up on a lathe for alignment. A light cut may be taken across the face of the spider legs in the lathe, if one is handy. By drilling holes through the bakelite disc, it is readily secured to the spider by machine screws and nuts, or the holes in the spider legs may be tapped if the builder so desires. Care must be taken to see that the disc rotates as perfectly as possible in both planes of rotation, that is, flatwise and edgewise; in other words, it must not wobble and care must be taken to see that the spiral is rotated in a true manner. These two requisites are easily checked up by means of a machinist's surface gauge, or else by making up a gauge from a nail driven in a block of wood and holding this near the disc as it is slowly rotated by hand.

NEON TUBE MOUNTING

THE frame for supporting the neon tube behind the revolving television disc is simply constructed from light brass bar, measuring about 1/16-inch by 5/8-inch. Strap iron may be used if the builder happens to have this stock on hand. No dimensions are given for the height of the frame as many builders will want to use a different size disc than the one we used, and so the height of the frame and the dimensions of the metal composing it will depend upon the diameter of the disc, of course.

Examination of the drawings herewith will show that the neon lamp may be rotated, so that the front plate inside the tube may be placed exactly parallel with the perforated television disc. This is easily accomplished by the simple expedient of using a standard vacuum tube socket having a hole in the center, or what is known as the one-hole mount. By passing a machine screw through the center of the socket and putting a nut on top of the bakelite shelf, the socket and neon tube can be rotated as required. Two sub-base brackets or supports, available at any radio supply store, are used in building the top of the superstructure which carries the neon tube. Two well insulated wires lead from the vacuum tube socket down to the base of the machine. The connections to the socket for the average neon tube is to the plate terminal and to the diagonally opposite filament terminal. This can be determined by experiment after the machine is built, or else beforehand by testing the neon tube on your receiving set. The plate that faces the television disc is the one that has to be illuminated. In some neon tubes there is a large and small plate; the large square plate is the one that is to face the television disc.



This indicates the arrangement of the holes and the direction in which the disc should rotate to receive television from station WRNY.

HINTS ON RECEPTION

WITH regard to the style of motor to use this is best of the series type; that is, with the armature and field winding connected in series. Small induction motors can be used, but do not regulate well in speed much below one-half their normal speed of 1750 r.p.m. If the picture image is observed and drifts toward the right, the motor is going too slow; if the picture drifts to the left, it is going too fast. The editor has found it advisable to regulate the motor speed to a point considerably above the desired value, and then to apply a piece of cardboard or a blotter against the surface of the disc to slow down the speed to the desired point. D.C. motors will regulate very well with the electrical rheostat arrangements shown in the circuit accompanying this article, however.

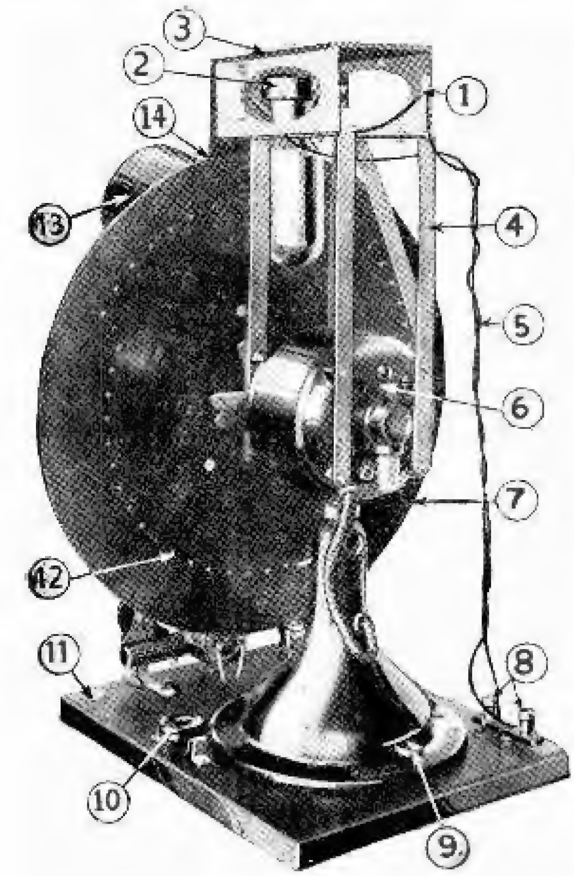
VIEWING HOOD AND LENS

THE viewing hood or visor shown on the machine herewith was built by cutting down a standard megaphone which can be purchased in any sporting goods store. The heavy metal ring at the mouth of the megaphone enabled the designers to secure it by means of three spring brass clips, soldered to the brass front plate shown in the drawings. It can be snapped off whenever desired. One of the accompanying drawings shows how the size of the diaphragm plate is determined, the rule here being that only one disc hole or perforation must be exposed at a time. A thin piece of leaf copper was used in the present case, from which to cut the diaphragm opening, and this was sweated to the brass front plate of the instrument. A fairly strong lens, about 2 inches in diameter, with a focal length of approximately 3½ inches, was procured for the purpose of helping to enlarge the image. This lens was secured inside the megaphone viewing hood by placing three machine screws through the megaphone shell and putting nuts on these, inside the shell. This is probably one of the best ways to build the viewing visor for any size television receiver, as the visor can always be snapped off the machine when it is to be moved to some other location.

STROBOSCOPE INDICATES CORRECT SPEED

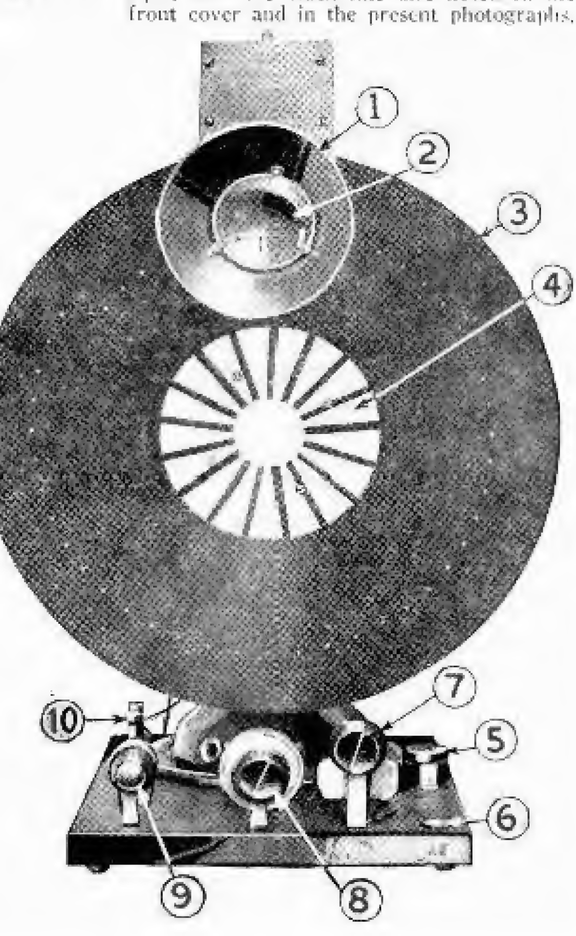
ONE of the greatest problems the beginner in television reception will encounter is that of checking the correct speed. Of course the average machinist or electrician will not mind checking the speed frequently with an ordinary speed counter, or possibly he may be so fortunate as to own a tachometer for the purpose. However, the average tachometer cannot be used with a small motor, as it takes too much power from the motor, and therefore slows the disc down and you do not know where you are at.

The method of using the *stroboscope* principle, with the black line disc noted on the front cover and in the present photographs,

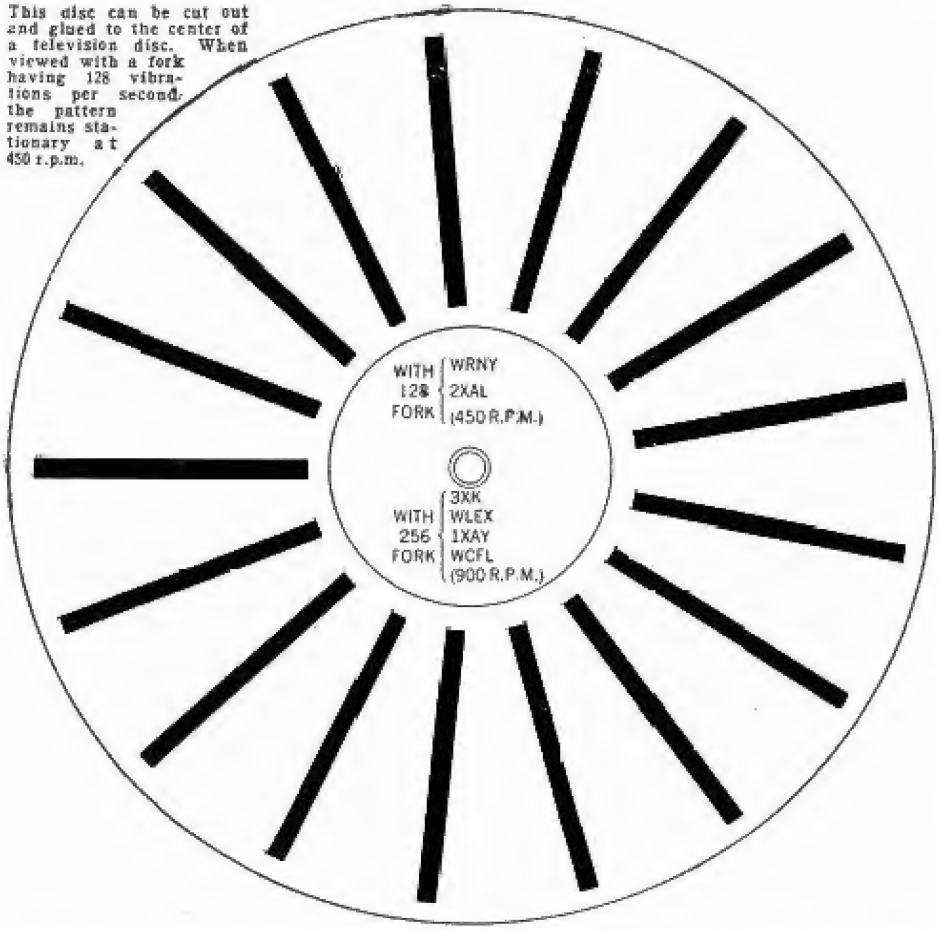


In the diagram at the left, 1 indicates a separation of the wires leading to the socket 2, affixed to top plate 3, which in turn is mounted on the uprights 4, screwed fast to the motor by the screws which hold the case in place. The wires 5, lead down to binding posts 8, which connect with the ordinary receiving set. 9 is the standard switch on the fan motor which receives its current through plug 10. 11 is a control button, 12 the holes in the television disc, and 13, the cone.

Right: 1 indicates the cone; 2, the lens; 3, the disc; and 4, the stroboscopic pattern; 5, attachment plug; 6, control button; 7, vernier rheostat; 8, main motor control; 9, neon lamp control; and 10, leads to the receiving set.



This disc can be cut out and glued to the center of a television disc. When viewed with a fork having 128 vibrations per second, the pattern remains stationary at 450 r.p.m.



together with a tuning fork of the proper pitch, was suggested by the Editor, Mr. H. Gernsback, and details were worked out by members of the staff.

For the benefit of those who are desirous of using the stroboscope principle for checking other speeds than those here given, the following table and formulae will be found useful.

STROBOSCOPE TABLE

R.P.M. of Shaft	*R. P. Sec.*	*Tuning fork frequency*	*No. of marks on chart*
60	1	128	128
120	2	128	64
180	3	128	42.6
240	4	128	32
450	7.5	128	17
480	8	128	16
900	15	256	17
1080	18	128 (72)	7.1 (4)
1260	21	128	6

These formulae will help to solve your problems: here N = Rev. per second of disc; F = freq. of fork per sec.; and M = number marks on disc. Then $N = F \div M$; $M = F \div N$; and $F = M \times N$.

The following pitch forks are available: 426.6, 256, 128, 288, 320, 341.3, 384, 480, 512.

For the benefit of the constructor we have provided herewith a good size reproduction of the stroboscope discs which can be cut out or else copied on to a piece of Bristol-board or drawing paper, and either glued or attached to the front of the television receiver. A tuning fork of the proper pitch may be obtained from music stores or from college laboratory supply houses, names of which will be furnished upon request from the editor.

For checking the speed of the motor at 450 r.p.m., a tuning fork giving 256 vibrations per second is necessary. This is used with a disc containing 17 black marks for the 450 r.p.m. specified. For other speeds, either a different fork has to be used, or else the number of lines on the stroboscope disc will have to be changed. All this data is contained on the drawings of the discs reproduced herewith.

All one has to do in using the stroboscope check for the proper speed, is to regulate the rheostats in series with the motor, and then repeatedly take a sight on the revolving black line disc through the legs of the vibrating tuning fork. The tuning fork is struck on the edge of the table or across the knee, and while vibrating, it is held a few inches from the eyes and twisted, so that the revolving disc is observed in a diagonal line passing under the corner of the upper fork leg and over the corner of the lower fork leg. This line of sight is shown in one of the accompanying diagrams.

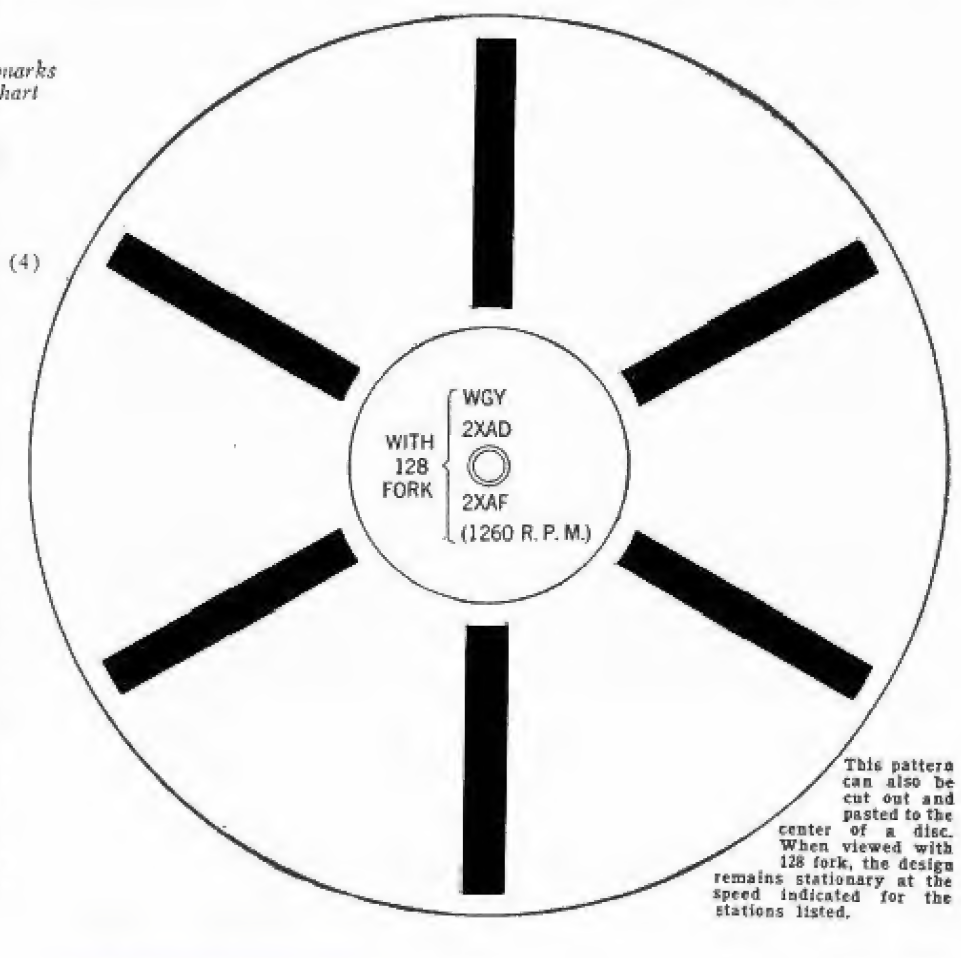
While in most cases it will probably be found that the number of marks on the disc or else the vibrations of the tuning fork to be used will come out to an even figure, or at least that a suitable combination can be worked out for the speed desired, the calculation may show that an uneven number of marks will be required with any standard fork. Here, instead of using a number of radial black marks on the rotating disc, a spiral may be used and with this sort of design, any uneven number of convolutions such as 7½, 7-1/3, etc., may be employed.

HOOK-UP OF APPARATUS

ONE of the accompanying diagrams shows how the power clarostat (about 150 ohms maximum resistance) and the small 10 to 15 ohm variable resistance is connected in series with the motor. Across the small variable resistance a push-button is connected, and by pushing this button periodically, it becomes possible to keep the motor speed quite constant. In setting the speed of the motor in the first place, the rheostats are adjusted until the speed is a little below the 450 r.p.m. (if you happen to be "looking in" at WRNY's television signal), this factor being indicated when checking the speed with the stroboscope fork, by the fact that the black lines on the disc are seen to rotate slowly backward. If these lines rotate slowly forward or left-handed, then the speed of the motor and disc is above 450.

Rubber-covered wire or lamp cord may be used to connect the rheostats and the motor. The small clarostat at the extreme left of the motor baseboard is connected in series with the wires supplying the energy

(*Continued on page 632*)



This pattern can also be cut out and pasted to the center of a disc. When viewed with 128 fork, the design remains stationary at the speed indicated for the stations listed.

Dec. 25 Cents

WRNY

Science and Invention

Can We Control Sex ?

By Oscar Riddle, A.B., PH.D.
Carnegie Institute
See Page 682

EXPERIMENTER PUBLISHING COMPANY, 230 FIFTH AVENUE, NEW YORK

It is prophesied that man will eventually be able to control the rearing of male or female offspring at will

Control SEX?

RIDDLE, A. B., Ph. D.

Station for Experimental Evolution

Sex can now be definitely predetermined in birds.

A SERIES

"The Gorilla," by Frémiet, has a different significance when we note this: ". . . mates so dissimilar as dove and pigeon would have to be sought by humans among the gorillas and Chimpanzees."

jingo chorus is often strengthened by the circumstance that many newspapers and newspaper writers—in response to the mental declination of their readers—often so dress, twist and garble the statements of competent scientific writers as to have it appear that marvelous changes already have been effected experimentally in the sex of human beings.

IN an effort to ascertain, in a strictly scientific manner, whether it is possible for us to control sex at will, SCIENCE AND INVENTION *Magazine has undertaken to publish a series of three articles, the first of which appears in the present issue. The other articles will be published in the January and February issues.*

SCIENCE AND INVENTION *has been fortunate in securing the latest scientific discoveries and data on this topic from the greatest scientists on this subject in this country. Much that is new will be found in these articles, which have been prepared with the idea uppermost in mind, that they should be presented in a straightforward manner and in non-technical language.*

There has been a great deal of controversy on the subject. There has been a tremendous amount of misinformation and superstition, and charlatans in the past have exploited the unwary to a marked degree.

In addition, a questionnaire, printed elsewhere, has been sent to 587 of a selected list of well-known physicians, obstetricians and scientists whose work makes them familiar with this more than interesting topic. Their findings on the question, "Can We Control Sex?" *will be printed in subsequent issues.*

It is quite certain that these articles will be the most outstanding ones that have ever been published anywhere.

Much Fiction in Sex Control

FOR a moment we may focus on some of the current products of such unscientific writers. One swollen volume is devoted to the view that the egg-cell of the human assumes two states or conditions, each of which—like the ebb and flow of the tide—is under the influence of the moon; and that one sex results if the plastic egg is fertilized at the ebb-tide, the other sex when fertilization occurs during flow-tide. Another writer is less careful about the time of day, but more careful about *which* day. In the functional lunar month of woman this authority thinks that sex may be controlled by observing the following rules: Consider the period of woman's indisposition as lasting always five days whether or not it does so in fact. Sperm uniting with an egg on the first and second days preceding this period, and on the first and second days succeeding it, will produce girls. But fertilizations occurring on the third, fourth and fifth days preceding, and on the fourth, fifth, sixth, seventh and eighth days after, the period are said to produce boys. In still a third recent volume we are told that it is the amount of sunlight falling upon the parents that settles all concerning the sex of the offspring in the human. We quote one sentence: If the father has been effectively subjected to sunlight in excess of the mother's subjection, theoretically the child will be female; and if the conditions be reversed a male will result.

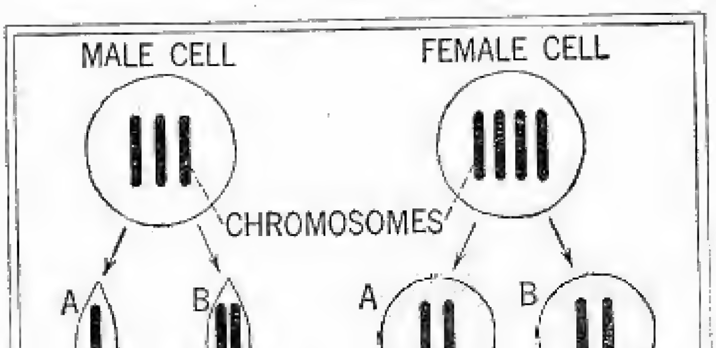


FIGURE 1

This diagram explains how two different kinds of sperms arise from a mother cell. The mother cell originally had an odd number of chromosomes. The sperms must, therefore, get either an even or an odd number from the division. When a sperm with an odd number of chromosomes joins a female cell, the sex of the offspring is different than when one with an even number joins a similar cell.

Male Sperms Cause in Some Cases

WITH the eyes of science—eyes trained adequately to test and to retest observations and experiments—let us have a look at the way in which sex is normally determined. Everybody knows that males produce sperms, and that these are cells. And we all know that females produce ova, or egg-cells, and that even human females are in no wise an exception to this rule. About 25 years ago we began to learn that the males of some animals—humans, dogs, frogs and grasshoppers—manufacture two kinds of sperms. The females of these same species of animals turn out only one kind of eggs. When we say that two kinds of sperms are produced we mean that at every division of cells which results in the formation of two sperms something happens to make the two sperms different. They are made different very regularly, and very simply, in the way shown in Figure 1. The mother cell has an odd number—such as 3, 5, 9—of bodies called "chromosomes"; and the

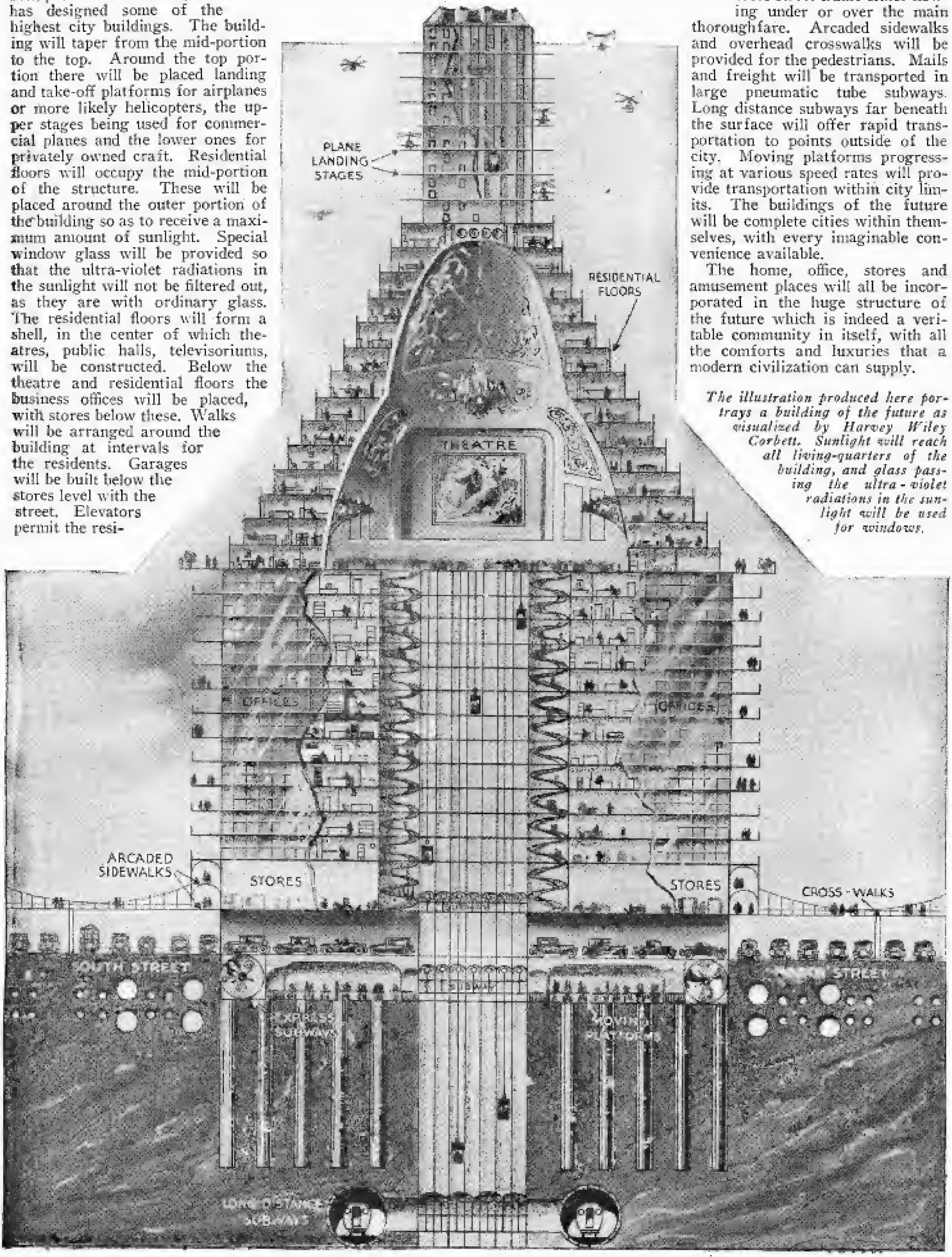
(*Continued on next page*)

Cities of Tomorrow

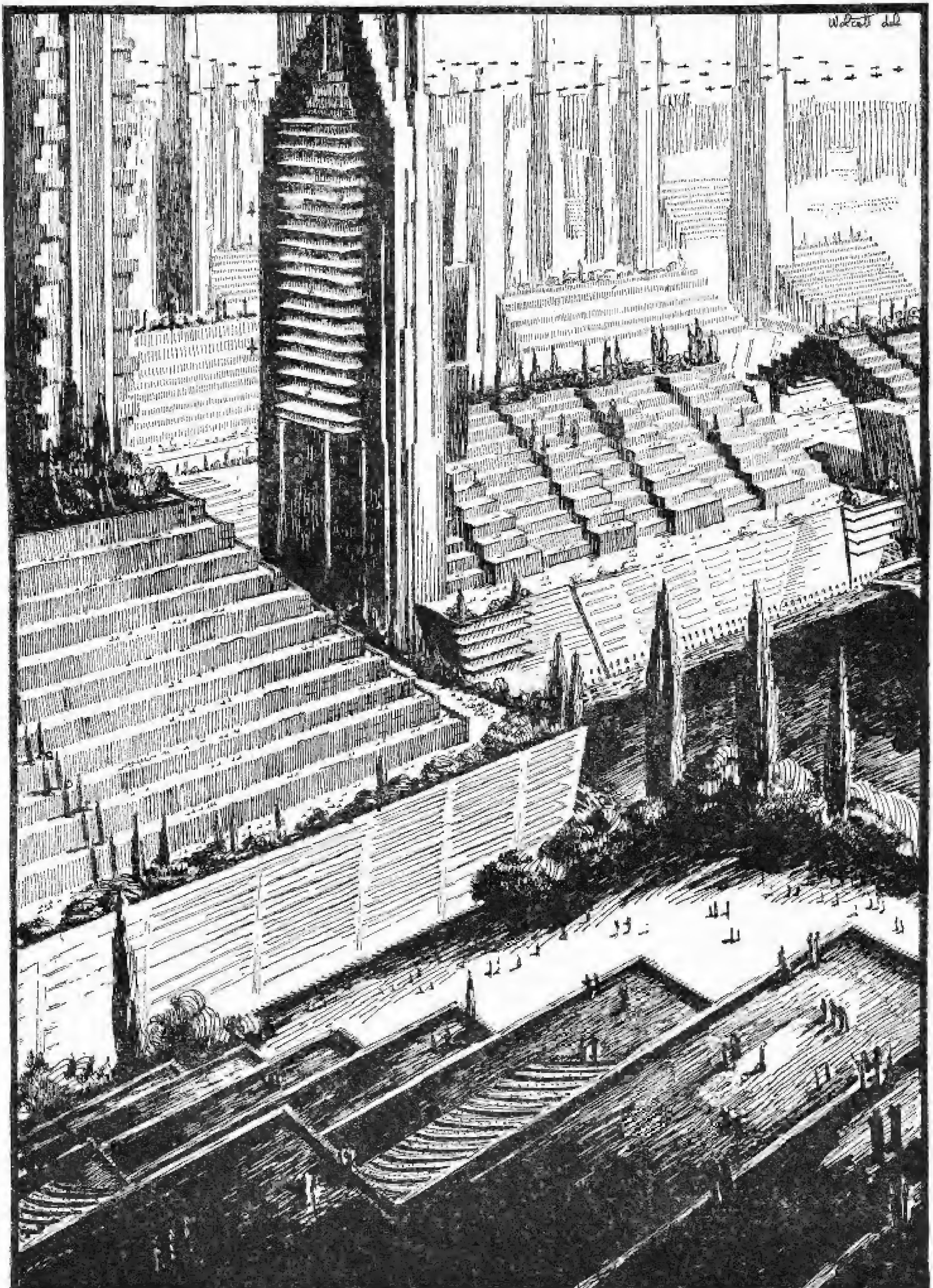
(*Continued from previous page*)

OUR future cities will consist of a group of large buildings such as that illustrated here, according to Mr. H. W. Corbett, prominent architect, who has designed some of the highest city buildings. The building will taper from the mid-portion to the top. Around the top portion there will be placed landing and take-off platforms for airplanes or more likely helicopters, the upper stages being used for commercial planes and the lower ones for privately owned craft. Residential floors will occupy the mid-portion of the structure. These will be placed around the outer portion of the building so as to receive a maximum amount of sunlight. Special window glass will be provided so that the ultra-violet radiations in the sunlight will not be filtered out, as they are with ordinary glass. The residential floors will form a shell, in the center of which theatres, public halls, televisoriums, will be constructed. Below the theatre and residential floors the business offices will be placed, with stores below these. Walks will be arranged around the building at intervals for the residents. Garages will be built below the stores level with the street. Elevators permit the residents to descend from their homes to their office, to the stores, to the street or subway. Traffic will move only one way on a street, with cross street traffic either flowing under or over the main thoroughfare. Arcaded sidewalks and overhead crosswalks will be provided for the pedestrians. Mails and freight will be transported in large pneumatic tube subways. Long distance subways far beneath the surface will offer rapid transportation to points outside of the city. Moving platforms progressing at various speed rates will provide transportation within city limits. The buildings of the future will be complete cities within themselves, with every imaginable convenience available.

The home, office, stores and amusement places will all be incorporated in the huge structure of the future which is indeed a veritable community in itself, with all the comforts and luxuries that a modern civilization can supply.



The illustration produced here portrays a building of the future as visualized by Harvey Wiley Corbett. Sunlight will reach all living-quarters of the building, and glass passing the ultra-violet radiations in the sunlight will be used for windows.



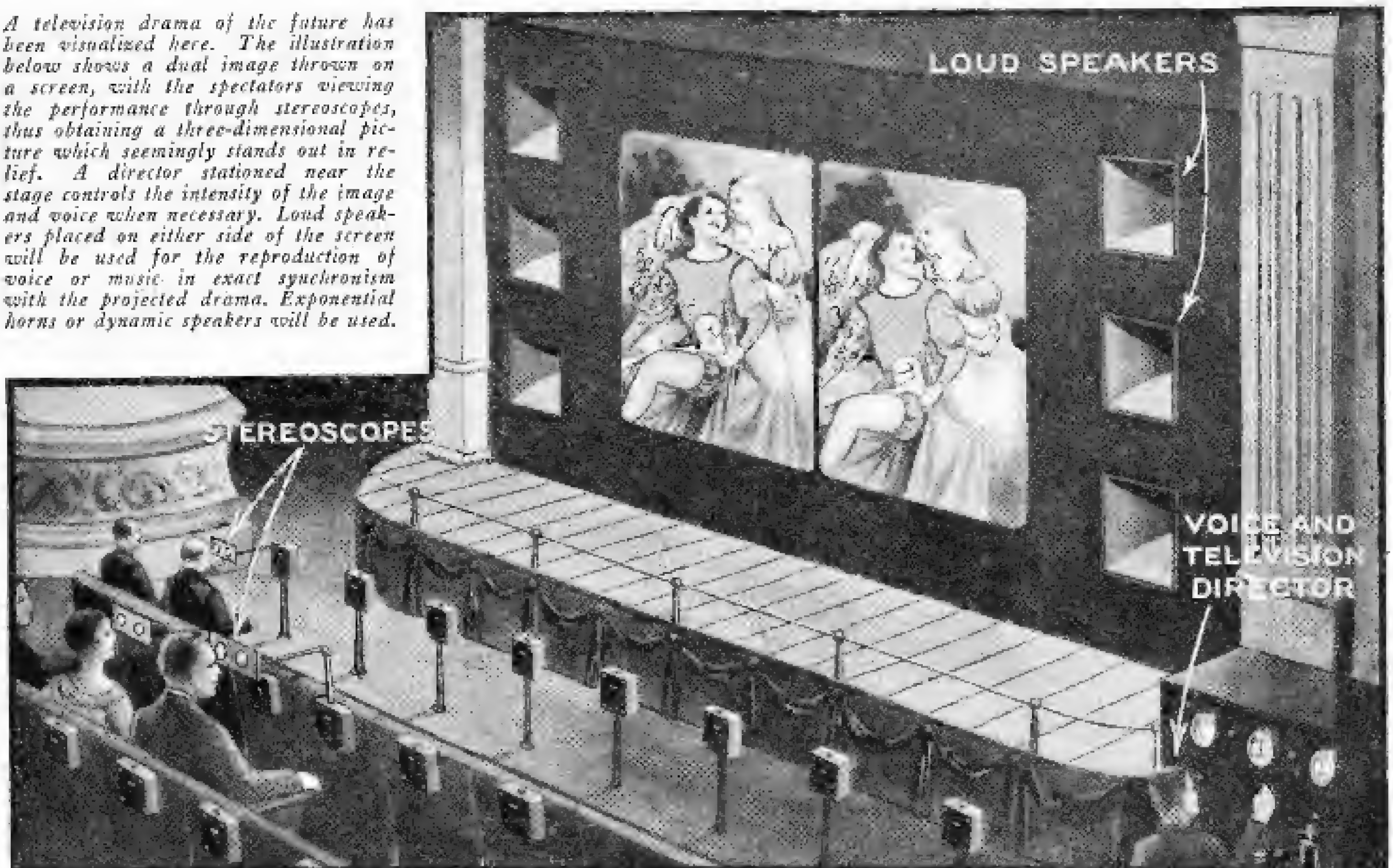
A glimpse of the city of the future, as envisioned by the well-known American architect, Harvey Wiley Corbett. Each building combines business and residential floors.

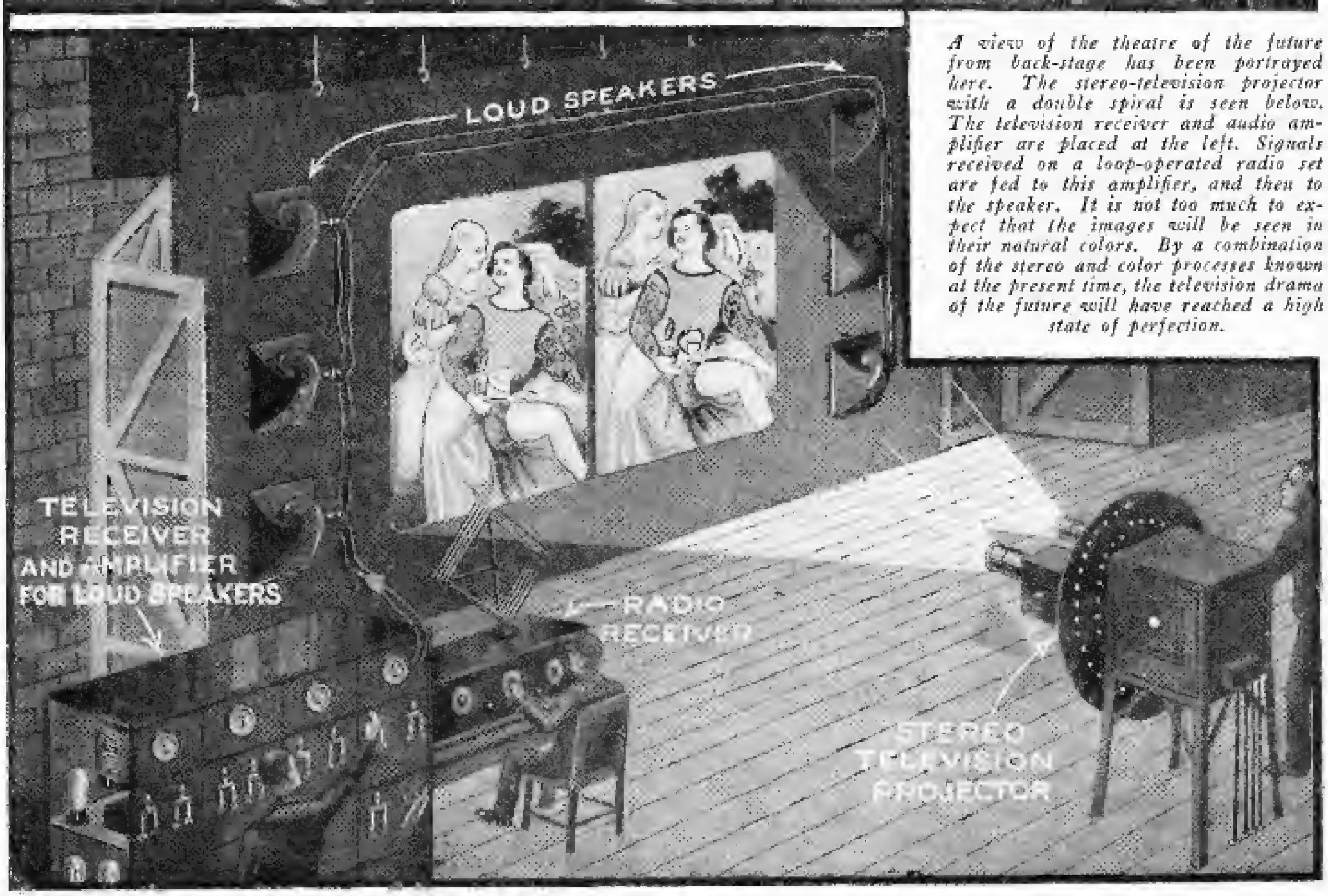
(See next page for sectional view)

Courtesy Arnold Constable, N. Y. C.

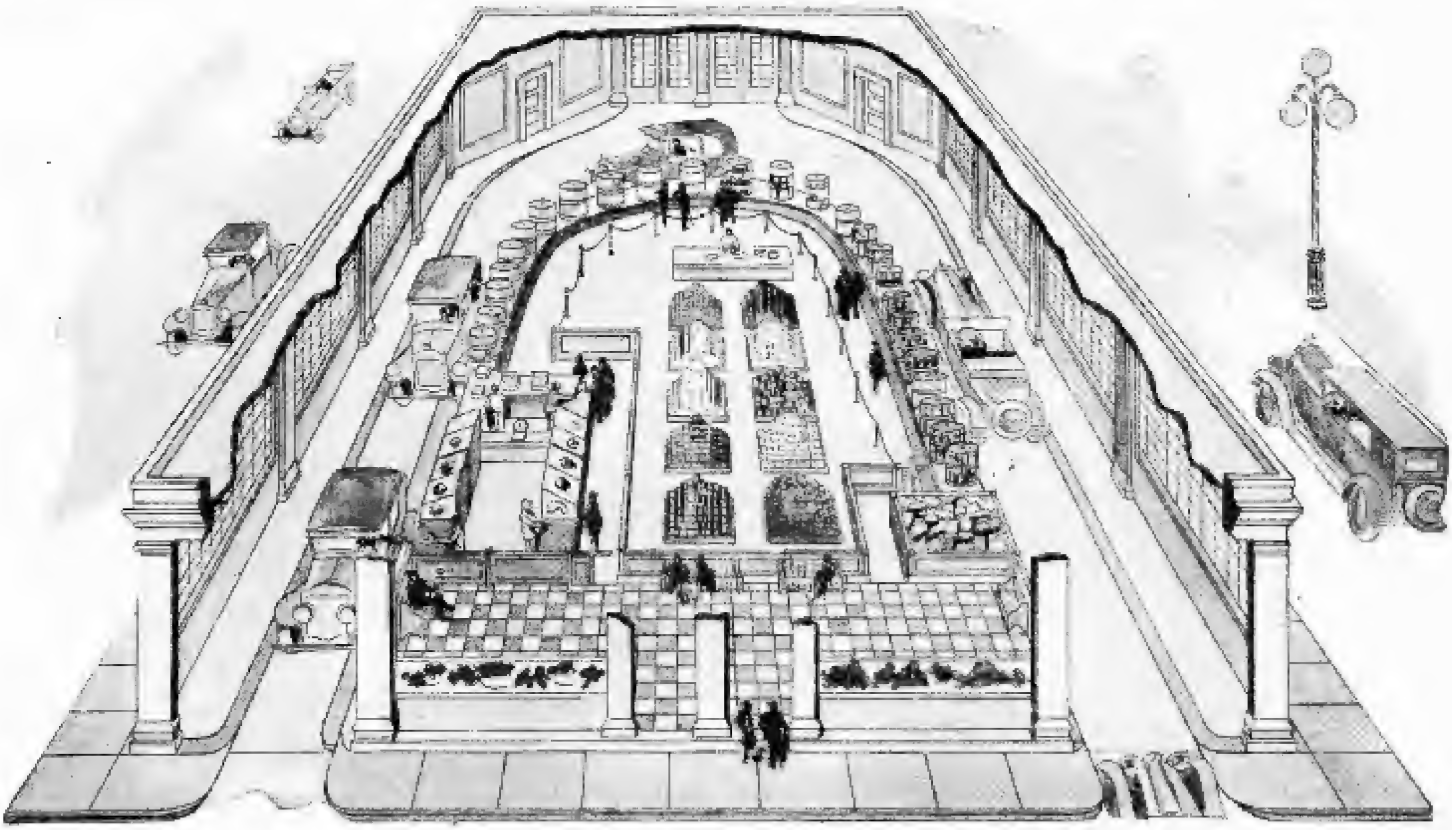
TELEVISION Drama OF TOMORROW

A television drama of the future has been visualized here. The illustration below shows a dual image thrown on a screen, with the spectators viewing the performance through stereoscopes, thus obtaining a three-dimensional picture which seemingly stands out in relief. A director stationed near the stage controls the intensity of the image and voice when necessary. Loud speakers placed on either side of the screen will be used for the reproduction of voice or music in exact synchronism with the projected drama. Exponential horns or dynamic speakers will be used.





A view of the theatre of the future from back-stage has been portrayed here. The stereo-television projector with a double spiral is seen below. The television receiver and audio amplifier are placed at the left. Signals received on a loop-operated radio set are fed to this amplifier, and then to the speaker. It is not too much to expect that the images will be seen in their natural colors. By a combination of the stereo and color processes known at the present time, the television drama of the future will have reached a high state of perfection.



Shopping Without Leaving Your Auto

New Auto Market Facilitates Purchasing

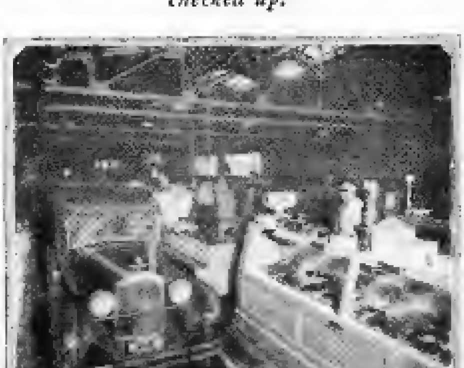
ONE of the most unique systems for facilitating shopping and purchasing is the idea illustrated in diagrammatic form on this page, and also shown in the photographs. This has appropriately been called the auto market.

It operates approximately as follows: On either side of the market, there is a driveway. The motorist who wants to drive into the market turns into the entrance at the right and then slows down to almost a crawl. He reaches out of the window of the sedan or out from the side of his touring car, or any other machine that he may have, and picks out those articles of foodstuffs which he requires. Most of them are, of course, wrapped up in convenient packages. The foodstuff is deposited in a tray moved along at the purchaser's will, on a roller conveyor.

The motorist does not need to worry about the ventilation, because this has been taken care of by the designers of the market. Giant exhaust fans provide a constant stream of air (heated in the the winter time) to diffuse any possible carbon monoxide gas accumulation. Consequently, the motorist can take as long as he desires in the selection of his material. Meanwhile, any pedestrians can wait upon themselves from the counters, and the revolving tables are conveniently arranged. As both pedestrian and motorist leaves the auto market, his purchases are checked up by the cashier at the point of exit and he pays for his purchases there. Just in front of this place there is the meat market, so that while a cashier is checking up the products, the butcher takes care of the meat order.

This gives a view of the revolving tables from which either pedestrian or motorist may choose whatever aricle of canned food stuff or bottled material he may desire.

An interior view of the automobile market in which both pedestrians and motorists are served. The photo shows purchases being checked up.



Market expedites the purchase of and the transportation of food and caters primarily to the motorist, who need not even leave his automobile.

This photograph indicates with what facility pedestrians and motorists are able to help themselves to the materials on the display counters.

Can We Control Sex? *In this Issue*

Jan. WRNY 25 Cents

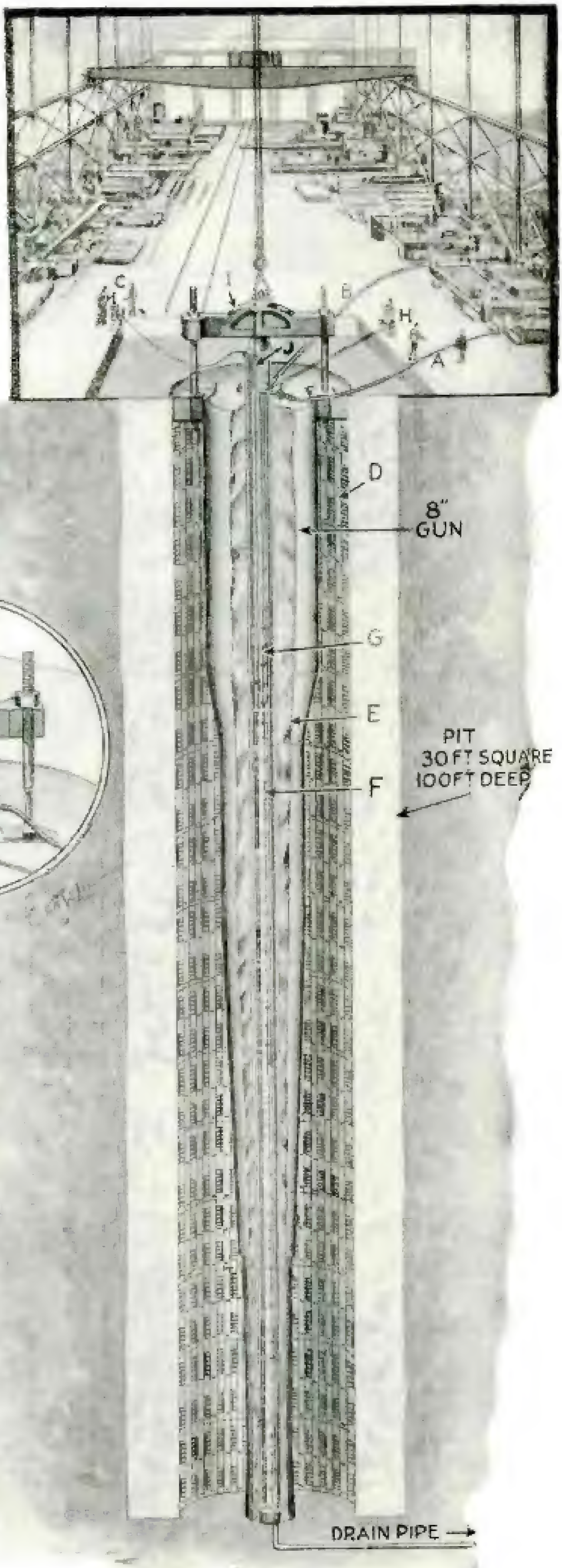
Science and Invention

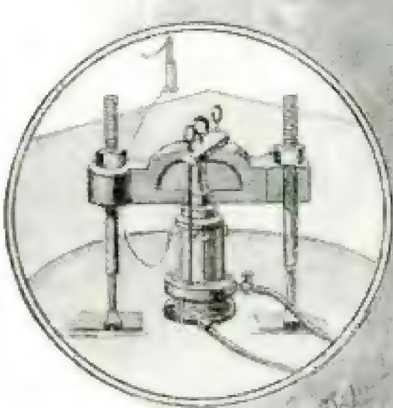
See Page 798

EXPERIMENTER PUBLISHING COMPANY, 230 FIFTH AVENUE, NEW YORK

The Shrink Pit and Its Purpose are Described Here. The Gun is Kept in a Pit, At a Heat of 600°F. for 24 Hours

Eight Inch Gun





ing the liner cool. The water runs through A, then up through the water-tight liner and out through B, valves on E not yet having been opened. As soon as the cooling system is operating, the hookring is screwed out and a hydraulic press is put on head I by a crane; pipe connections with a hydraulic pump C, which stands beside the pit, are swiftly made, and oil is pumped into the press in one-half minute. The pressure exerted on the liner has been estimated at around two hundred tons. The pump is manipulated by one man. The press is put on because the liner, which tapers a few inches from breech to muzzle, in the expansion due to the heat of the gun, might force its way up and out of position.

Not until the press is adjusted and can produce the required pressure, is the top valve of pipe G opened, and the breech of the liner allowed to be heated and to expand. From that time on the valves on pipe G are opened in succession, from top to bottom, a specified time allotted between each opening, thus allowing the liner the gradual heating from breech to muzzle. The liner is now left to expand as it will, until it finally does what the gun-makers term *freezes* to the outer covering—the original exterior.

The illustration at the right shows the shrink pit which contains cylindrical electric furnaces. A close-up view of the top portion is also shown. All letters are referred to in the text.

The furnace is then shut down, and the whole gun is permitted to cool. As the whole gun cools, all members shrink to their original dimensions; but as the liner is larger in diameter than the hole in which it has been placed, it is consequently subjected to considerable compression throughout its length. This results in the added strength to withstand the shock of discharge, and is the purpose of the shrinkage method of construction.

Reasons for Using Lining

ALL cylindrical parts of a gun—jackets, hoops, lock-rings, etc., are shrunk on the original tube of steel, making the gun elastic, and giving it a superlative degree of strength.

The very finest steel (*Continued on page* 889)

Here is a photograph of the municipal airport at Cleveland, Ohio, showing a close-up view of the new Neon beacon installed there. Note that even at this distance it looks like an airplane.

Neon Beacon Gives Aviator

It is often difficult for an aviator to tell the direction of the wind. This is particularly true on foggy nights. Beacon can be seen at great heights.

By

H. WINFIELD SECOR

THERE is no doubt but that everything is being done to aid commercial flying in the United States. In the field of aviation the advance is continuous and while not as rapid as one might hope, it is nevertheless persistent.

This publication attempts to portray the latest strides taken in aviation whether they pertain to airplanes or lighter-than-air craft; safety devices, landing fields, beacons or many of the ramifications of the aeronautical field.

It may be remembered by the reader that this publication was the first one to publish details concerning the Graf Zeppelin and also to give to the reading public full information concerning the spectacular flight from Friederichshafen, Germany, to Lakehurst, New Jersey. To the best of our knowledge no other magazine published this story in as early an issue as the December number, which was out on the newsstands throughout the country on November the 10th, considerably less than a month after the flight was completed. This point is emphasized to show the reader that everything is being done to bring the informaion of new discoveries and new inventions to his attention at the earliest possible moment.

New Landing Tee

THE front cover of this issue illustrates a scene in which the landing Tee has come in good stead. With the ground practically obscured by a heavy veil of fog, the Tee stands out as a blaze of light. The green and red lights indicate the port and starboard sides. The Tee itself shows the aviator how to light, indicating how he can nose into the wind. At a distance this signal looks practically like an airplane. As the plane approaches the ground the aviator will not find it difficult to make out a few of the landmarks. From an altitude he must know where the field is, for fear of running into a bank or cliff, or perhaps a large building. There is no way of telling him what to do, nor can he possibly know when, where and how to land unless he is warned of the nature of the ground on which he is to make a three point landing.

It has been quite well established that the red beam from a Neon lamp is far more penetrating than even the most powerful searchlight. This light has a peculiar characteristic which makes is very easily seen at a great distance. The green color disappears considerably before the red.

Details of the Landing Tee

AS will be observed in the photograph, this landing Tee is quite large. Its actual dimensions are thirteen feet long and nine feet wide along the top of the Tee. It is made entirely of twenty-six gauge galvanized iron with two reinforcing trusses lengthwise. There are three tube channels which house the Neon tubes although but two of them contain tubes. These channels are open at both ends. The Tee is pivoted about the center point of balance, which happens to be four feet and three inches from the top or cross member of the Tee. Here a 2⅛-inch shaft is to be found. This turns on a semi-thrust ball bearing and a radial ball bearing. In order to further counter-balance the cross-member of the Tee, the transformers which supply the current to the Neon tubes are mounted in the tail end. Balancing weights are fitted into each wing in sheet metal boxes.

The Tee itself is painted with bands of chrome yellow, while black sections are found between adjacent yellow stripes. The Neon tubes are red and green. The red tube is divided so that it goes to either side of the rudder. Thus the red tube is on the right (starboard) side of the plane and the green tube on the port or left side. There is a third channel for the housing of a tube still further to the right of the red tube, and this is made available for a yellow lamp when the same becomes available.

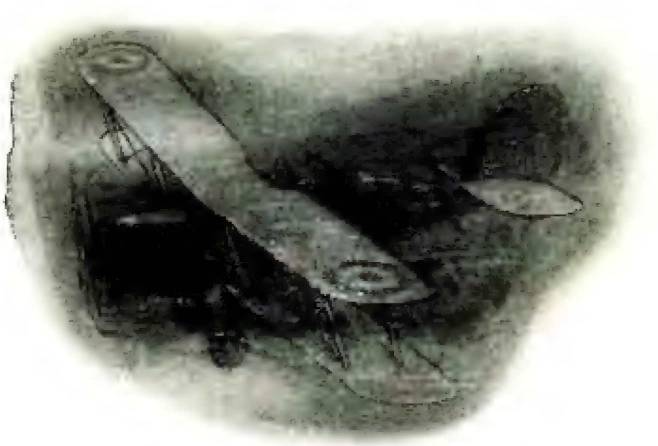
The electrical connections to this wind Tee are made through copper rings on a split wood pulley. The pulley is mounted on the shaft and the current is supplied to the rings by brushes. There are but four well-insulated wires delivering current to the apparatus and this current supply is controlled by a double-throw switch in the office.

The indicator is illuminated by current from a 110-volt 60 cycle A.C. circuit, which source of supply is delivered directly through the brushes to the transformer mounted in the

This shows the airplane landing Tee as it would appear on a foggy night. It will be observed that there are two long Neon tubes on the top part of the Tee, and also two on the bottom or vertical portion, assuming that we are describing the Tee in an erect position. One of the Neon tubes produces a green light. The one on the right side is red, as is also the extreme top tube.

Pierces Fog; Wind Direction

This beacon swings on pivots and always presents the correct position for landing. From a distance the beacon looks like another airplane.



Aviators find it very easy to read this signal while flying at great heights and in most unfavorable flying conditions. Neon lights possess the peculiar property of penetrating fog to a greater extent than do even the most powerful searchlights. Even a student aviator can understand this signal.

tail. There is one transformer for the red tubes and one for the green. The entire landing Tee consumes approximately ½ K.W. per hour. The current passing through the tubes is twenty-five milliamperes at 10,000 volts.

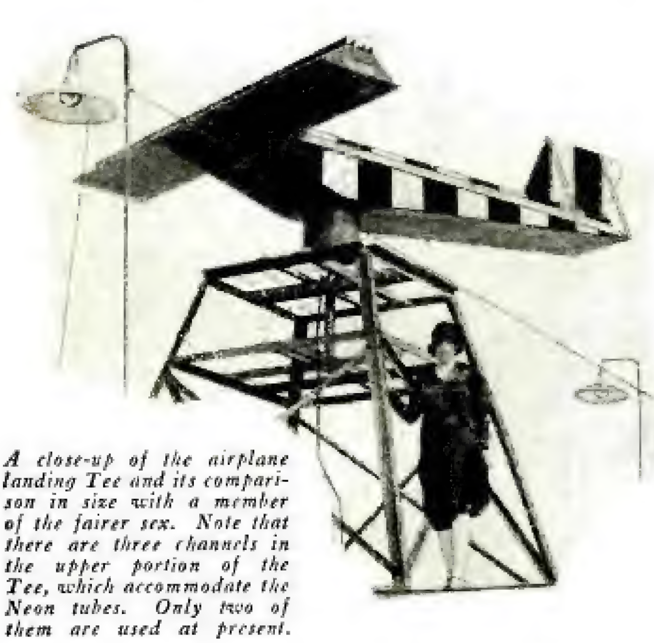
By way of further information it may be mentioned that this Tee is erected on a steel structure and swings eight feet above the roof of the N.T.C. hangar at the Municipal Airport at Cleveland. This Tee was designed and constructed by the Cleveland office of the Bellows-Claude-Neon Company, and the exclusive photograph illustrated on this page was taken expressly for SCIENCE AND INVENTION Magazine by Claude Neon Lights Inc.

In Constant Service

TO decrease the amount of elapsed time of a fair size journey, a great part of the flying must be done during darkness. To further aid such flying at night it must be made reasonably safe for aviators. All kinds of beacons and lights help materially in this safety factor, but beacons alone are not enough, nor are searchlights or any other source of illumination. The aviator must know where the nearest airport is and must be guided to that airport by signs which are not only readable in the daytime, but clearly distinguishable even at night. To be still better, these signs should be of such a nature that they will not be obliterated by even the heaviest of fogs or the most inclement of weather conditions. The aviator cannot ordinarily take a chance and fly down towards hazy land markings.

The reader will well remember how Commander Byrd frantically called for his bearings when lost in a heavy fog after completing his journey across the Atlantic to France. The reader will also recollect how the plane was brought down near the shore and smashed while landing; whereas had a suitable marker been available, a marker which could penetrate the fog, the flight would have been absolutely safe, not only for the occupants, who fortunately escaped injury, but also for the plane itself.

The need for markers is thus evident to even the lay reader. But markers are not sufficient. The aviator must know the direction of the wind. He must land *nose into the wind,* and of what use is a pennant, a flag or any other form of a wind indicator which cannot be seen? In so far as the pilot is concerned, it might just as well not exist, if he cannot make use of it when he needs it the most. Hence the reason for this wind Tee, which serves a dual purpose. Already requests for further details of this invaluable aid to aviation have been received from forty different flying fields. It is not at all doubtful but that these Tee beacons will soon find their place on every flying field in this country as well as abroad.



A close-up of the airplane landing Tee and its comparison in size with a member of the fairer sex. Note that there are three channels in the upper portion of the Tee, which accommodate the Neon tubes. Only two of them are used at present.

From this photograph, the pivotal point of this direction signal can be seen. Note the cable leading up to the commutator, where the current is taken off by brushes and fed to the transformers in the tail. Also observe the tail structure, which keeps the signal headed into the wind.

Looking Forward

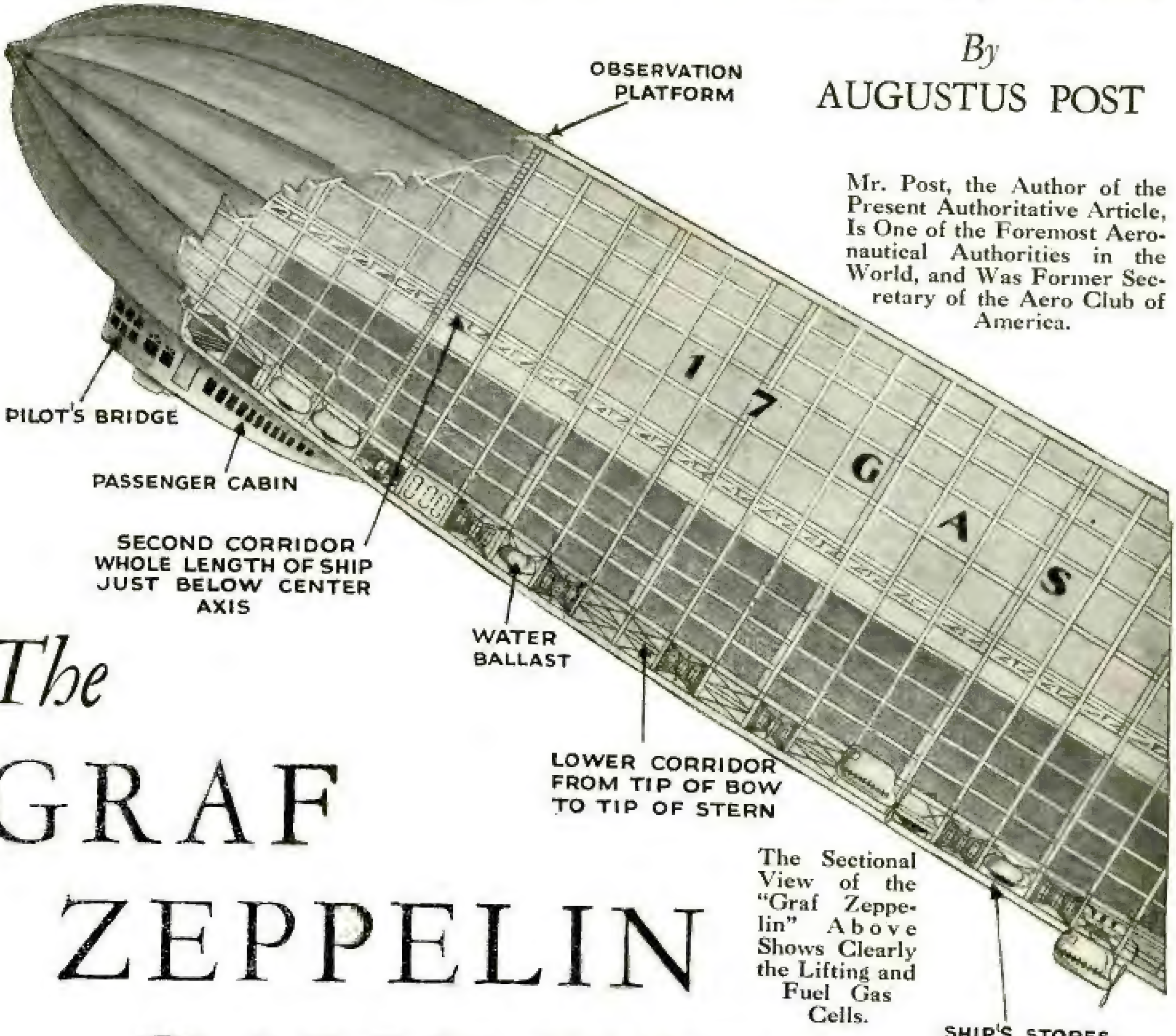
OF course the present wind Tee is only a miniature in comparison with those which the future will bring. Others will dwarf this particular wind direction indicator into significance. Larger buildings will have the names of the towns written on their roofs in bold, fog-piercing Neon letters; the letters themselves being twenty or more feet in height and made of gas-filled tubes. Illuminated arrows will point to municipal airports or the arrows themselves may be made in the form of monster tubes.

A suggestion which comes to mind now would be the illumination of air lanes with arrows of red or green showing the north and western routes, whereas the green arrows would indicate southern and eastern air lanes. When trails become too numerous, it is just as easy to mark air trails as it is to mark our highway systems. Large illuminated numbers would indicate the trail the aviator is following.

Up to the present time, all of the neon beacons consist of long tubes that must be placed in an advantageous position to be seen by the aviator. Very little has as yet been done with searchlights in which the neon lamp takes the place of the carbon arcs. It has been reported that automobilists can see the road better if they cover their headlights with pieces of cheesecloth, when driving through areas where fog is heavy. It is not conceivable that there must be some kind of a filter that will make available the thousands of candlepower obtainable with our modern searchlights?

Lastly, we must not loose sight of the fact that vertical searchlights have not even been put to a thorough test. These beams can be seen for a hundred miles or more, even from the earth's surface. Their spots of illumination on the clouds must, of course, be seen by the aviator. The next step is to make these beams produce their guiding signal in any kind of weather. This will also be done, thanks to neon.

This is the age of surprising developments in aviation and the commercialization of flight.



By AUGUSTUS POST

Mr. Post, the Author of the Present Authoritative Article, Is One of the Foremost Aeronautical Authorities in the World, and Was Former Secretary of the Aero Club of America.

The GRAF ZEPPELIN DISSECTED

The Sectional View of the "Graf Zeppelin" Above Shows Clearly the Lifting and Fuel Gas Cells.

Landing of the "Graf Zeppelin"

AT dusk on the afternoon of Monday, October 15th, over the landing field of the U. S. naval air station at five thirty-eight P. M., the "Graf Zeppelin" arrived at Lakehurst, New Jersey, after her voyage in the air lasting four days and thirty-eight minutes, covering over six thousand three hundred miles from Friederichshafen, Germany. The largest airship in the world drifted slowly down from the sky in a gentle glide to earth; she soon reached the spot indicated by smoke signals on the ground, placed in the center of a large V with its apex toward the direction from which the light wind was blowing, and marked by squads of sailors placed in landing position along each leg of the V. Suddenly the engines, which had been noiseless up to this moment, started up with an impressive roar, full speed astern, gradually checking the momentum of the ship like a great ocean liner coming to her pier. When she came to a stop, a small trap door opened in the bow about halfway from the bridge to the nose and a coil of rope shot down to the ground about 100 feet below. Soon a second rope followed and later a third, shorter than the others but with branching parts or *crow's feet* at its end, each small branch rope having a "toggle" or hand cross-piece of wood for the ground crew to hold on to. The landing crew seized the long ropes and rove them through pulley blocks made fast to the control rails of the landing gear. They then began to walk away, hauling the nose of the airship to the ground. When the shorter hand lines could be grasped, other sailors pulled down on them until the bumper, underneath the gondola or passengers' cabin, rested upon the ground. The wind was blowing ten miles an hour, and while the decision was being made whether to bring the airship into the hangar or not, the ground crew held the "Graf Zeppelin" pointed into the wind on the field in front of the hangar, while the Custom House officials and the committees of welcome went on board. The decision was finally made to moor the ship to the stub mast. This is a mast about 70 feet high, smaller than the large mooring tower, 162 feet high, which is used by the "Los Angeles" when the winds are in the wrong direction for taking her into the hangar.

The stub mast used for mooring is on the western side of the field. It has a winch to haul in the mooring cable and is equipped with pipes to service an airship with gasoline, oil and water. It is being equipped with yaw-booms such as those used on the naval ship *Patoka* for steadying the airship and keeping it headed into the wind. A track encircles this stub mast upon which the rear motor gondola can rest and swing around with the changing direction of the wind. A movable mooring mast is being constructed so that it can be moved to any part of the field upon caterpillar treads.

World's Largest Dirigible Has Range of 7,000 Miles and a Pay Load Capacity of 30,000 Pounds.

Author Meets Captain Eckener and Other Celebrities

AUGUSTUS POST, the author of the present article describing the technical details of the famous *Graf Zeppelin*, which has safely returned to its German home airport at Friedrichshafen, had the pleasurable experience of being at Lakehurst, N. J., when the giant visitor from the skies arrived from Germany. Mr. Post, who knows personally practically all of the leading aeronautical people, congratulated his friend, Captain Hugo Eckener, and he also learned many details of the construction and operation of the *Graf Zeppelin* from the other experts on the trip to America. Our readers will enjoy the accompanying article, coming as it does from the pen of Mr. Post, as he is a practical balloonist and airplane pilot himself, and knows whereof he speaks from actual experience. Mr. Post was the official observer and timer at the first airplane flights of the Wright Brothers at Fort Myer, Virginia, in September, 1908.

Author Meets Dr. Eckener and Lady Hay

DR. ECKENER said that although he required 111 hours and 38 minutes to make this voyage, he had enough gasoline to continue on for 65 hours more had it been necessary. Of the blau gas he had enough to last for 35 hours, and could have kept going 30 hours longer by changing to a gasoline mixture for fuel. Commander Rosendahl was very frank in his statement that transatlantic flights are feasible, although a larger ship would be much more practical, and he no doubt referred to the new airships being built by England and those already contracted for by the United States Navy.

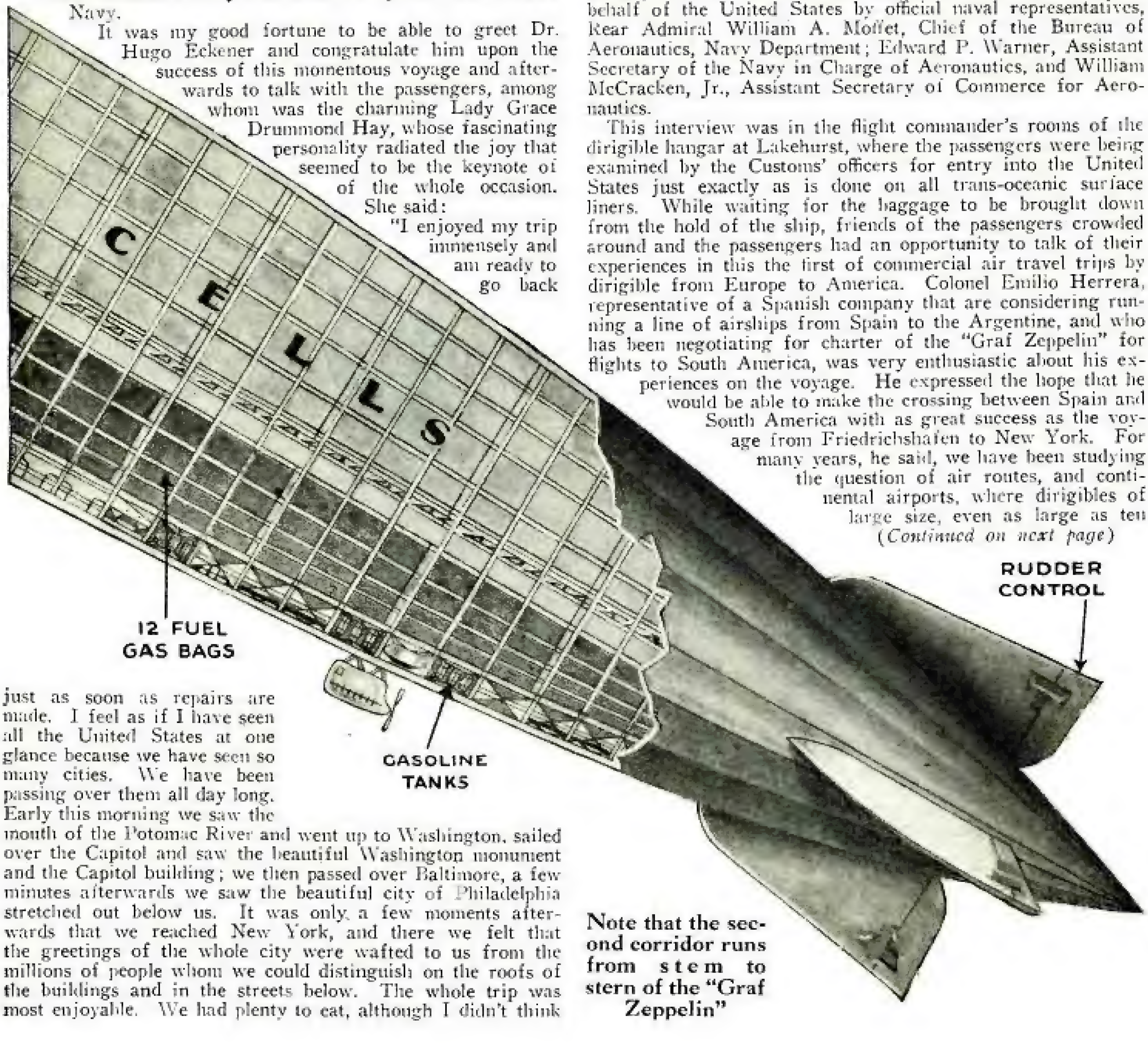
It was my good fortune to be able to greet Dr. Hugo Eckener and congratulate him upon the success of this momentous voyage and afterwards to talk with the passengers, among whom was the charming Lady Grace Drummond Hay, whose fascinating personality radiated the joy that seemed to be the keynote of of the whole occasion. She said:

"I enjoyed my trip immensely and am ready to go back just as soon as repairs are made. I feel as if I have seen all the United States at one glance because we have seen so many cities. We have been passing over them all day long. Early this morning we saw the mouth of the Potomac River and went up to Washington, sailed over the Capitol and saw the beautiful Washington monument and the Capitol building; we then passed over Baltimore, a few minutes afterwards we saw the beautiful city of Philadelphia stretched out below us. It was only a few moments afterwards that we reached New York, and there we felt that the greetings of the whole city were wafted to us from the millions of people whom we could distinguish on the roofs of the buildings and in the streets below. The whole trip was most enjoyable. We had plenty to eat, although I didn't think much of food. We had frankfurters and eggs. I was with the ship while almost every rivet and bolt was being put into it, and I knew all of the officers, and was at Friedrichshafen during most of the time that the ship was building, so I felt a deep affection for the 'Graf Zeppelin.'"

This is the way Lady Grace Drummond Hay described to me her voyage across the Atlantic Ocean after 111 hours sailing about 2,000 feet above the water, covering the "pretzel" route over Bermuda and arriving at the Atlantic coast over Norfolk, Virginia, and sailing over the eastern capitals of the United States, and landing at the gigantic airport to receive the warm welcome extended on behalf of the United States by official naval representatives, Rear Admiral William A. Moffet, Chief of the Bureau of Aeronautics, Navy Department; Edward P. Warner, Assistant Secretary of the Navy in Charge of Aeronautics, and William McCracken, Jr., Assistant Secretary of Commerce for Aeronautics.

This interview was in the flight commander's rooms of the dirigible hangar at Lakehurst, where the passengers were being examined by the Customs' officers for entry into the United States just exactly as is done on all trans-oceanic surface liners. While waiting for the baggage to be brought down from the hold of the ship, friends of the passengers crowded around and the passengers had an opportunity to talk of their experiences in this the first of commercial air travel trips by dirigible from Europe to America. Colonel Emilio Herrera, representative of a Spanish company that are considering running a line of airships from Spain to the Argentine, and who has been negotiating for charter of the "Graf Zeppelin" for flights to South America, was very enthusiastic about his experiences on the voyage. He expressed the hope that he would be able to make the crossing between Spain and South America with as great success as the voyage from Friedrichshafen to New York. For many years, he said, we have been studying the question of air routes, and continental airports, where dirigibles of large size, even as large as ten

(*Continued on next page*)

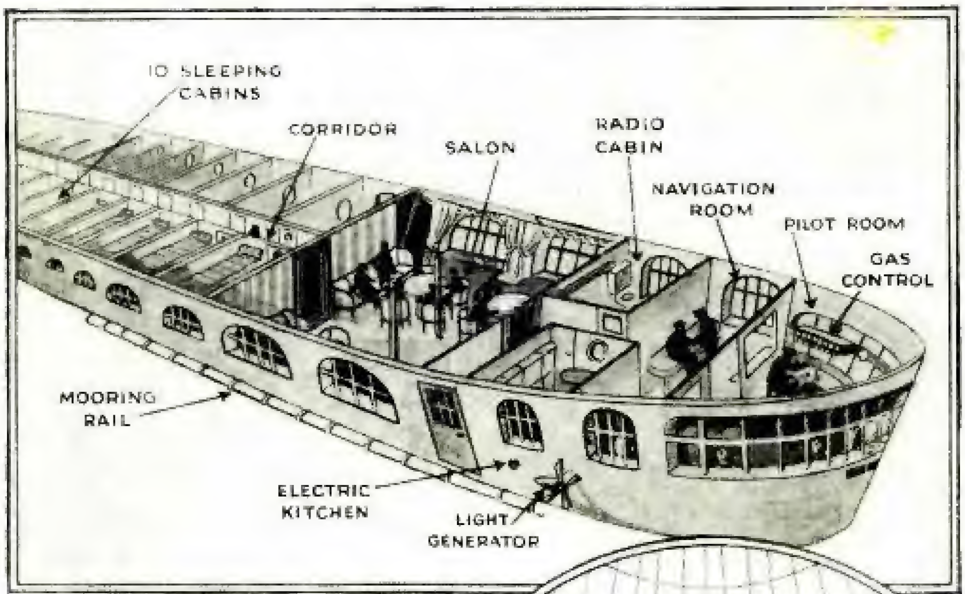


Note that the second corridor runs from stem to stern of the "Graf Zeppelin"

THE GRAF ZEPPELIN DISSECTED

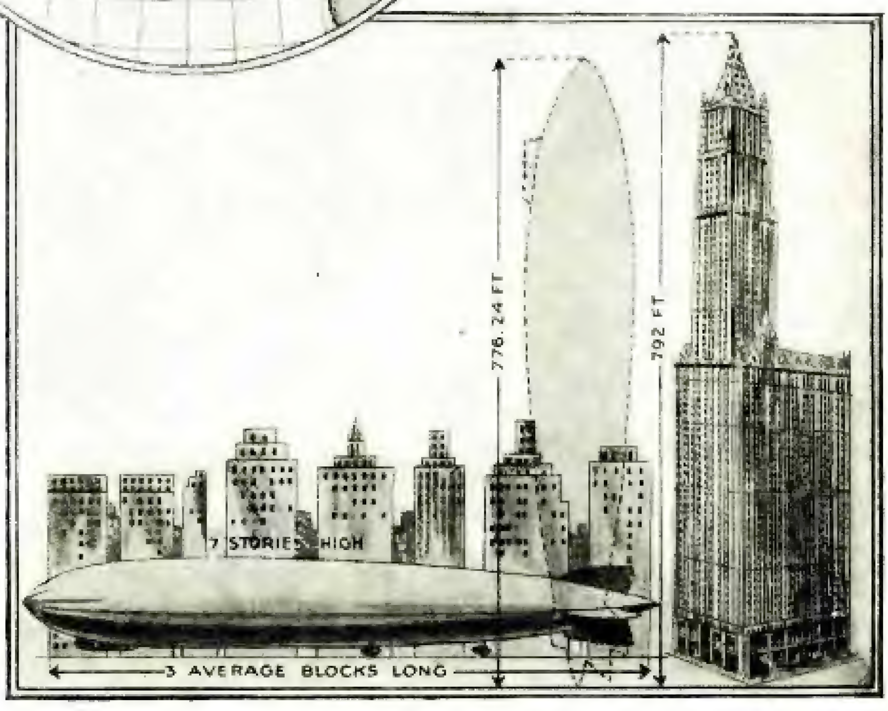
(*Continued from previous page*)

and fifteen million cubic feet, may be docked and cared for while the passengers and the cargoes from the airships may be taken to different parts of the continents by airplane or subsidiary lines. These continental airports would be located in the great aeronautical centers of the world, such as England, France, Germany and Italy. Mammoth dirigibles would go to India and Japan, Australia, South Africa, Canada, the United States, and South America. American dirigible lines would radiate from the western shores of the United States across the Pacific, to Japan, and to the south along the west coast of South America via Panama.



Exceptional picture above shows pilot room, dining salon, and passengers' cabins aboard the "Graf Zeppelin," which recently completed a successful round trip from Germany to America and return.

At left, map shows "Graf Zeppelin's" route to and from America. Picture below shows airship is three city blocks long or equivalent to the height of the Woolworth Building. New Yorkers had a chance to actually see this comparison.



Giant English Dirigibles

THE English dirigibles R-100 and R-101 are to be 6,500,000 cubic feet capacity. A friend of mine who has just returned from Karachi, India, tells me that the hangar there will be larger than the hangar at Lakehurst, and will be able to house two of these mammoth dirigibles. The next airships of the Zeppelin company are to be 7,500,000 cubic feet capacity with added efficiency of operation. The English government have already practically perfected plans for a dirigible of 10,000,000 cubic feet capacity. As dirigibles increase in size, their efficiency and airworthiness becomes marked, and the great distances that can be covered on their voyages makes them an important factor in terrestrial transportation.

In a conversation with Rear Admiral William A. Moffett, Chief of the Bureau of Aeronautics of the Navy Department on the field at Lakehurst, he said he was looking forward to the perfection of a heavy fuel motor which combined with the use of helium gas would eliminate another one of the chief sources of danger, namely the fumes from gasoline fuel. The first crossing of the Atlantic by steamship was made in 1838, only ninety years ago; what will a century of airship travel accomplish? The Great Western Steamship Company of Bristol, England, sent its coal-burning side-wheeler "Great Western" with seven passengers to New York on April 8th, 1838. At the same time Mr. J. Laird of Birkenhead, England, bought the Cork-London steamer "Sirius," which left Cork on April 4th, and crossed in seventeen days; the "Great Western" crossed in thirteen days, and they entered New York Harbor almost abreast. Mr. Samuel Cunard founded the line of his name, in 1840, and the steamship developed in speed, luxury and comfort to the floating palaces of today.

The Birth of the Zeppelin Idea

IT is only by a glance at the past achievements of the Zeppelin airships that we may realize their future possibilities. Count Ferdinand von Zeppelin was the originator of the rigid type in a practical form. He was sixty years old when he started carrying out his dream, conceived during the early period of his life, when as a soldier he ascended in Professor Lowe's balloon, used by the northern army during the siege of Richmond. I had the pleasure of meeting him in Germany when representing America in the Gordon Bennett balloon races in 1908.

The first ship, LZ-1, of 11,300 cubic meters capacity, was flown over Lake Constance (Bodensee), in July, 1900, and it is eminently fitting that the latest airship, the LZ-127, should bear the name of *"Graf Zeppelin,"* embodying as it does so completely and faithfully the ideas and principles originally laid down, but with successive improvements in materials, construction, and engineering design. Landing on the fourth anniversary of the arrival of the LZ-126, now the "Los Angeles," the points of improvement are clearly seen and suggestive of future developments. To one who saw the arrival of the LZ-126 without passengers or freight, it was to me the most significant fact that twenty passengers who paid at the rate of $3,000 for their tickets disembarked and nearly a ton of cargo, that paid a freight rate of $5.00 a pound, together with fifteen sacks of mail containing 28,124 letters, 37,590 postal cards, and 2,627 pieces of registered mail, were taken "down" from the hold of the ship.

To witness the passengers disembark from the first cabin gangway and to talk with them about their voyage; to see the immense truckloads of baggage and freight come out of the hatchway below the center of the ship, tells more vividly than any figures can, of the great progress made in the last four years.

Dimensions of the "Graf Zeppelin"

THE dimensions of the airship are 776.24 feet in length, 98.44 feet in diameter, 110.56 feet in height above the ground. The rated gas capacity is 3,708,043 cubic feet. The useful lift under normal atmospheric conditions, that is to say, the total weight which she will lift from the ground, is about sixty tons metric. Deducting the weights of fuel, crew, etc., from this figure, she will normally be able to carry a paying load of about fifteen tons —for instance, twenty passengers and twelve tons of mails and freight—over a distance of about 6,000 miles at an average speed of sixty-five to seventy miles an hour.

The photo above shows the "Graf Zeppelin" as she sailed majestically over Philadelphia on her way to Lakehurst, N. J. The damage to the stabilizer fin shown in center photo was plainly visible to the city dwellers.

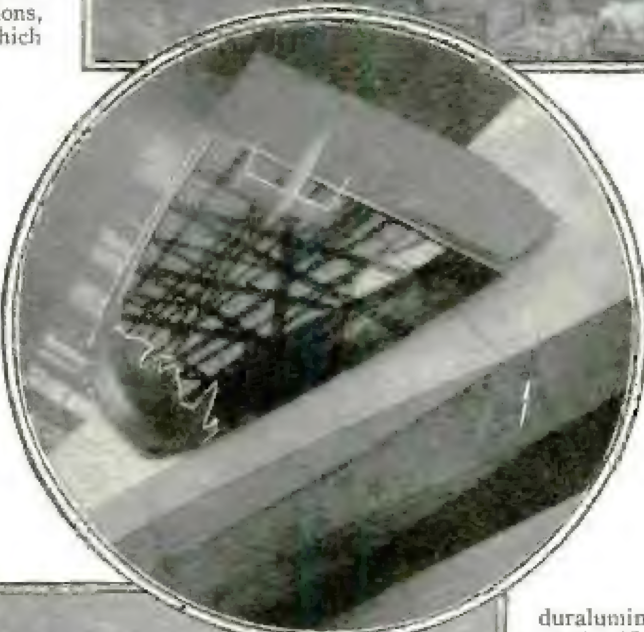
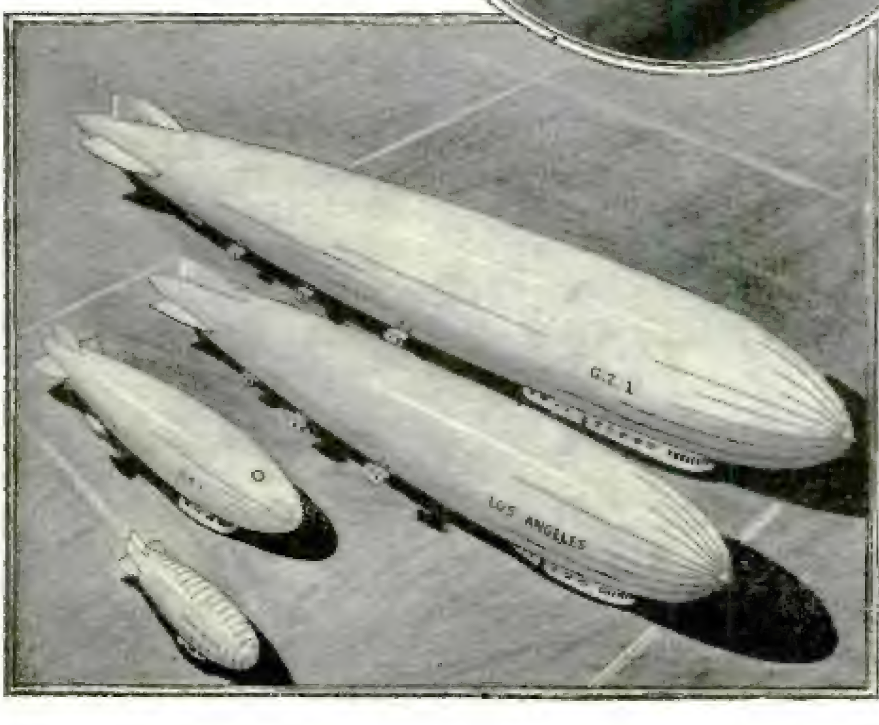


Photo at right shows badly damaged stabilizer fin of "Graf Zeppelin" on arriving at Lakehurst, N. J. Below—one of U. S. Navy's proposed new airships, the GZ-1, compared with "Los Angeles," an army semi-rigid, the RS-1, and a pony blimp.



The "Graf Zeppelin" is of the characteristic Zeppelin type of rigid airship, its framework being made up of longitudinal and transverse girders. If these were placed end to end, they would cover a distance of ten miles over the ground. It is cigar shaped and covered with strong, lightweight cotton fabric, doped with a lacquer of metal powder. The entire cover has been sandpapered and doped to obtain the smoothest possible surface, thus offering the minimum resistance or skin friction in the air.

The principal features of advance in the construction of the "Graf Zeppelin" over the "Los Angeles" consists of its being about one-third larger in size and includes the improvement in the construction of the metal girders of the framework, giving approximately twenty per cent more strength proportionately to the same weight of the duralumin over that used in the construction of the "Los Angeles." The entire structure is the size of an ocean liner, but does not weigh more than a harbor tug boat. The interior is divided the same as the "Los Angeles" into seventeen compartments, containing the gas cells for the lifting gas. These cells are made of cloth lined with gold-beaters' skin, the inner membrane of the large intestine of cattle, to make them gas-tight. To each of these cells are attached valves by means of which a portion of the gas may be released when it is desired to make the ship heavier in order to descend. Along the lower keel of the hull from the bow to the stern, is the corridor called the "cat walk," giving communication to all parts of the ship with cross walks to the motor cars on either side. The ship's service rooms are placed on each side of this "cat walk"; here also are the fuel tanks, ballast tanks, engine stores, general provisions, and various rooms for the airship crew, men's room and sleeping accommodations; there are compartments also for freight in different sections so that it may be possible to change the loads in order to trim the ship. Above this corridor and extending along the entire (Continued on page 860)

Scientists and Architects

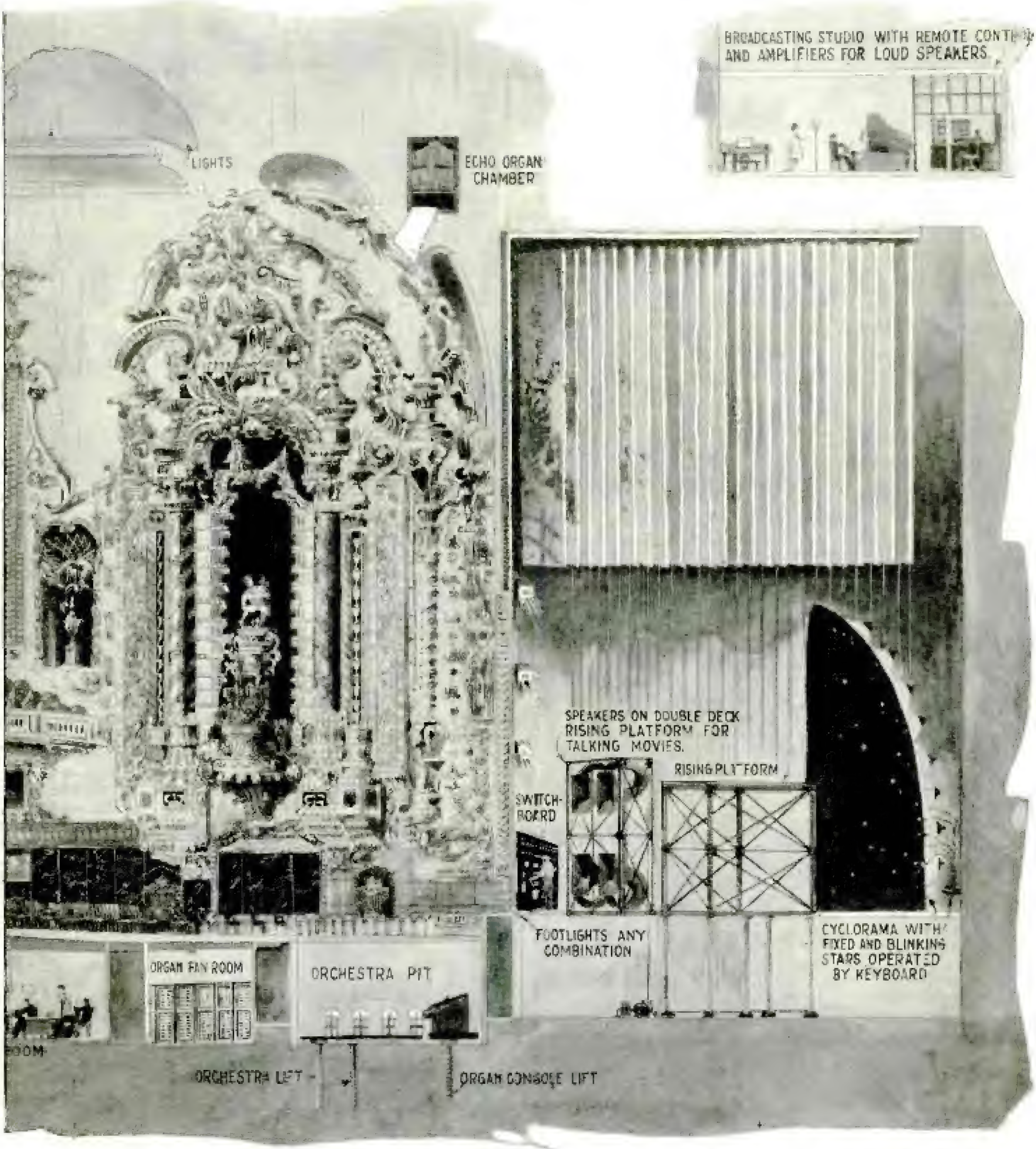
Newest Theatre Has Many Interesting Features Both from the Artistic and Scientific Standpoint. Air Supply System is Interesting Feature. Rising Platforms and Lifts Also Used in Fox's Brooklyn Theatre.

Public lounge, generator room, projection room, ventilation air duct, refrigerator room, spot lights, and musician's rest room, are shown above.

A NEW cathedral dedicated to the motion picture god, which contains the newest in both science and art, has recently been opened by William H. Fox in Brooklyn, New York. The illustration appearing here shows the features of the new theatre. The musicians' rest room, public lounge space, refrigerator room and organ fan room, are placed beneath the orchestra in the basement. Fresh air is drawn in from the roof, it is next heated or cooled, depending upon the season of the year and properly moistened. Outlets are arranged in the floor and the foul air escapes to the roof through

Build Latest Movie Palace

Equipment Provided for Both Vitaphone and Movietone Sound Pictures with Speakers Mounted on Rising Platform. Broadcasting Studio with Remote Control and Amplifiers Placed in Upper Portion of Building.



Organ chamber, orchestra pit on the left above. Details of the arrangement for talking movies, the cyclorama and rising platforms on the right above.

openings in the ceiling which contain concealed lights, greatly adding to the appearance. A portion of the foul air remains and is drawn up again to the fresh air inlet, so that the incoming air is not too cold. All the lights are controlled from a switchboard back stage. The spotlights are placed on the front of the first balcony. A cyclorama with fixed and blinking stars operated by a keyboard aids in producing many novel stage effects, as well as those produced with the rising platform. Any combination of footlights is obtainable. Both the organ and the orchestra are placed *(Continued on page 884)*

Feb.

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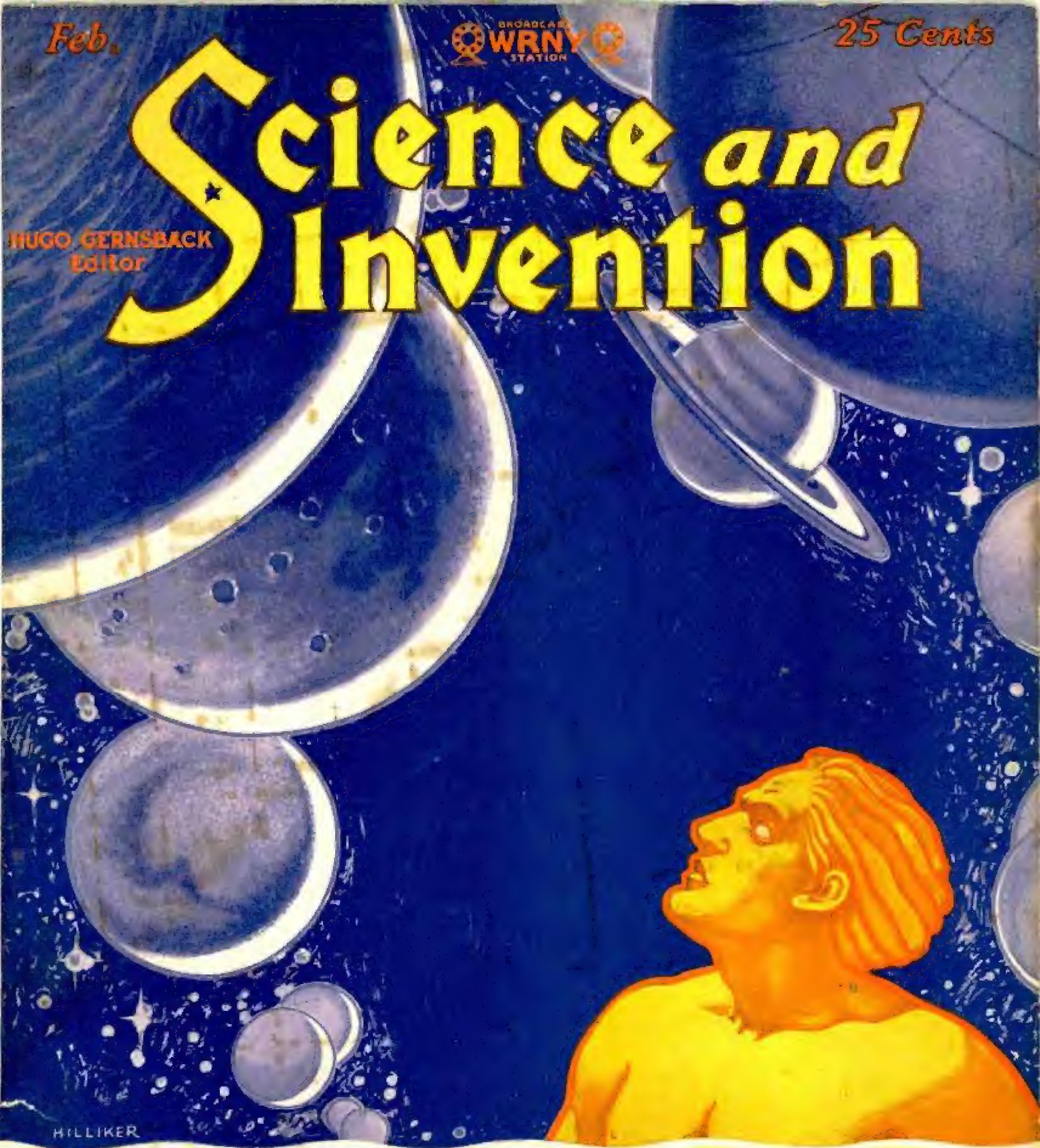
Science and Invention

HUGO GERNSBACK
Editor



THE SPIRIT OF
ASTRONOMY

EXPERIMENTER PUBLISHING COMPANY, 230 FIFTH AVENUE, NEW YORK

Fig. 4. The above illustration shows the birth of Jupiter's ninth moon by tidal fission of the red spot from the parent body.

Jupiter's Moon in the Making

By DONALD P. BEARD

STARTLING changes, shifting of cloud belts and alterations in the form and motion of the Great Red Spot on Jupiter have occurred within the year past. News of an eruption more colossal than a thousand Etnas came from Prof. Schaer's observatory on the Jungfrau, Switzerland on October 15th, 1927. The dispatch reads like the opening of H. G. Wells' amazing "War of the Worlds," yet it remains sober fact, not fiction.

Prof. Schaer, a German astronomer at the University of Geneva, spent ten nights at the Jungfrau Observatory, 11,340 feet above sea-level. While observing Jupiter through the 10-inch Zeiss refractor there, Prof. Schaer noted "a luminous eruption on the planet which lasted an hour, and the light, more intense than that of Jupiter's satellites, was visible between the two equatorial belts of the planet."

Other recent observations indicate that the Great Red Spot, long a prominent feature of the planet, is now wholly severed by obscure Caesarian forces from the parent body of Jupiter and is actually pursuing an independent motion about the latter!

About twenty years ago Sir George Darwin sought to apply the principles of the doctrine of natural selection to certain unstable planetary species under rapid rotational stress (much as in specimens of amoeba) leading to ultimate fission as in Fig. 1. Sir George calculated that 54,000,000 years ago our own moon was sundered thus from the earth which, in that remote epoch, was rotating once in five or six hours. Under a condition of low density and high centrifugal stress, sufficient rotational instability was developed to slough off the moon-mass from the present circular basin of the Pacific Ocean. This process has been termed "tidal evolution" and its failure to transpire would have created a tideless fishpond of the entire earth's surface, inhabited today by amphibians instead of human beings.

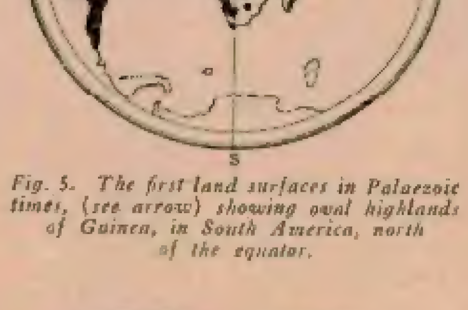


Fig. 5. The first land surfaces in Palaezoic times, (see arrow) showing oval highlands of Guinea, in South America, north of the equator.

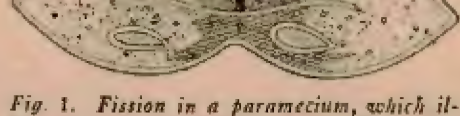


Fig. 1. Fission in a paramecium, which illustrates the formation of satellites from rotational instability. Sir George Darwin advanced this principle twenty years ago.

Red Spot Is Ninth Moon

BRIEF summary of this theory prepares us for the recent statement made by Scriven Bolton of the Royal Astronomical Society of Britain that the famed Red Spot, so long an enigma, is nothing less than a ninth moon in process of formation! His belief is based upon systematic increases in the rotation period of the Great Red Spot over a period of a half-century, following its discovery in 1878 by M. Niesten at Brussels.

In outlining his theory Scriven Bolton writes: "There is at present a phenomenon which suggests an epoch in the evolution of moon-making processes in the solar system. That puzzling object

New Safety Lifeboat

VESTRIS Disaster Demonstrates That Present Day Open Lifeboats Are an Anachronism

By HUGO GERNSBACK

Member: American Physical Society; American Association for the Advancement of Science

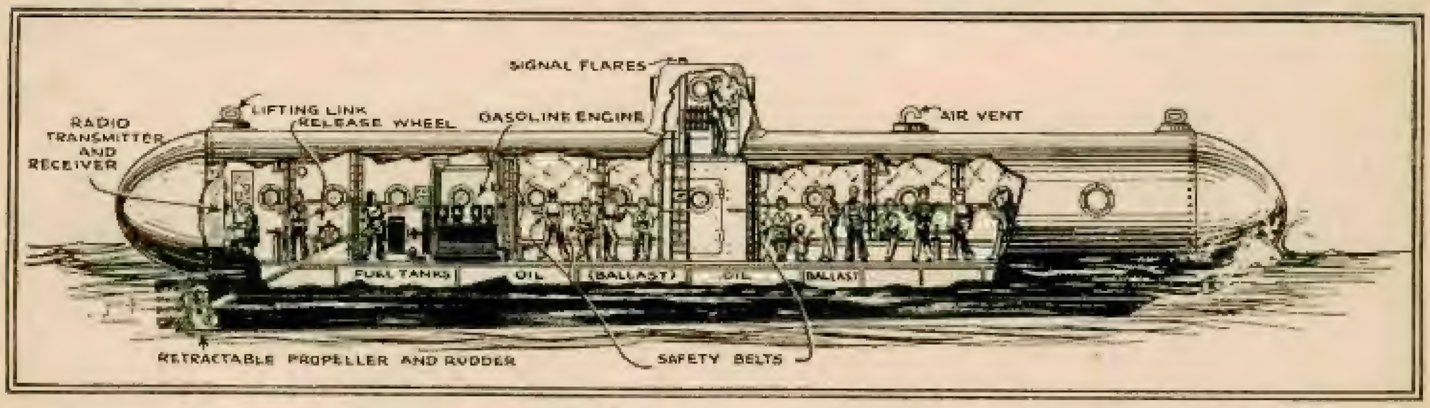
THE sinking of the *Vestris* again teaches that the present-day open lifeboats are totally unfit for life-saving purposes. Lifeboats are very much like Mark Twain's weather: "Everybody talks about it, but nobody seems to do anything about it."

If the *Vestris* disaster were the first one in which a huge loss of life was caused directly by the fact that the lifeboats might just as well not have been in existence, there would perhaps be an excuse; but similar occurrences, such as, for instance, the *Titanic* and *Lusitania* disasters conclusively prove that the open lifeboat is not to be trusted; particularly when the sea is rough and when the disaster is of the variety where the ship goes down quickly, as was the case with the *Titanic*, the *Lusitania* and now the *Vestris*.

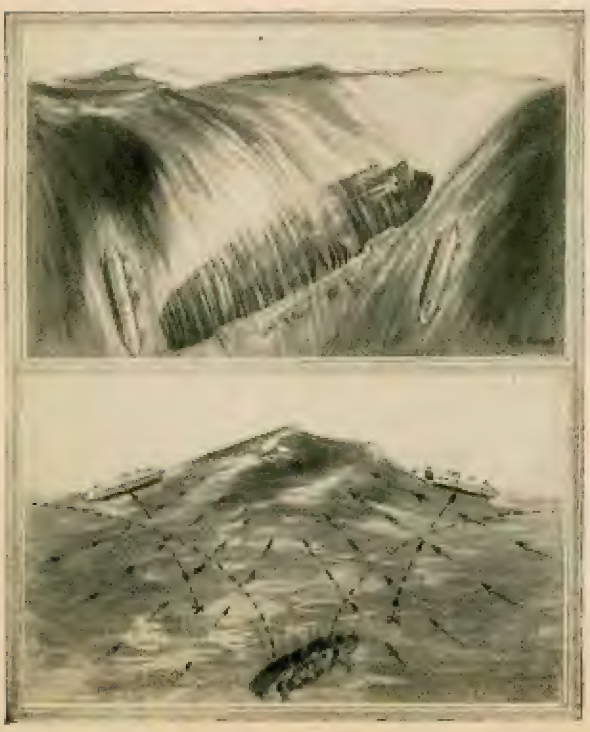
The most remarkable picture ever taken of a disaster; this shows the crew of the VESTRIS with life-belts rushing to the lifeboats. Many of those shown were drowned.

The Vulnerability of Open Lifeboats

WITH present-day lifeboats, it is always the question of the human element. In the first place, the listing of a rapidly sinking liner is usually so great that even with a heroic crew, it becomes often impossible to safely launch a lifeboat at all. There is no crew living which has ever been trained to put lifeboats into a heavy sea with a ship listing 30 or more degrees. The usual lifeboat drills are silly, because the conditions under which they are made are totally different from what usually happens in a disaster.



Cross-section of the new life-pontoon to accommodate 200 passengers. The entire inside is padded so as not to hurt the passengers in a rough sea or during launching. Safety belts are provided to hold passengers fast to their stations, in order not to break limbs and injure passengers.



In very extreme cases there is a suction as a steamship goes down. The life-pontoons might be carried down for 15 or 20 feet as shown in the upper illustration, but would immediately bob right to the surface of the sea, as shown in the lower illustration.

But granting that some lifeboats can be safely launched, we then have the *Vestris* experience, where many people perished because the lifeboat upsets or becomes filled with water, and either capsizes, or what is worse, many of the unfortunate survivors die of exposure; and the few who are saved usually contract pneumonia or die from the effect of exposure. So all in all, the present-day open lifeboat is to be severely condemned as an anachronism and is to be placed in the same class with sail ships, of which it is only a miniature duplicate.

Brand New Lifeboat Needed

WHAT then is needed is a totally different sort of lifeboat, suited to modern conditions; a lifeboat that cannot be swamped by the open sea; a non-wooden lifeboat that is seaworthy, that will not fall apart when it is launched into the sea, and what is more, a lifeboat that is not dependent upon a panicky crew for its launching.

The illustrations on these pages illustrate (*Continued on next page*)

This illustration shows the launching of the Gernsback life-pontoon in the extreme case where fire breaks out in the ship. The pontoon is easily released from its davits and slides down into the sea, passengers and all. The passengers are strapped with leather life belts inside of the padded pontoon, so they will not be hurt as the pontoon rolls over in the sea, for a few minutes, till it rights itself.

Giant Bridge Joins Two States

New York and New Jersey to be Connected With a Span 1½ Miles Long.

By
H. Winfield Secor

The main elements of the bridge will be the great span across the river, the supporting towers and approaches. Above one of the towers is compared to the Woolworth Building which is 792 ft. 1 in. high. The bridge towers will be 650 ft. in height.

IN the January 1928 issue of this publication a complete description of the greatest bridge in the world, which would span the Hudson, was given. Now, one year later, we are giving further data and interesting facts concerning the colossal suspension bridge which will be 1½ miles long, with towers standing 650 ft. high.

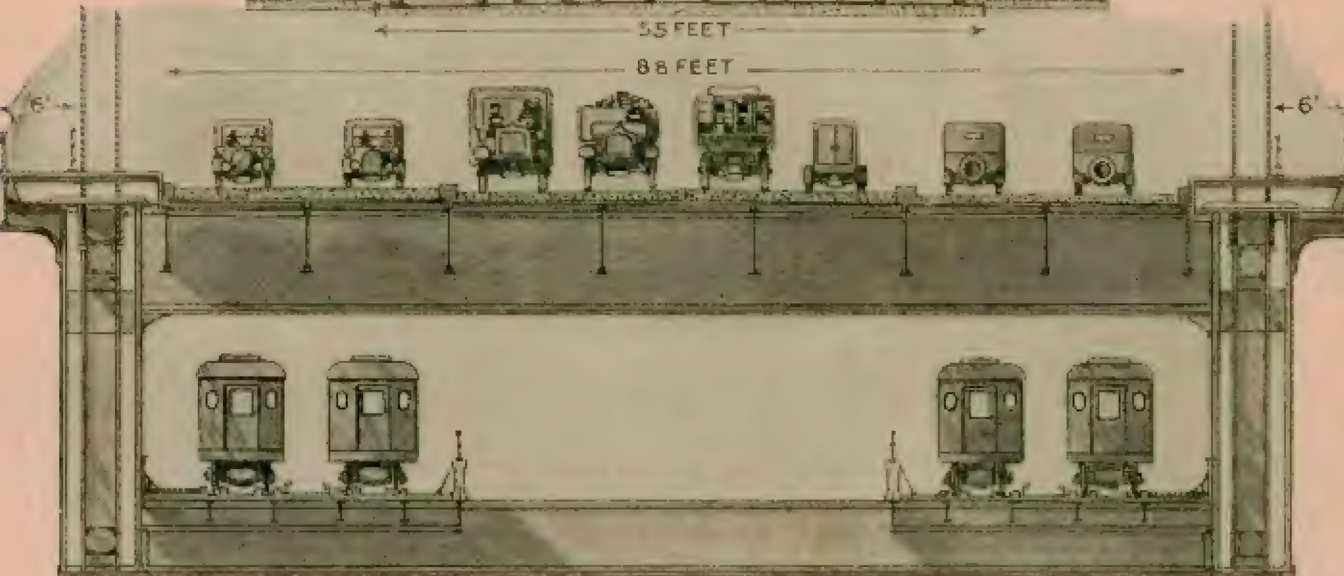
The supporting columns will rest upon separate concrete bases 90 ft. x 100 ft. faced with granite. To build these foundations, the river bottom was excavated for about 100 ft. under water to reach bed rock. One of the towers is compared to the Woolworth Building in an illustration on this page. Photographs of the 16 section steel skeletons for the towers also appear. The towers will be of steel and concrete construction with stone facing. Two sidewalks each 6 ft. wide and a roadway for motorized traffic 88 ft. wide will be supported by these towers, as well as four rapid transit lines. The cables for the bridge of which there are four, each 36 in. in diameter made up of small wires 1/5 in. in diameter, will be anchored in solid rock. The drawing appearing here shows a diagram of the New Jersey cable anchorage which will be 240 ft. deep. The weight of the bridge and therefore its inertia will be so great that the force of a gust of wind would be spent before the bridge would move appreciably. The steady force of a high wind would hold the center of the bridge 12 or 18 inches out of its normal position. However, a maximum swing of 5 ft. has been allowed for. In cold weather, the contraction of the cables will raise the bridge about 5 ft. and the two towers will move about 7 in. toward the center under a load. The concrete floor will be supported from the suspension members by great steel trusses which will allow the bridge to swing without their breaking or cracking. The Hudson River Bridge will have a span of 3500 ft. which is twice the length of the Camden, N. J., span. The weight of the suspended structure will be 120,000 tons and the weight of the complete bridge is estimated as 1,000,000 tons. The live load carried will be one-quarter of the dead weight. To resist the pull of the cables on the New York side, at 179th Street, a concrete anchorage weighing 370,000 tons is to be used. The bridge will be the

In the above photograph may be seen the steel skeleton of one of the towers. Each leg of the tower rests on a separate reinforced concrete base resting on bed rock and faced with granite. Arrows point to workmen.

A view of one of the towers taken while standing at the base and looking upward appears at right. The 16 section steel columns that form the New Jersey tower of the giant span have risen to a height of more than 200 ft. in two months. The towers of the bridge are four times as high as the famed Colossus of Rhodes.

The traffic roadway on Fifth Avenue and that of the new bridge are compared in the illustration appearing here. The bridge roadway will be 88 ft. wide.

On either side of the bridge there will be a 6 ft. sidewalk for pedestrians. Below the vehicular road will be four tracks for trains.

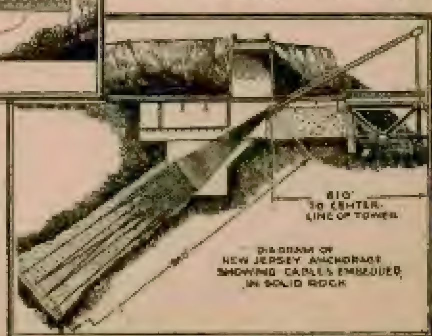


The floor of the bridge is hung by pairs of steel wire suspenders from four wire cables. On the upper deck is an 88 ft. roadway which will accommodate eight lines of motorized traffic. This deck is carried on transverse floor beams spaced about 60 ft. apart.

The lower deck of the bridge will carry four rapid transit lines. This makes it necessary to have a large railway terminal at the Manhattan end of the bridge and an elevated structure crossing Manhattan at 59th Street for direct connection with Long Island.

most impressive connection between New York and New Jersey which has ever been made. It will aid the ferries and the vehicular tunnel in bridging the gap between the two states and will further afford an outlet for metropolitan inhabitants. It will also be a main auto highway connection between New England and New Jersey, Pennsylvania and the south that will avoid to a large extent the congested districts of New York and vicinity. The bridge will open a large area of New Jersey as a suburban district for New Yorkers. Traffic surveys and estimates indicate that 8,000,000 private vehicles and nearly 500,000 buses will use the bridge in the first year after it is opened. The theoretical capacity of the roadways of the bridge is nearly 30,000,000 vehicles per year, but it is assumed that before such a volume of traffic is reached, other Hudson River crossings will have been provided. By 1960 traffic is expected to increase to 16,000,000 pleasure vehicles and 1,000,000 buses. Traffic coming along the Lincoln Highway from the south will pass around Newark by a route soon to be constructed and will cross the bridge to Manhattan far from the congested area. The Washington Bridge across Harlem River will connect with the Bronx and the Boston Post Road.

The above illustration shows the total length of steel cable used on the bridge which would reach from New York to Cincinnati. At the left we see how provision has been made for contraction and expansion. At the right is a diagram of the New Jersey anchorage showing how the cables are embedded in solid rock. The four 36 in. cables will be jointly able to support a load of 352,000 tons.




March
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"THE ORIGIN OF MAN"
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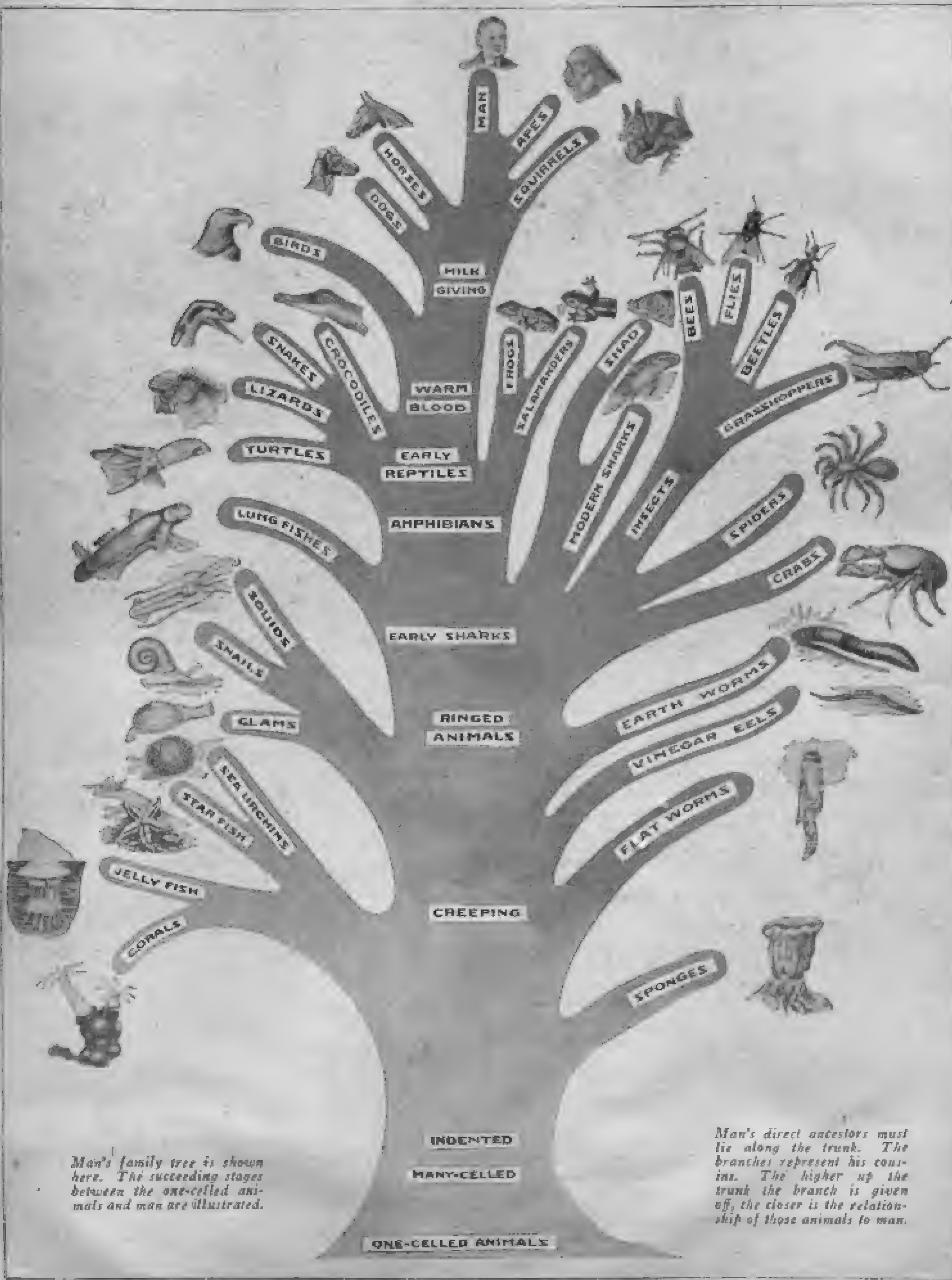
PROF. SAMUEL C. S
Ph.D., Sc.D
The Spirit of
EVOLUTION
EXPERIMENTER PUBLISHING COMPANY, 230 FIFTH AVENUE NEW YORK

The Evolutionary Tree of Man



Man's family tree is shown here. The succeeding stages between the one-celled animals and man are illustrated.

Man's direct ancestors must lie along the trunk. The branches represent his cousins. The higher up the trunk the branch is given off, the closer is the relationship of those animals to man.

This illustration at the left shows how a plane shortens the path of lightning between two clouds.

If You Should Fly Into a Thunderstorm?

By B. FRANCIS DASHIELL
Member, American Meteorological Society

Aviation's Greatest Menace Is the Thunderstorm With Its Dangerous Squalls and Lightning

THE great tri-motored mail and passenger plane was flying smoothly toward the west on a warm July afternoon. Far off on the horizon some dark and high-topped clouds were visible. But they mounted higher and higher into the sky as the plane continued its rapid progress.

"Looks like a thunderstorm ahead," remarked the pilot to his flying companion.

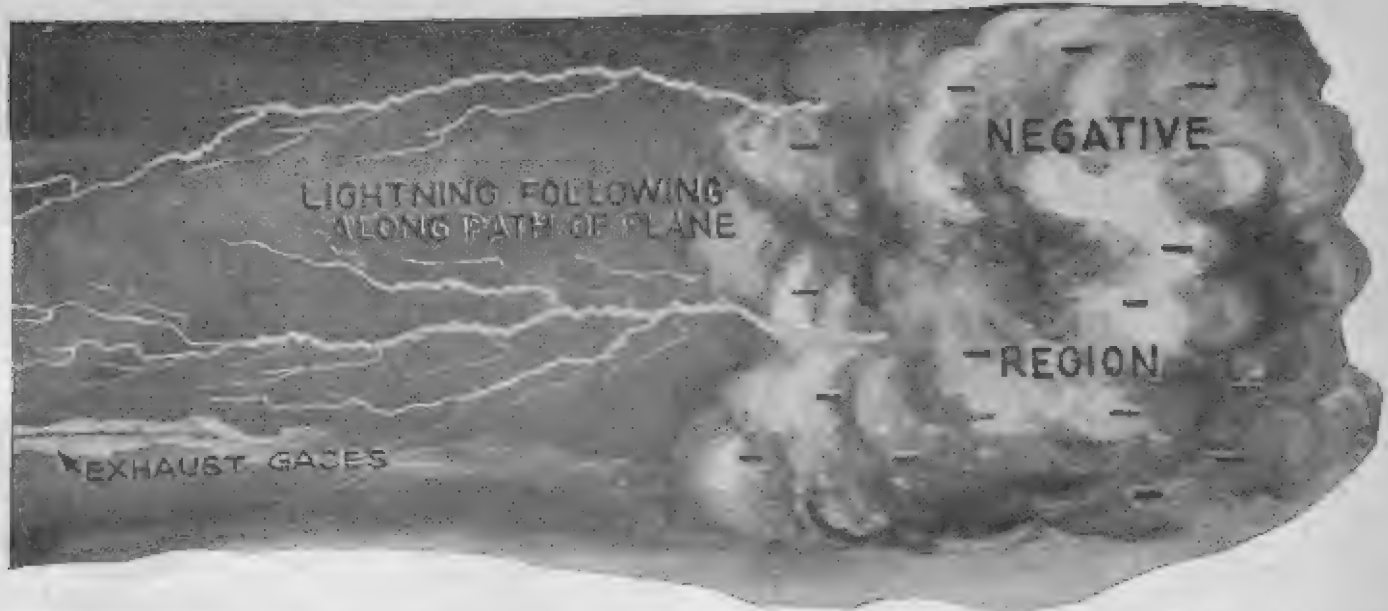
"Yes. The Dayton airport said we might encounter some thunderstorms over this part of Illinois. Better go off to one side and try to pass around it." With this advice the aviator glanced around apprehensively at their passengers seated comfortably in the cosy cabin of the big plane.

A passenger plane can afford to take no chances. The lives of the travelers are entirely in the hands of the pilots. And aviators fully realize that in no other mode of transportation are the lives of the passengers so completely entrusted to the judgment and skill of the persons in charge. Aerial navigation with increasing passenger travel opens new and greater responsibilities to those engaging in the business.

Thunderstorms, fog, snow and darkness present serious obstacles to aerial navigation. But the thunderstorm is the most violent and dangerous menace to aviation as it presents uncertain and uncontrollable conditions. Flying in fog, snow or darkness does not affect the stable operation of the plane; it simply presents serious chances of becoming lost, of crashing into some hill or mountainside, or failure to make a safe landing.

Thunderstorms Most Disastrous

A THUNDERSTORM is something to be avoided by all types of aircraft. Many accidents with loss of life have occurred during the thunderstorm season. Airplanes and, in fact, all types of aircraft, have been destroyed by the dangerous squalls as well as by lightning and electric induction. Balloon explosions as a result of lightning and electric sparks have always exacted heavy tolls. In fact, the recent balloon disasters during summer races should discourage the holding of such events

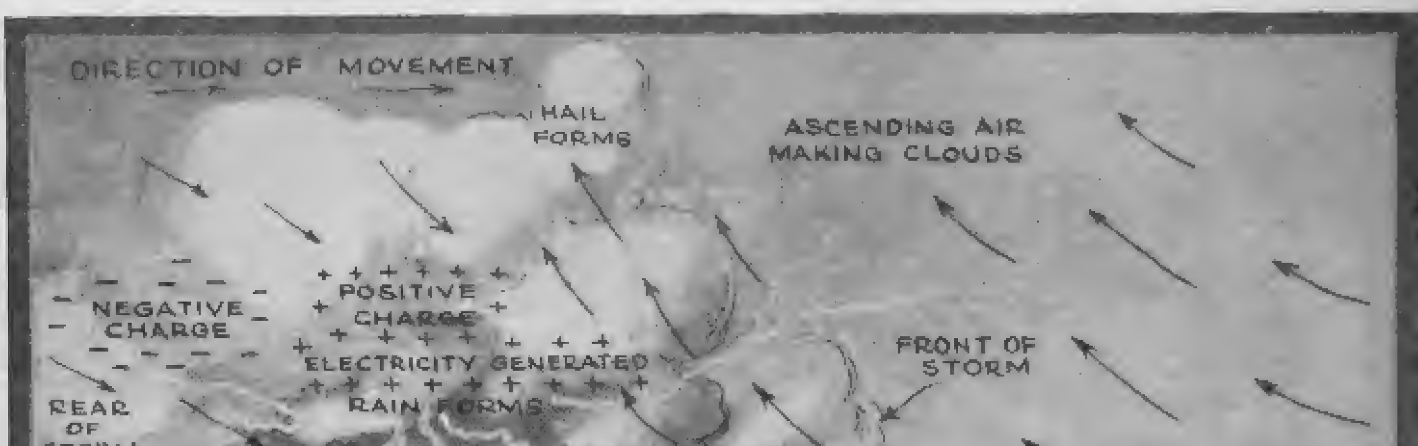


Above we see how lightning follows along the path of a plane. Frequently the exhaust gases shorten the lightning path because of the increased conductivity of those gases due to carbon-particles and heat. Thus a greater risk occurs under such conditions.

during the months when thunderstorms and atmospheric electricity are common.

The turbulent conditions of a thunderstorm are of such magnitude and, in fact, are so violent, that great danger is entailed by flying into or about their immediate neighborhood. Few aviators have flown successfully through a thunderstorm and have been able later to describe their experiences. Lightning, electric induction, and turbulent and twisting winds are constant sources of peril. Some think that the actual danger from lightning to an airplane when flying into a thunderstorm may be little more than to a person walking across an open and level space. Such is not a fact, as the potential danger is always very great, and the careful and capable aviator will immediately avoid the region of a thunderstorm.

The turbulence within the clouds of the storm is beyond description. Planes have been stripped of their equipment. The wings, and the cloth of the fuselage, are ripped off with ease. The plane, in the meanwhile, is out of control of the pilot as it is at the mercy of the elements. The only salvation is to try to get far above the storm or out to one side. Once within the grasp of the rushing and erratic air currents, there is little hope of keeping the plane in control. This danger to balloons or any lighter-than-air craft is much greater as they are clumsy and slow moving. In rare cases, after one of these nerve-racking struggles with the winds, during which the plane is dashed perilously close to the earth only to be carried high to the tops of the clouds, the pilot manages to break through the sides of the storm and emerge into dry weather and comparatively steady winds. If the storm is of short duration, and the plane is able successfully to (*Continued on page* 1078)



The illustration above shows vividly the side elevation of a thunderstorm. It portrays the direction of winds and their nature, as well as the areas of calm. An airplane pilot generally tries to circle around such a storm as the lightning discharges present a serious risk.

Saving the Lives of Crews of Disabled Submarines

By WALTER G. KIPLINGER

The pupa-case escape chamber and the account of some mid-western experiments.

190-lb. man in a cylinder 15 inches in diameter remained in this can, closed at the top and water-sealed at the bottom for one-half hour without discomfort. Below, same experiment in deep water.

Pumping air into the can. The other end is also sealed. The side through which the man entered remains beneath the water.

THIS chamber is to be released through the torpedo tubes or through suitable hatches. It can be made of a very thin metal and an internal pressure is used to counteract the external crushing pressure. The chambers are to be nested, and each supplied with covers containing soda-lime.

AT the time of the S-4 disaster, the writer, in common with several thousand other corn field naval experts, "wished" his brilliant ideas for crew escape buoys on the long-suffering Naval Department. Our plan, which was similar to many others sent in, involving letting the men take their chances in war but in peace times carrying one "dummy-torpedo" built up of several containers nested inside of each other like drinking-cups.

Late in the summer an unofficial letter was received from the chairman of the board of civilian experts, expressing an interest in our work and experiments but pointing out various military objections to the scheme as presented. These objections, made chiefly on the score of weight and space, were sustained by figures which showed that each unit would weigh 200 pounds if made strong enough to stand the external pressure of 100 pounds per square inch met with at rescue depths. As there are normally some 40 men in a submarine crew, the scheme obviously had a high relative humidity. In fact, it would not be an exaggeration to say it was "all wet."

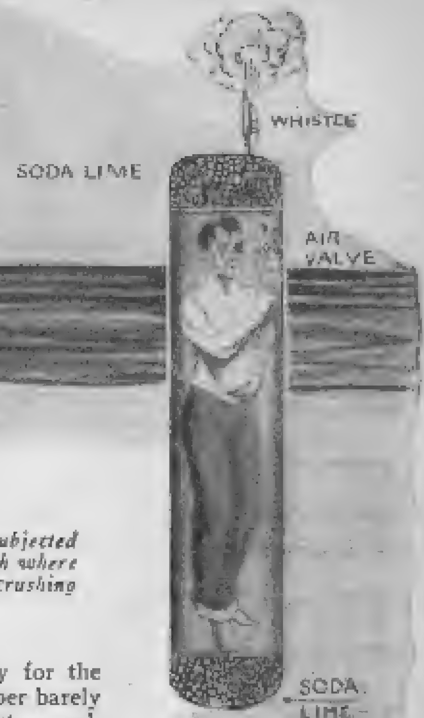
The following modification of the original plan has received favorable comment as to its possibilities, however, and is presented to the readers. In the first place, as has been emphasized in these columns several times, it must not be forgotten that submarines are built primarily for fighting purposes. Almost everything about them means only that. In any sort of a scrap, the best safety device of all is our old army friend, "fire superiority." Nothing must jeopardize this. Crew-escape buoys, therefore, became less of an engineering problem than that of a Rocky Mountain pack train-master's task of finding space where absolutely none exists on an already overloaded burro.

We had already found that a man can get into a much smaller space than seems possible. The can in the illustration is fifteen inches in diameter and though the man weighs 190 pounds, there is some room to spare. Also, the figures on the amount of air one needs in a closed space are wrong. Rather, they are based on a full tidal volume for each breath.

Extra Air Not Needed

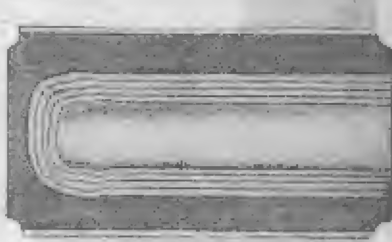
IT takes a little practice to acquire the trick, but if one borrows a bit of the hibernating groundhog's technique, remains calm and relaxed, a little oxygen goes a long way. Houdini's stunt of remaining 90 minutes under water in a sealed coffin was no fake. We have been able to stay in our models a half an hour without any great difficulty even without soda lime. In our improvised diving bells where we could exhale under water, we have stayed under ten to fifteen minutes on the amount of air in an ordinary wash-boiler. We felt, therefore, that as far as breathing is con-

This shows the 190 lb. experimenter, quite comfortable in a can only 15 inches in diameter.



When a man enters the can in the submarine he is subjected to a pressure of 75 lbs. This means that even at a depth where the pressure is 100 lbs. per square inch, the actual crushing pressure on the can is but 25 pounds.

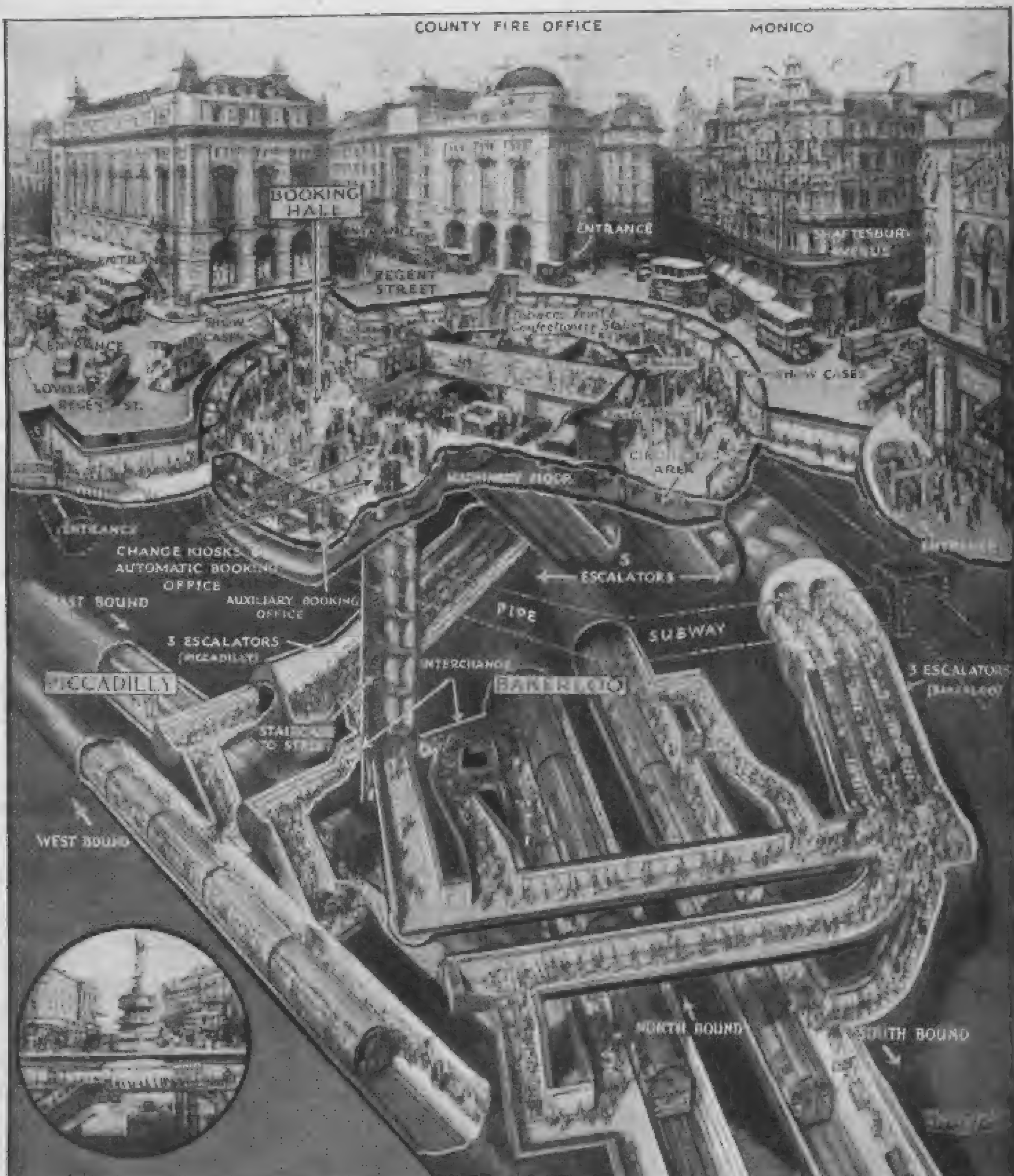
cerned, we could dispense with any fresh air supply for the time needed to reach the surface and could use a chamber barely large enough to hold a man if we could reduce weight enough to give buoyancy. This apparently simple problem gave more trouble than black ants at a picnic. Theoretically, a perfect cylinder will stand a great amount of crushing pressure even when the walls are thin. Practically the slightest dent breaks the arch and the tank folds up like an accordion. When the Massachusetts Institute of Technology cited an instance where a few dents caused a thin-walled cylinder used in cotton fumigation to cave under less than ten pounds external pressure, we did an abrupt about face.



HOW THEY COULD BE NESTED

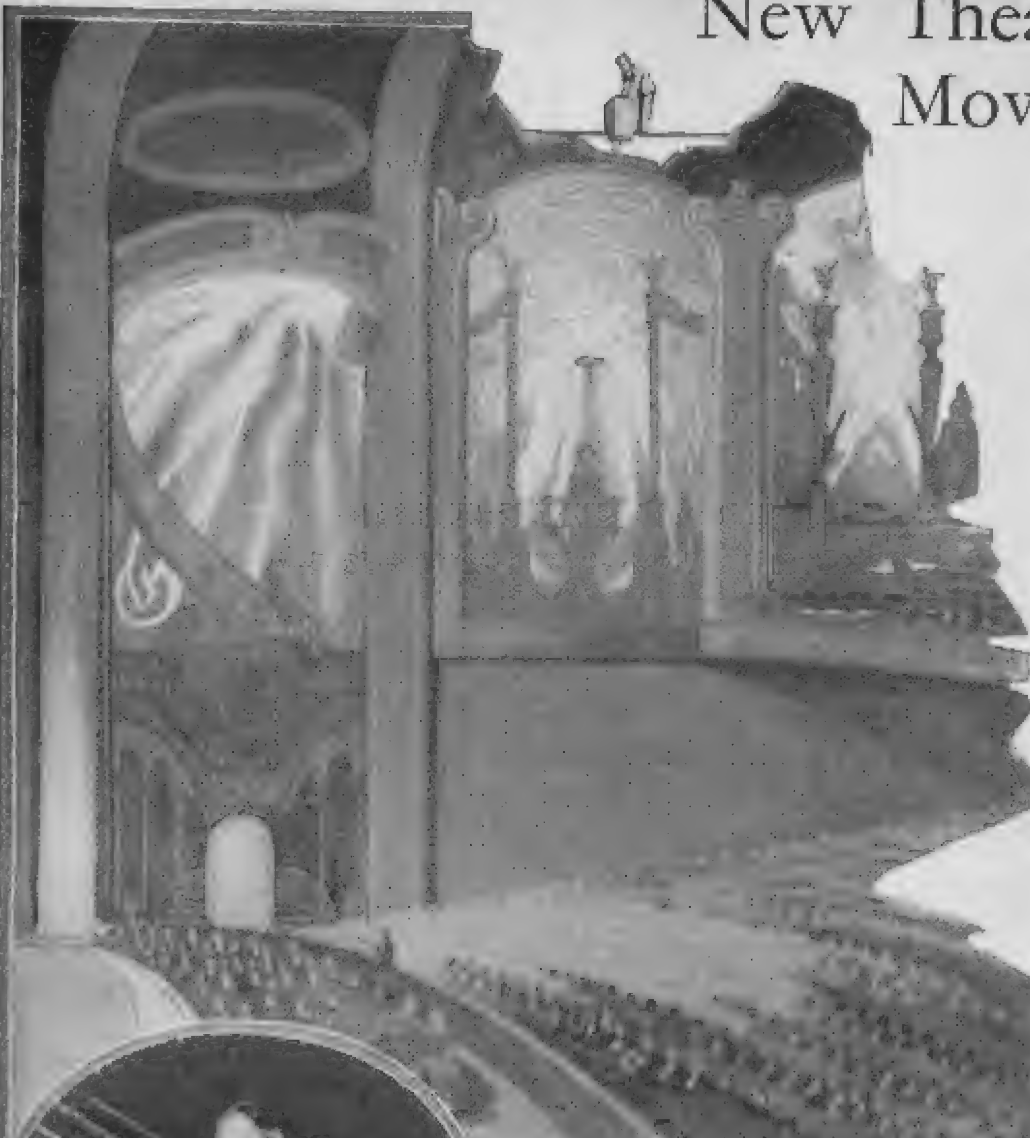
Any escape-chamber which a submarine can carry without lowering its military value will have to serve a double purpose either as an air-tight container for soda lime and other materials that must be carried anyhow or built up in an emergency from open-ended cylinders and bonds that will line hatchways or serve as carrying racks. In either case, they will have to be thin-walled and will be subjected to much battering. There is apparently no metal light and strong enough to stand one hundred pounds pressure under these conditions. (Continued on page 1087)

London Has Huge Subway Station



ONE of the most elaborate subway stations in the world was opened in London recently by the Mayor of Westminster. The task of construction is a noteworthy engineering feat and took about four years to complete. The cost is estimated at about $25,000,000. The above illustration shows the location of the new subway station at Piccadilly Circus, with a view of the various levels. Just below the roadway is the booking hall, showing the termination of the upper flights of escalators. A service shaft with an emergency stairway is placed at the left of the main level. Against the shaft may be seen the lower flight of three escalators which connect with the Piccadilly Tube. This tube is 102 feet below the level of the ground. To the right is another set of three escalators which connect with the Bakerloo Tube, 86 feet below the surface. Other features of the underground station will be found indicated on the illustration, which is well worth studying.

New Theatre Has Moving Murals



IT has been the general custom to paint murals on the walls of theatres. These murals are the admiration of theatre-goers for the first two or three visits to the theatre. After that they become commonplace. Now, however, a theatre has installed moving murals, the colors of which blend with each other, and the designs constantly change when the murals are in operation. This system is the adaptation of the Wilfred color organ, first described in this publication many years ago, to theatre work. The illustration at the left shows the position of the color organ. Four of these instruments are located on top of the arches and throw the color onto a white wall. The instruments are operated by the electrician back stage. This system is installed in the new Paramount Theatre, located in Brooklyn, N. Y.

When the orchestra is rendering an overture or the organist playing a composition as a specialty, the murals on the walls become alive with motion and color.

Mr. Wilfred at the keyboard.

Here is another interesting fantasy. Characters can move in front of the murals, in this way greatly enhancing the effect of the designs.

This photograph shows Thomas Wilfred, the inventor of the color organ, and Frank Cambria, art director for Publix Theatres. Immediately in back of Mr. Cambria the "luminar" can be seen, the name given to the mural color organ.

This is only one of the many different designs that can be produced with the color organ.

This photograph shows the beginning of one of the effects which are produced by the mural color organ.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A ONE-MAN SUBMARINE

"Taxi-Sub" May Be New Under-Sea Terror---Has a Cruising Range of Five Hours

By FREDERICK C. JONES

THE "taxi-sub" opens up an entirely new phase of naval warfare, for many factors lacking in the larger submarine have been added to the "taxi-sub." The points in its favor being: low cost of construction, unlimited cruising range, a smaller target, less vulnerability, and absolute safety to the operator.

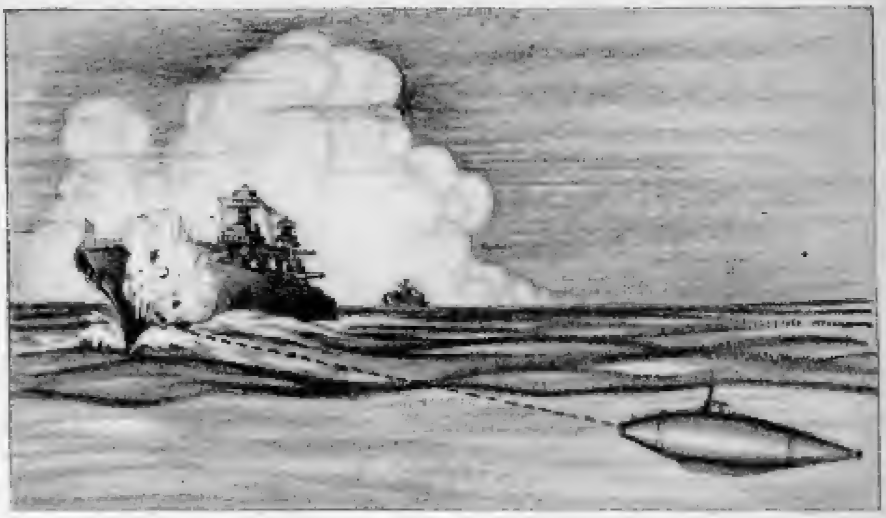
Disadvantages of Present-Day Submarines

THE risks attendant on the old type of submarine renders it sometimes difficult to secure a highly satisfactory crew, and so far entirely reliable life-saving equipment is lacking. The submarine is large in structure and easy to hit, it cannot move about and be handled with the ease the commanders would like and the time taken to submerge and disappear is far too long. It is also a good target, for even when submerged its water disturbance betrays its presence, to say nothing of leaking oil and hydrophone equipment on enemy ships.

Except in a few rare instances, the cruising range of the submarine is limited to a few days from its base and very few can undertake a long voyage. This, coupled with the enormous cost of building, upkeep and payment of crew, still leaves much to be desired.

The "Taxi-Sub"

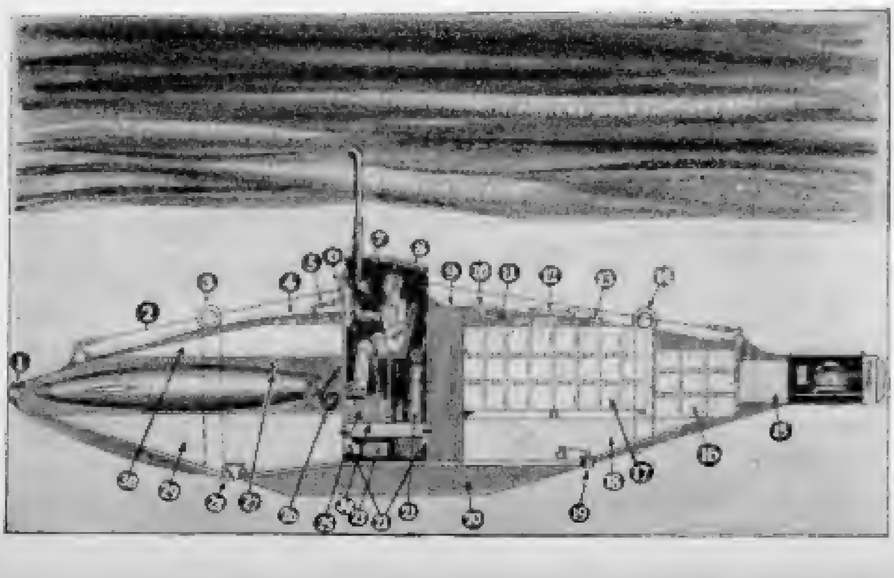
NOW with the "taxi-sub" none of these disabilities prevail, all former submarine difficulties have been studied and the inventor claims to have achieved as near perfection as practicable, with the one-man sub.



The small submarine will carry torpedoes and can creep close to a ship without being noticed. The above illustration shows a one-man submarine which has launched a torpedo at a battleship.

Above is the cabin or tapering cylinder released from the sub.

In the illustration below, 1 is the torpedo door; 2, the antenna; 3, lifting ring; 4, electric controls; 5, jack plug; 6, port; 7, vent; 8, door; 9, diaphragm; 10, electric controls; 11, manhole; 12, vent; 13, antenna; 14, lifting ring; 15, air tank; 16, emergency tank; 17, batteries; 18, ballast tank; 19, valve; 20, air tank; 21, emergency air tank; 22, release bolts; 23, buoy; 24, weight; 25, battery; 26, spring; 27, torpedo; 28, valve; 29, ballast tank, and 30, air tank.



This little craft measures 30 ft. in length with 5 ft. 6 in. beam and is 8 ft. high at its tallest part; this renders it extremely portable and two or more can be carried with ease on the average battle cruiser, and, being entirely operated by one man, a great saving in personnel is effected, thus leaving more men for other duties.

Cabin Release

THE great feature is the cabin release, which acts as a life-saver for the operator should his craft sink or be disabled. This release is operated by three different methods: by the hand lever, which is worked by the hand of the operator at his own will; next comes the "Deadman's Control," operated from the seat, should the man faint or become injured, for it is certain he could not remain on the seat which is just sufficient to rest upon, and as soon as his weight is removed, springs close the contacts and the cabin is released. Next is the diaphragm release. This operates at specified depths which can be set, so in the event of the craft getting below a safe working depth, the contacts close. Thus we have three methods of safety that cannot fail.

The cabin itself is a tapering cylinder which contains the operator, all switches, radio apparatus, and a compressed air tank. It is weighted to insure its floating in an erect position and has no connection with the main shell. All controls which are electric throughout pass through a large jack which plugs into the cabin after the operator is snugged down.

Position Buoy

BELOW the cabin is a small buoy and several hundred fathoms of cable, which, after the cabin is released, would float to the surface and indicate the position of the "taxi-sub" as she rests on the bottom. If she was in a safe working depth, divers would then salvage her or if in a greater depth she could be grappled, as lifting rings are fitted fore and aft; this would permit lifting the vessel bodily, which would be impossible with a larger vessel.

The release action consists of a double-

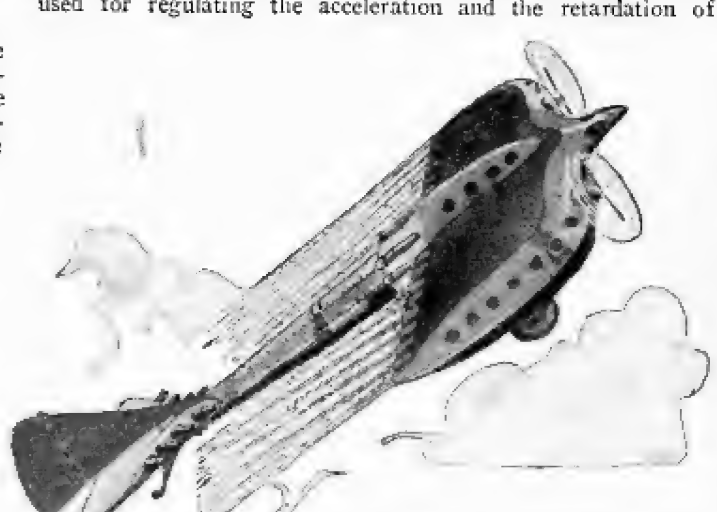
(*Continued on page* 1211)

Berlin to New York in Twenty-Six Minutes

The above illustration shows a rocket plane in flight. The manner in which the retard rockets are used is also shown.

THE start of the stratosphere flight of the representative of the press was set for 13 o'clock today. On our arrival at the Tempelhofer Field, we were received by the superintendent of the Union for Aerial Travel, and the features of the rocket flight were described to us. The machine destined for the stratosphere flight seemed like ordinary commercial airplanes; it was different from these in size and the thickness of its air foils, in which the cabins for the passengers were placed. The body of the machine is proportionately small, and the same is to be said of its steering planes. In the body of the machine, between each two cabins, there is placed the rocket apparatus, with the nozzles of the rockets pointing backward. Very near the stern, there is another rocket system opening forwards which is designed to act as a brake on the velocity of flight, when a landing is to be made. The stratosphere plane has a pair of propellers, which at the start of the flight carry the plane up to a certain height before the alcohol-oxygen rockets can come into play.

According to the theoretical explanations, the most important parts of the machinery and arrangements were explained to us, as well as the arrangements for making and purification of artificial air and the heating apparatus. All these apparatus resemble the corresponding parts in a submarine. The entrance door to the body of the machine has leather gaskets. During the flight, it is tightly closed with bolts and wing nuts. The windows of the cabins are closed air-tight and the walls of the plane are made of lead glass of a dark gray color. The dark gray window panes only let a little daylight pass through them, so that the interior even in sunlight is lighted electrically. The walls of the cabins and the floors are upholstered with leather, and are covered with granulated cork composition. On the deck, on the walls and on the benches, there are numerous hand straps by which the passengers can pull themselves out when they have lost weight by diminishing gravitation. The special interest lies in the cabin benches placed at right angles to the line of flight. The benches are anatomically shaped, cushioned divans, over which a net can be stretched. In quick positive and negative acceleration on the plane, it is of importance that all ballast should be absolutely secured against motion, the luggage must therefore be contained in the cushioned and closed boxes bolted fast under the eyes of the flight captain. The entrance to the rocket chamber, on account of the danger involved, is naturally not permitted to anyone, but the captain's "bridge" can be inspected, in which, except for the crane for raising and lowering the rockets and the racks for holding them, there is nothing especially new to be seen. It must be noted, howver, that in the pilot house there is a speedometer to be used for regulating the acceleration and the retardation of the flight. The latter corresponds to brake action. There is also an actinometer for measuring rays, and finally, on the outside wall of the plane, there are various thermometric instruments, which indicate the low temperatures of the stratosphere.

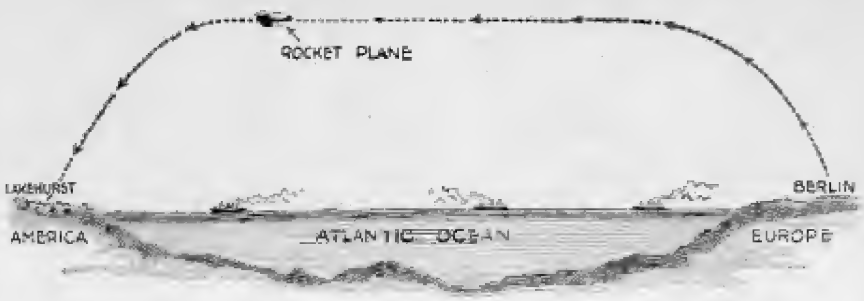


After the plane has gained altitude by using its propellers, the rockets are then discharged as shown.

It was 20 minutes to 13 o'clock before these explanations and the sight-seeing was over, and when we began to close our baggage, we found our "bath-tub" and drew the net like a mosquito screen over us and fastened it down with snap-hooks. It was 30 seconds before 13 o'clock, and the bell of the clock rang. After ten seconds, there was another ring, and then, my heart beating, I waited our start. 13 o'clock came, and the announcement "We're off" came through a loud speaker, and at once we heard the sound of a propeller driven by a compressed air turbine and felt that the machine was rising from the ground. We might have flown about three minutes, when the third clock bell rang; a tremendous noise began, and I was suddenly pressed backwards against my seat, with gigantic force. At first, the tremendous pressure affected me disagreeably, and I almost had to part with the "ponies" of cheering liquors which I had drunk before the start. The pulses of my blood beat in my ear, and I felt as if I were being overcome by a giant. The pressure, with which my body was pressed against the back, prevented my free breathing, sweat poured down my face, and the bunch of keys in my pocket pressed against me heavily. My clothes suddenly seemed too small, and my shirt seemed drawn tightly around my body. I tried to move my limbs; my arm, which I stretched out so as to get at my watch—for the few seconds which had passed seemed to me like hours—suddenly seemed to weigh 100 pounds. It was with the greatest effort that I managed to get at my time piece.

The Tempelhof aviation field in Berlin could be used for landing and take-off of the planes.

Unaccustomed to the excessive weight, I had taken too slight a grip on it, and it was jerked out of my hand, flew through the meshes of the net, dragged the watch chain through my button-holes and with threatening noise, struck the wall. Discouraged, I refrained from further attempts at moving, and resigned myself to my fate. Then I suddenly got a violent colic, I thought they were tearing the entrails out of my body, at least that was the way the thing seemed to me! I made the greatest efforts to take my troubles in a more philosophic way, and overcome them, when suddenly the noise of the rockets deafened me. If I had hitherto been pressed against the elastic net of my divan, now I flew like a tennis ball against the other side of my resting place. It seemed to me that I fell from a mountain into a deep canyon, and when I came into possession of my senses again, I found I was holding fast to the net with both hands. The plane seemed to be always falling and I waited with anxiety, every second, for the shock of our rocket chest falling on the surface of the waves of the Atlantic Ocean.

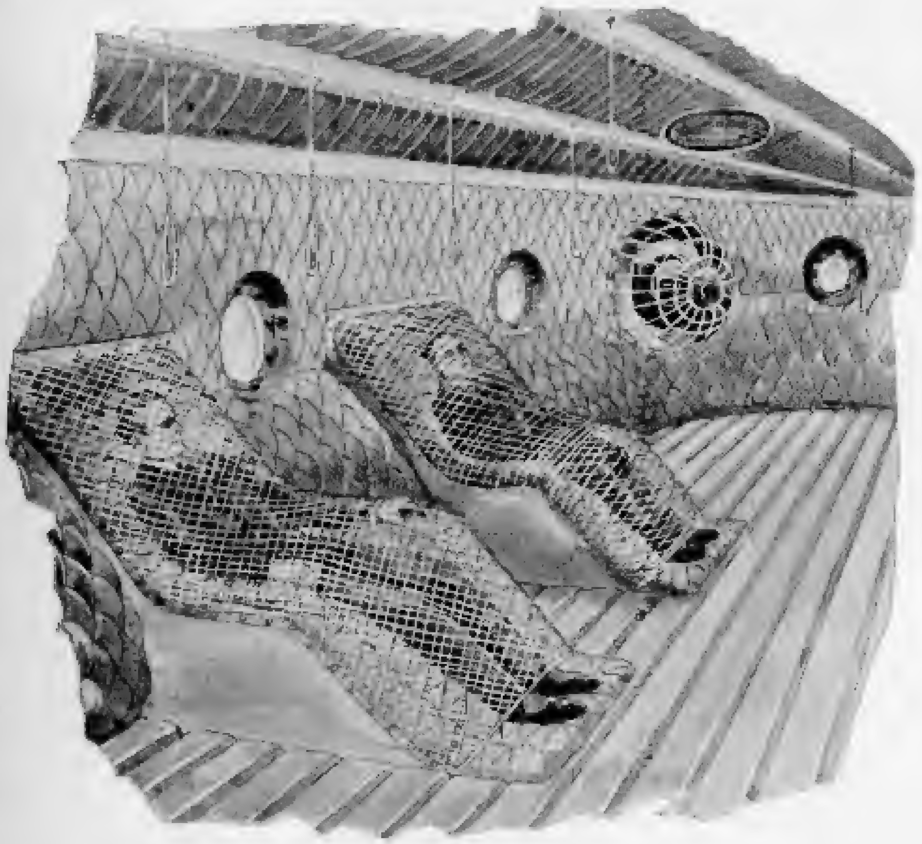


The path which the proposed rocket plane would take in its flight from Berlin to New York is shown above. It would rise by means of propellers and then be driven along a straight course by the rockets.

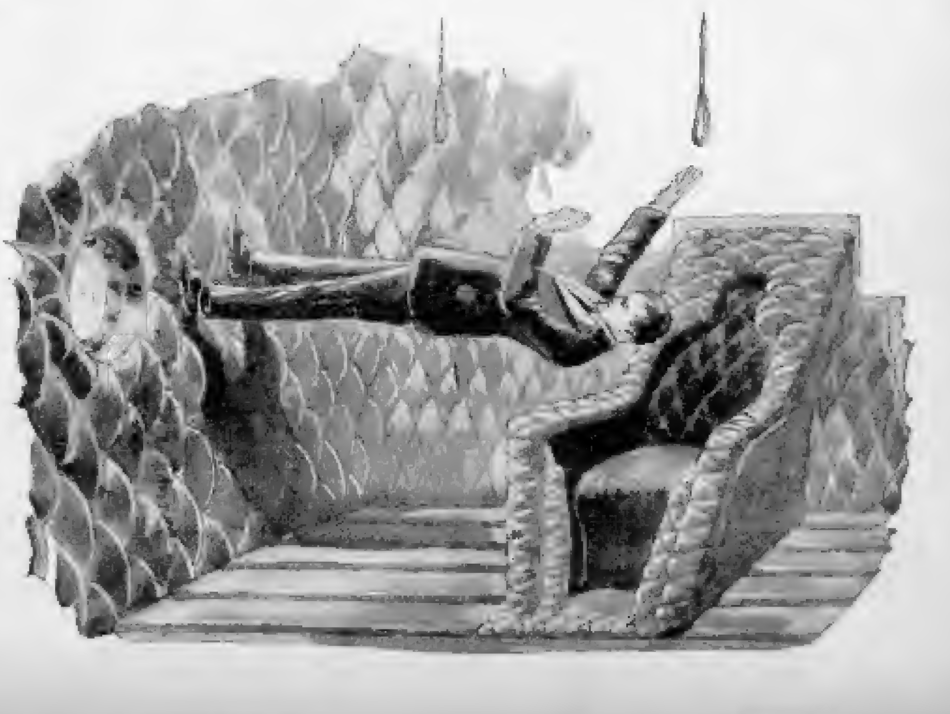
Then through the loud speaker came the voice of the captain, "Twenty minute period without weight! The passengers now can unhook their nets and move about in freedom. Do not let go of your hand straps so that you won't strike anything, and get injured in any way." It was a strange feeling of "weightlessness" not yet experienced that came over me, somewhat as if I had swum some time under water; I didn't know what was up and what was down. I became dizzy and the whole cabin semed to turn diagonally about me, so that I was in the condition of the victim of alcoholism, needing help to leave my bed and stand up. I unhooked my net hastily in order to walk upon the floor—I found that I swept through the space like a ghost. It is somewhat like what the spiritualists would represent the awakening after death to be. Then I suddenly saw the captain of the plane swim around me in the air like a skillful diver. He came directly to the cushions of my divan and helped me to grip one of the hand straps. His appearance brought again to my mind the physical laws of gravity-free condition—I had looked forward to this experience with the greatest curiosity—and now discomfort disappeared, and my interest was aroused.

While the pilot was busy trying to catch the pieces of my watch which were flying around in space, I "hung" myself to the cabin window. I had now returned to my senses, and I was amused at the comic aspect of my present experiences. While upon the side facing the earth the daylight came through the windows only as a dark glimmer, I now looked upon the globe of the sun with its streaming

(Continued on page 1184)



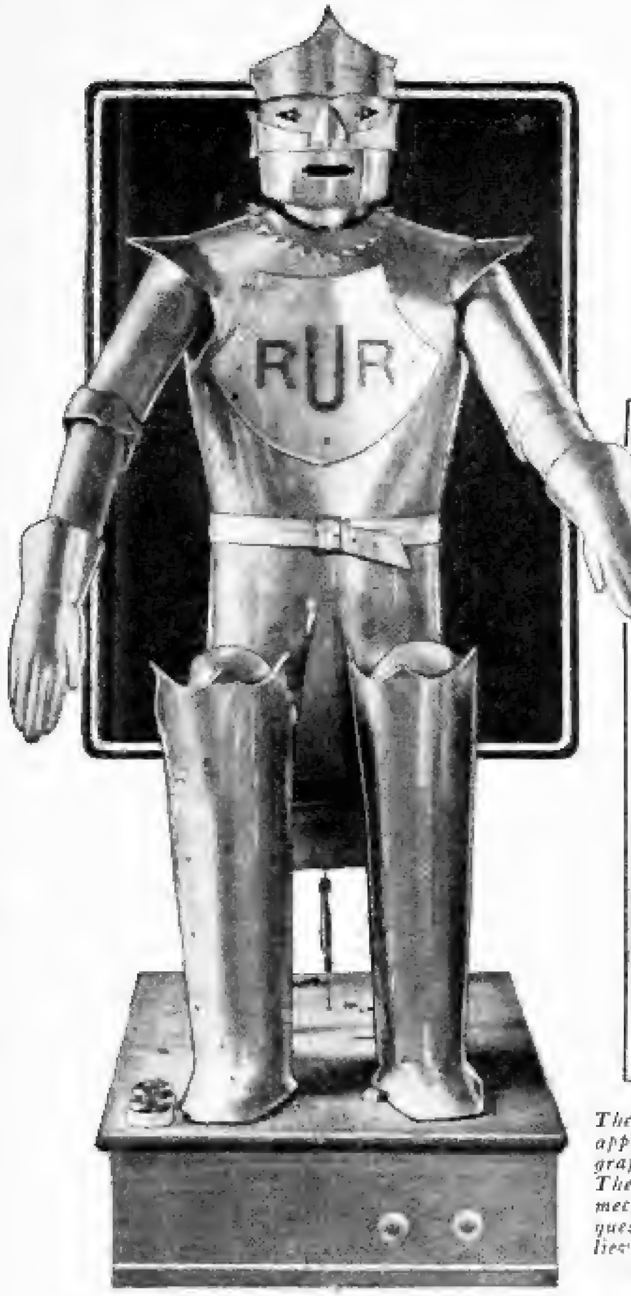
Special rubber-padded passenger compartments and chairs constructed to fit the body would be used, with a safety screen stretched over the passenger.



At the right we see the predicament of one of the passengers who has not obeyed orders and fastened himself in one of the safety seats. Due to the great speed, gravity has little influence upon the car occupants.

Science and Invention Offers a $300.00 Award

IS ROBOT GENUINE?

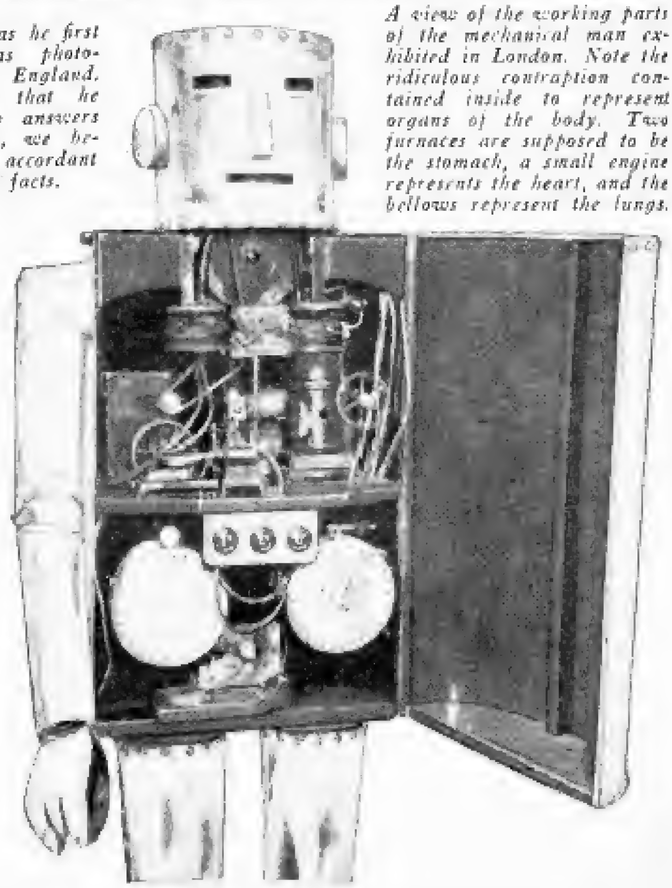


$300.00 AWARD

THIS magazine will pay $300.00 to any charitable organization mentioned by Captain William H. Richards, of London, the inventor of "Eric Robot," a six foot 140 pound metal-mechanical man, if the Robot will mechanically or electrically, correctly answer ten questions, even if he knows the answers thereof, and if the questions can be put to him by us in any order; on condition that no human agency is involved during the answering of these questions.

Captain Richards has claimed that Robot can answer hundreds of questions. It is the contention of this publication that Robot is operated by a human being concealed in or about the mechanical figure, and it is this human agency that answers the questions put to it, not any form of mechanical selecting mechanism.

The Robot as he first appeared as photographed in England. The claim that he mechanically answers questions is, we believe, not accordant with the facts.



A view of the working parts of the mechanical man exhibited in London. Note the ridiculous contraption contained inside to represent organs of the body. Two furnaces are supposed to be the stomach, a small engine represents the heart, and the bellows represent the lungs.

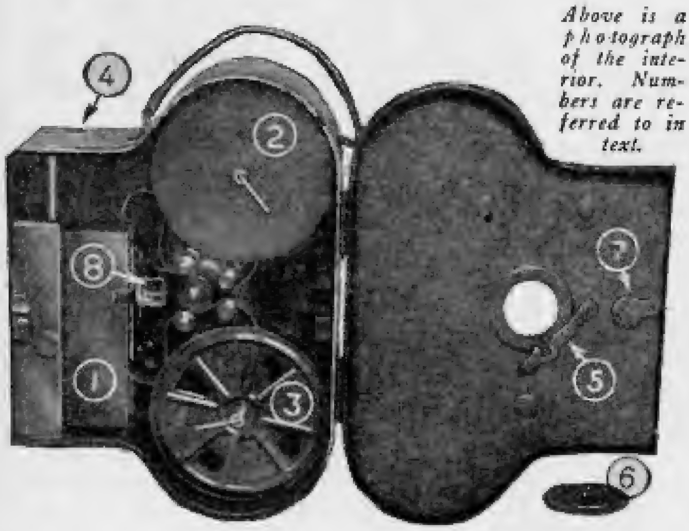
ON January 19th, the *New York Times* published an article on "Eric Robot," a mechanical man invented by Captain William H. Richards, of London. Quoting the *Times*—"Captain Richards explained that Eric was made of aluminum, copper, steel, wires, and dynamos, and moved by electricity. He said, while Eric required only 12 volts to move, he needed 35,000 volts to speak. . . . He denied that Eric is manipulated by anything outside his interior. . . ." Captain Richards said that, "he can answer hundreds of questions." In answer to questions from the audience, the Robot again and again told his age, counted to ten, and told the time.

Aside from the ridiculousness of the operating voltages necessary to make him speak, SCIENCE AND INVENTION distinctly questions the ability of the Robot to answer ten of the stipulated "hundreds of questions" in any order put to him, and to do so in a distinctly mechanical or electrical way. Repeated attempts to reach Captain Richards have been of no avail, but Mr. Lee Keedick, his press representative, has promised to invite us to the next demonstration of Robot's ability, which has not yet taken place.

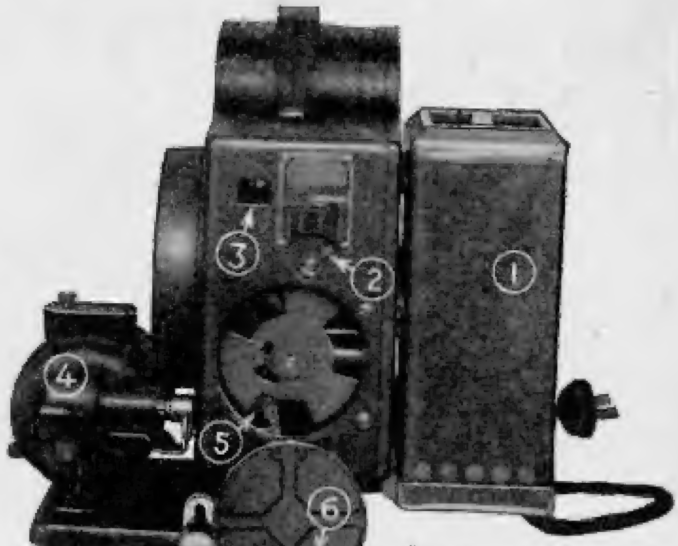
This magazine contends that human intelligence is responsible for giving the answers to the questions, perhaps through amplifiers, but human nevertheless. We therefore and herewith post $300.00 to back up our contention.

"Two in One" Instrument for Home Movie Fans

Same Instrument Can Now Be Used for the Taking and Projection of Amateur Moving Pictures



Above is a photograph of the interior. Numbers are referred to in text.



The camera arranged for projection with lamp house and motor, is shown here.

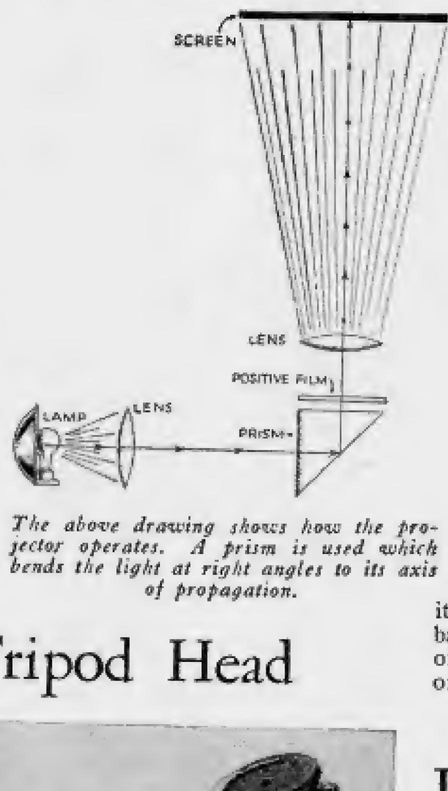
New Combination Camera *and* Projector

OF interest to those engaged in amateur moving pictures, is a new combination camera and projector which takes up little space, is readily portable and always convenient for immediate use. The carrying case is provided with compartments for all parts and equipment.

The Camera

THE camera operates by a spring motor or by an attachable hand crank. The latter is used for fast or single frame exposures. The lens of this instrument serves as both the camera and projection lens. No focusing is necessary, as it is of the fixed focused type. Both waist level and eye level view finders are provided and are gauged to cover the same field view as the lens. In the photograph of the interior, 1, shows the housing covering claw and feed mechanism, 2, feed reel, 3, takeup reel, 4, level finder, 5, lens compartment circle door, 6, light proof door disc, 7, door latch, 8, prism and prism bracket. Light proof spools with closed sides are used for the film when taking pictures.

Only one adjustment is necessary for three positions on the entire camera and projector optical system. These are the diaphragm stops and are used only when the instrument is employed for taking the pictures. One winding of the spring motor will run 25 feet of film. A large key is inserted in the right side of the instrument for rewinding the motor, after it becomes run down. A footage dial on the back of the camera tells exactly the number of feet of unexposed and the number of feet of exposed film.

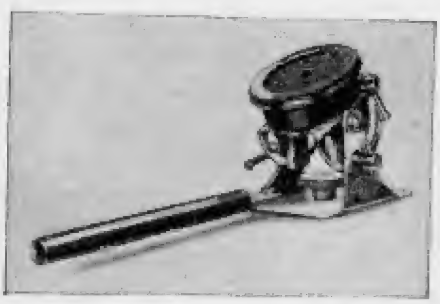


The above drawing shows how the projector operates. A prism is used which bends the light at right angles to its axis of propagation.

Projector

IN order to convert the camera into a projector, the front of the circle door is opened and the camera shutter removed. The projector shutter is then inserted in its place. In order to connect the lamphouse, the light proof disc is removed and the key slots at the upper section and a snap slot at the lower section of the camera door permit installing the lamphouse in a rigid position which guarantees alignment of the optical system between the lamp, lamphouse, condenser and prism, in the camera. The projector operates by a hand crank or an electric motor of the universal type. The photograph at the top of the page shows the instrument arranged as a projector with 1 designating the lamphouse, 2, the lens diaphragm indicator, 3, front view finder, 4, electric motor, 5, projector shutter, 6, lens compartment circle door. After the film has been projected, it is rewound on the upper reel spindle, using the camera hand crank.

All Motion Tripod Head



SHOWN in the above photograph is an all motion tripod head usable with all types of amateur moving picture cameras. The illustration at the left shows the flexibility of this type of mounting. Any camera angle can be obtained and the tripod head locked in position if desired. A handle is provided for quick and easy adjustment with thumb nuts for locking in position. The mounting of the camera upon the head is effected by means of a machine screw placed through its top.

Names and addresses of manufacturers on request.


WRNY W2XAL
May
25 Cents
Science and Invention
Man-Carrying Gliders
By Augustus Post
Origin of Man
By Dr. Aleš Hrdlička
Einstein's New Theory
By Prof. H. H. Sheldon
HILLIKER
The SPIRIT of ELECTRICITY
EXPERIMENTER PUBLISHING COMPANY, 230 FIFTH AVENUE, NEW YORK

Landing Platform for Planes Equipped with Thomas Air and Water Turbines Produces Electrical Energy for Lights and Radio Station

The above illustration shows a proposed ocean landing platform for airplanes. The wind turbines may be seen. *A top view and a side view showing the construction of the generator turbines appear in the insets.*

MID-OCEAN AIRPLANE STATION GENERATES OWN POWER

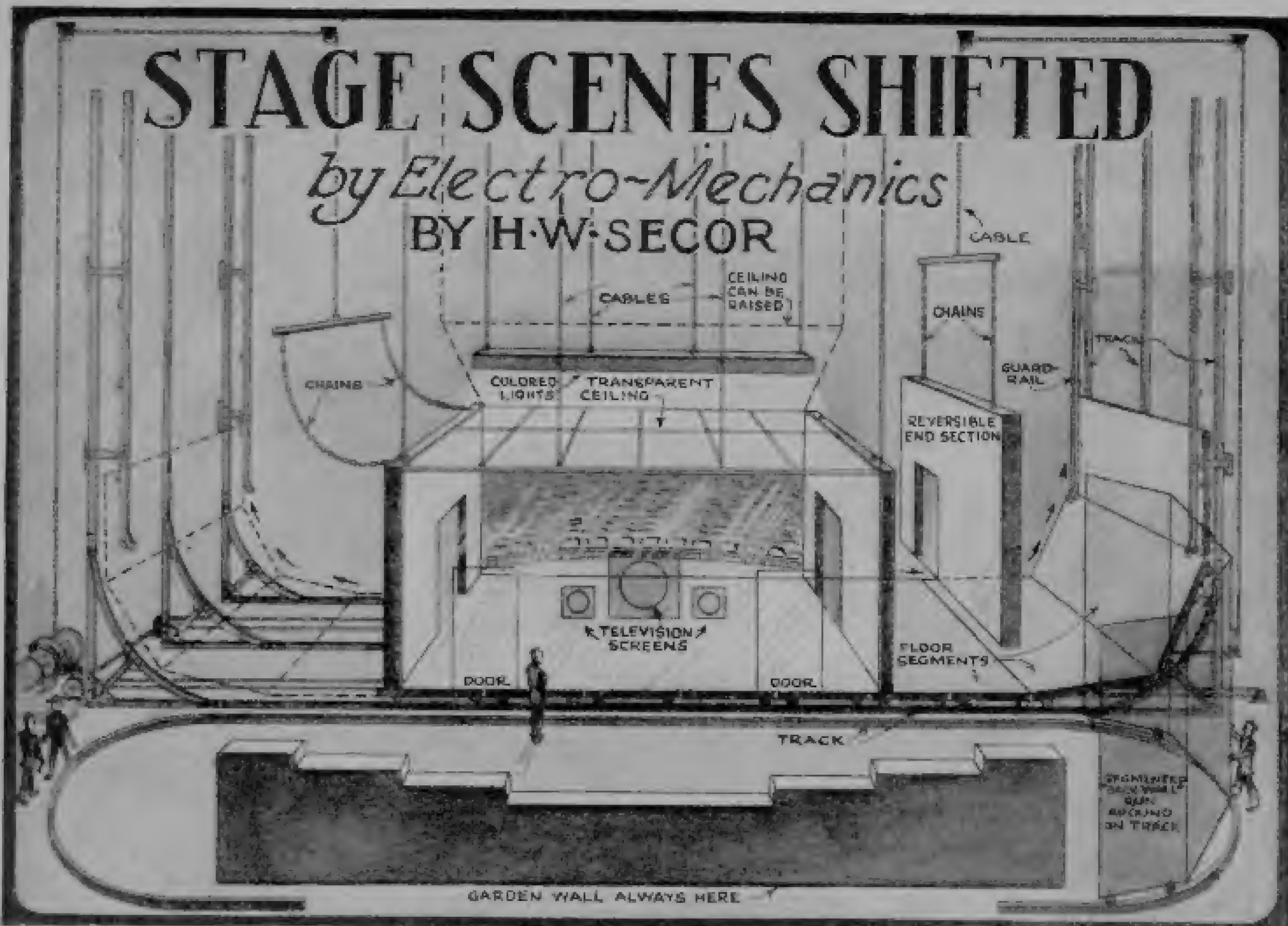
THE invention of the Thomas wind and water turbine opens up a new field for the development of natural power. Boats equipped with these turbines are enabled to generate their own power, resulting in a saving of money, besides simplifying the installation of propelling mediums. The same turbines can be used on land for generating electrictiy at an extremely low cost.

A mid-ocean landing platform for aircraft using the new invention has been proposed by the French magazine *La Science et La Vie*. This seadrome is shown in the illustration and generates its own electric power for operating the searchlights, landing lights and the radio station, which may be seen on the left-hand section of this peculiarly shaped floating haven for aircraft. The land planes will alight on and take off from the largest section of the "U" shaped float. The water enclosed by the floating airdrome provides a harbor for the seaplanes. Life boats are arranged at intervals along the landing platform and the interior provides ample housing space for mechanics, gasoline, water and spare parts. Trans-oceanic planes will refuel and make repairs at the mid-ocean platform. Passengers and mail could also be transferred from one plane to another. By means of powerful searchlights and neon beacons, the platform will be visible to aviators even in the most foggy weather, and will offer a haven where they can repair until storms have abated. For shelter, the planes could be lowered into the interior of the platform, or suitable hangars could be arranged upon the upper deck.

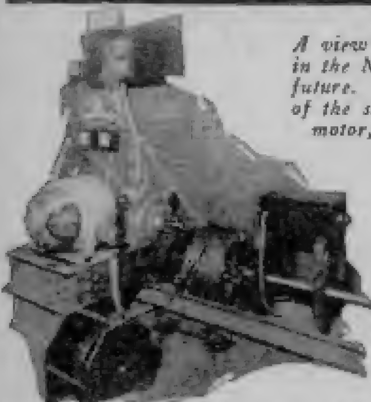
The construction of the Thomas turbine which makes this mid-ocean landing stage possible is shown in the smaller illustrations. A vertical shaft is fixed in the center of a rigid frame which can be of steel or reinforced concrete. This shaft carries two rectangular frames whose horizontal arms are fastened to the shaft by means of sleeves. The vertical members of these rectangles are formed by tubes which can turn on their own centers. Each of these tubes carries a wing or sail which is free to turn in or outside of the frame. The extent of motion is limited by two springs, R and R_1. Both are attached to the lower sleeve of the main shaft, prolonged by two cables which pass over two pulleys on the upper sleeve which carry them to the two extensions of a sort of lever arm, the latter fastened to the vertical tube which carries the sail or wing.

When the wing occupies position A, the impulse due to the current which may be wind or flowing water is at its maximum. The spring R is completely stretched while the spring R_1 is completely slacked. This position is brought about by the maximum tension of the spring R_1, so that the angle made by the sail and lever arm has a fixed value. At this instant, the opposite arm A_3 has a position sensibly parallel with the current. Each sail works through an arc of 270 degrees, so that there is only 90 degrees of useless rotation and, as the turbine carries at least two sails, forming an angle between them of 280 degrees, there is a constant force exerted, whatever the wind direction.

STAGE SCENES SHIFTED
by Electro-Mechanics
BY H. W. SECOR



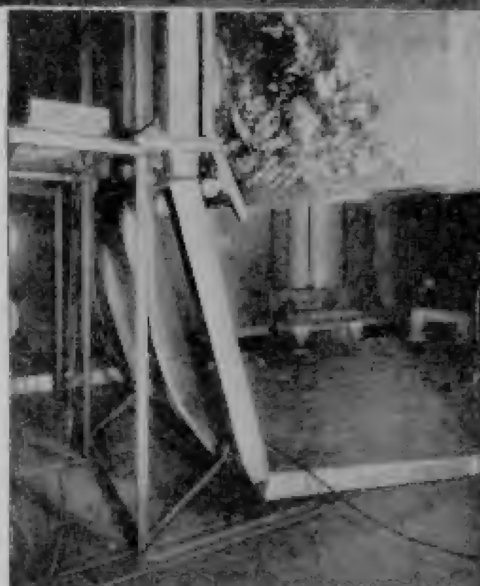
A view from back of stage, looking toward the auditorium, in the New York production of "Tomorrow," a play of the future. The jointed floor rolls up the tracks at either side of the stage, as the room scene changes. A single electric motor, by means of cables, causes the scenes to move as indicated.



"Tomorrow"—A Remarkable New York Theatrical Production, in which the Scenery Was Shifted by Operating a Single Electric Switch

ONE of the most refreshing productions seen in New York City in a long time was the show *Tomorrow*. This play *Tomorrow* proceeded to show how we will live 50 years from now. To open a door, order a meal, and to accomplish dozens of other things, one has simply to speak a certain code number to a radio transmitter disk worn on the wrist. Fifty to seventy-five years from now, we may live in such a perfect Utopia, where we shall summon a servant or order the family helicopter, by giving voice to our desire through the medium of a certain pre arranged number or code word. At the present time we have a number of sound-operated telemechanisms, for instance the voice-operated toy dog, which comes out of his kennel when the command "come out" is spoken. Then we have the famous *televox*, which executes a considerable number of commands by means of certain sounds sent over the telephone line, and toy railroads, several years ago, were started and stopped by a special voice-control relay.

Photo above, at left, shows control switch and speed regulator, together with motor and cable winding drum for changing scenes. Scene below at left shows arrangement of tracks up which the jointed floor rolls. The back scene moves on wheels along the track shown.



Above, we see the close-up view of curved vertical track with jointed floor being pulled up along the track. One of the room end scenes is to be seen rising simultaneously.

In one of the scenes, a pair of hands are observed playing on a piano keyboard in a vertical position through a "television" window. How this mystical scene is staged is clearly shown above. Scene at right shows how face is made to grow larger in "television" screen.

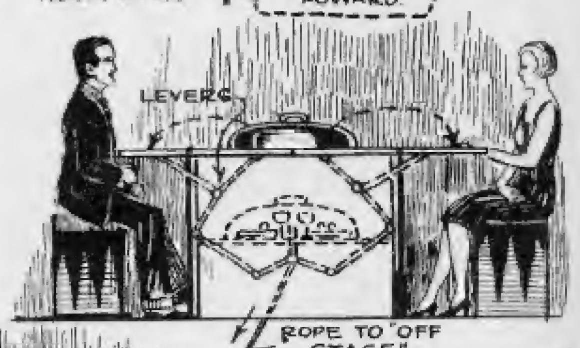
Elaborate helicopter flying machine used in "Tomorrow." It cost $4,000.

The flying machines shown in the play *Tomorrow* were quite elaborate affairs and one of them is illustrated herewith. The larger of the two models appearing in the play cost about $4,000 and is fitted with electric lights, while the tail and roof propellers were driven by electric motors. A brand new arrangement of the stage scenery was worked out and produced under the direction of Mr. John Ashley, and the general idea behind his scheme for progressively changing the scenes is made apparent by a study of the illustrations here presented. The audience had the unusual experience of seeing the actors walking from one room to the next, through a door, while room No. 1 was disappearing off the left of the stage and room No. 2 was coming onto the stage.

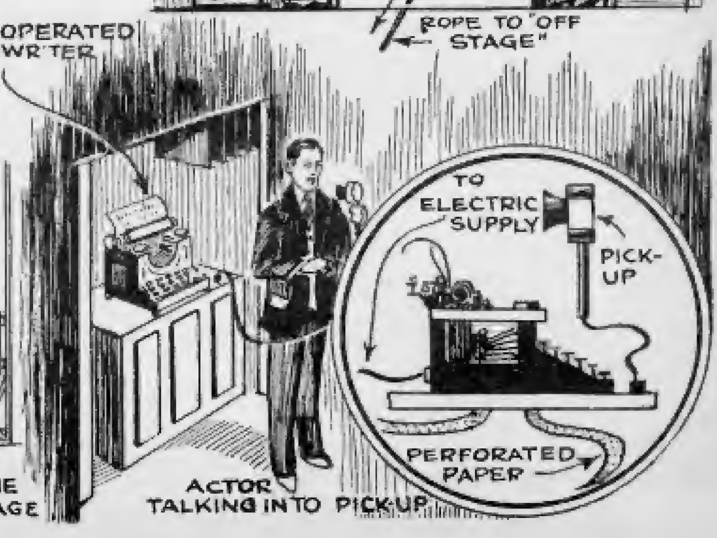
Jointed Floor Curls Up

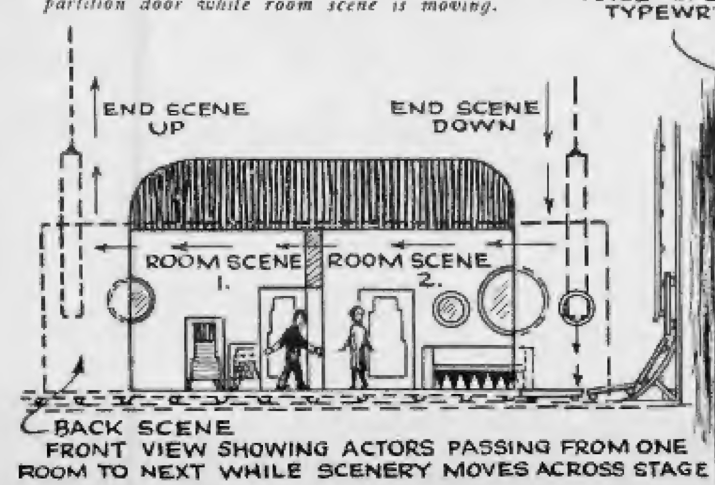
THE long jointed floor rolled along on rubber-tired wheels in grooved steel tracks, the movable floor being pulled by cables secured to a motor-driven drum, the motor being controlled by a single reversing switch and a speed controller, shown in one of the pictures. While the floor sections roll along and up the vertical tracks, at either side of the stage, the corresponding end wall of the room is automatically pulled upward about twelve feet to allow the actors room to pass under it. The *rear wall* scenes, as the illustrations clearly show, move along the curved stage floor tracks.

(*Continued on page 67*)



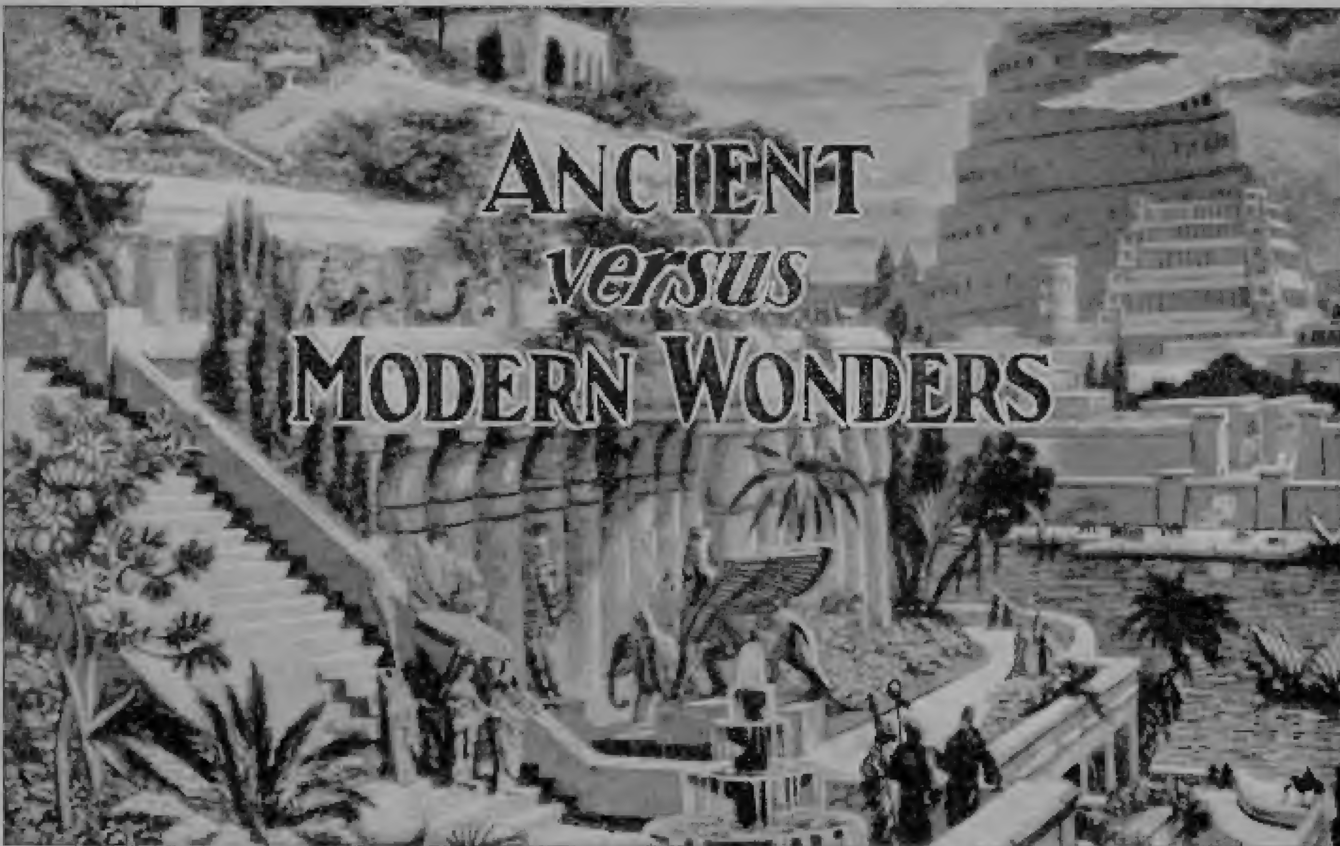
Pictures at right show how meal is served at word of command, and how letter is written by a "voice" operated typewriter. Below, how actors walk through partition door while room scene is moving.



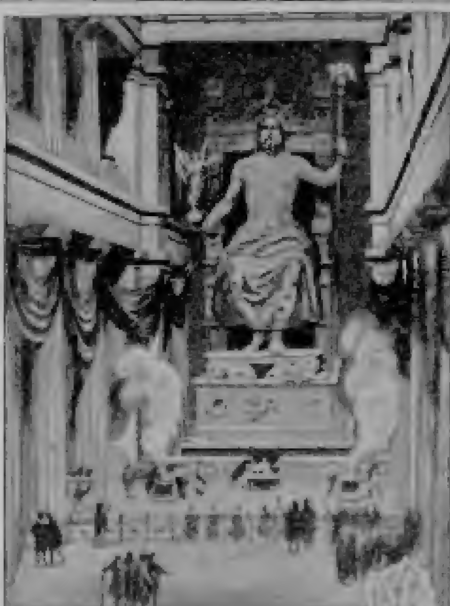


FRONT VIEW SHOWING ACTORS PASSING FROM ONE ROOM TO NEXT WHILE SCENERY MOVES ACROSS STAGE

ANCIENT *versus* MODERN WONDERS



This illustration shows one of the seven wonders of the ancient world. Built according to tradition by King Nebuchadnezzar to please his homesick wife, Amytis, the beautiful hanging gardens of Babylon became one of the world's show places, and their reputation has been brought down through history. The Tower of Babel is seen at the right.



At the left the Gold and Ivory Monument, 60 feet high, known as the Statue of Zeus, in the Temple of Olympia.

Right—The Pharos Lighthouse erected by Ptolemy on the rocky island, Pharos, off the Mediterranean coast. The base of this lighthouse was 100 feet square.

Below—the Mausoleum of Halicarnassus, reconstructed by an artist from the best drawings and photographs available.

On these two pages are shown the artist's conceptions drawn from the best information or recognized drawings available, of the world's Seven Ancient Wonders.

Photos—Ewing Galloway

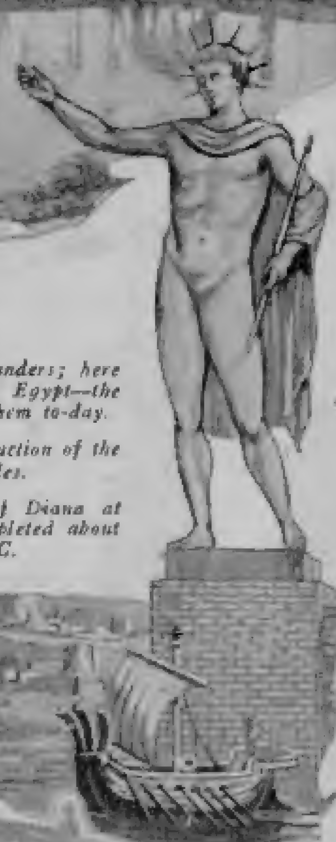
SEVEN WONDERS OF THE WORLD

THERE are two lists of the seven wonders of the world, which differ from each other but slightly. The first is known as Antipater's list, which calls for the Walls of Babylon, the Statue of Zeus at Olympia, the Hanging Gardens at Babylon, the Colossus of Rhodes, the Pyramids of Egypt, the Mausoleum of Halicarnassus and the Temple of Artemis (Temple of Diana). The second list, illustrated here, combines the Walls and Hanging Gardens as one, and adds the Pharos of Alexandria.

AS mentioned in the blurb on the left-hand side of this page, two lists of the seven wonders of the world are recognized. The first, known as Antipater's list, differs but slightly from the second, in that it combines the Walls and the Hanging Gardens of Babylon under one classification and adds the Pharos of Alexandria as the seventh wonder. For purposes of illustration, the best available data has been used by the artist for the foundation of the drawings which appear on this page. This data was culled from books, sketches, and written descriptions made by those who are considered authorities on these subjects of antiquity.

At first it was thought advisable to limit the modern wonders to only seven, but that was

By
JOSEPH H. KRAUS



Above—Other ancient wonders; here we see the Pyramids of Egypt—the world still marvels at them to-day.

At the right is a reconstruction of the Colossus of Rhodes.

Below is the Temple of Diana at Ephesus, which was completed about the year 400 B.C.

impossible. The list grew, until there were so many topics included that it would have taken this entire magazine to illustrate the modern wonders, but that is getting a little ahead of the story.

By way of further description, we shall add a few lines about each of the seven wonders of the ancient world, and then compare them, indirectly, with the wonders of the modern age by describing these.

Hanging Gardens and Walls of Babylon

ON these pages we have listed the seven ancient wonders. The first one indicated is the Hanging Gardens and the Walls of Babylon. According to tradition, these were built by King Nebuchadnezzar to please his home-sick wife, Amytis. Tradition further states that Amytis was from the hill country. The flat country around Babylon bored her, and apparently "got on her nerves." In order to please her, and to make her satisfied with the country of her adoption, the king had these elaborately terraced gardens constructed, to give her the "hill" effect. The terraces were built up to a height of 300 feet, and were beautifully planted with trees and flowers. Frequent fountains and dining halls were distributed through the gardens. Irrigation was accomplished by pumping water from the Euphrates River, seen in the background. On the other side of the Euphrates, if one will refer to the illustration, one will see the Tower of Babel.

As we proceed with these

(*Continued on next page*)

ANCIENT *versus* MODERN WONDERS

We surely must include modern engineering among the modern wonders. Here is a view of the skyline of New York. It shows also the advance of modern transportation in the form of both a plane and dirigible.

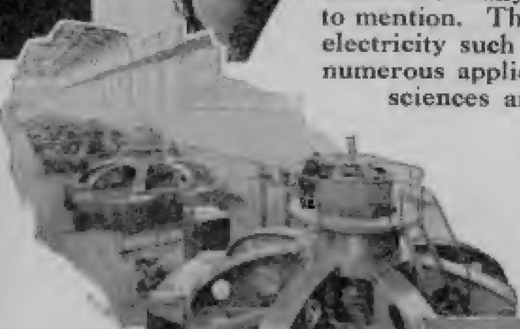
The modern horseless carriage, a high-powered automobile has brought us in closer contact with our country.
Photo—Rolls-Royce Co.

Radium—one of the world's modern wonders. The photograph below shows the apparatus employed for securing emanations for medical treatments.
Photo—U. S. Radium Corp.

Modern transportation in the form of a large steamship is a modern wonder.
E. W. Photo.

On these two pages, some of the modern wonders are illustrated. There are many others too numerous to mention. The various branches of electricity such as lighting and other numerous applications, and the many sciences are not recorded.
Photo—Ewing Galloway.

Modern rail transportation. This shows a tug-of-war between two steam locomotives and an electric engine. Electricity won.
Photo—General Electric Co.



A modern hydro-electric power plant. The generators can be seen extending down the building nearly as far as the eye can follow.
General Electric Co. Photo.

X-rays are included in this general grouping. This photograph shows one of the largest X-ray apparatus ever built.
General Electric Co. Photo.

seven wonders, we will find that the majority of them were considered such because of architectural beauty. In this modern age of science, architecture does not hold the same universal appeal which it did then, yet there is no doubt but that any one of our skyscrapers would by far surpass the most marvelous production of the ancient days.

The Statue of Zeus

MYTHOLOGY tells us that Zeus surveyed the doings of Gods and men. When wrathful, he would hurl his thunderbolts. He was supposed to have had his throne on the summit of

We cannot conceive of a group of modern wonders without including therein a mention of the Panama Canal. Were it not for sanitary engineering, this canal would probably never have been built.
Photo—Ewing Galloway.

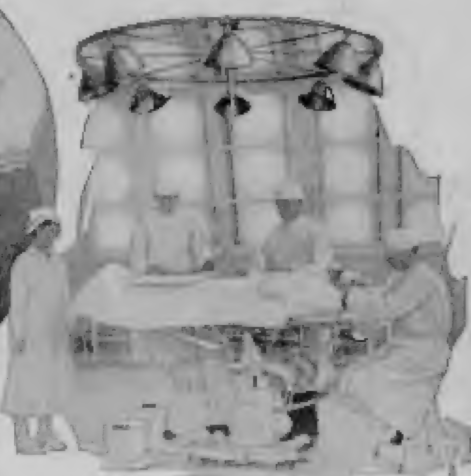
At the left, the modern wireless transmission plant. Radio is a relatively new art, and perhaps aside from television, it is one of our most recent of sciences. In a short time it has attained world-wide popularity.
Photo—Ewing Galloway.

Television—This science is in its infancy in so far as its radio connection is concerned. We dare say that within a few years we will be able to see and talk to anyone who has a pocket radio transmitter and receiver.

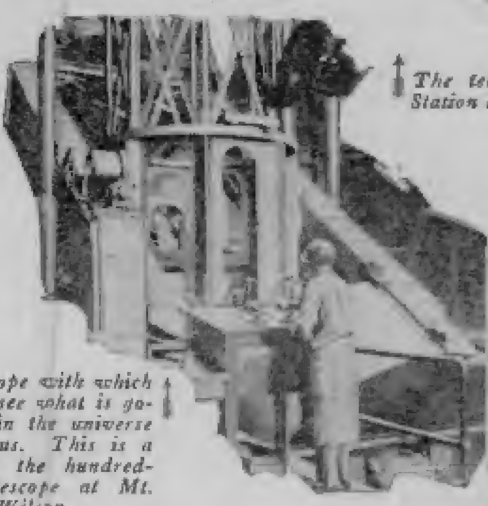
Mt. Olympus. The artist has reconstructed this Statue of Zeus which was 60 feet high in the original. It was made of gold and ivory, and was executed by the Sculptor Phidias, considered to be the supreme among ancient sculptors. Zeus was the Jupiter of Greek mythology. He was the King of Heaven and had complete sovereignty over countries and men.

(Continued on page 84)

The television apparatus installed at Station WRNY. This shows the receiver.



Diagonally at the right we have an interior view in a floating hospital. What would modern surgery be (another modern wonder) without the aid of anesthesia.



A telescope with which we can see what is going on in the universe around us. This is a view of the hundred-inch telescope at Mt. Wilson.

Here is a television transmitter located at Station WRNY in New York. The person sitting at the transmitter is having his living "moving" image broadcast by means of electrical impulses, which are unscrambled at the receiving end.

Should we not include modern chemistry, the microscope, and bacteriology among the modern wonders? This photo shows a well-equipped laboratory.

July

25 Cents

Science and Invention

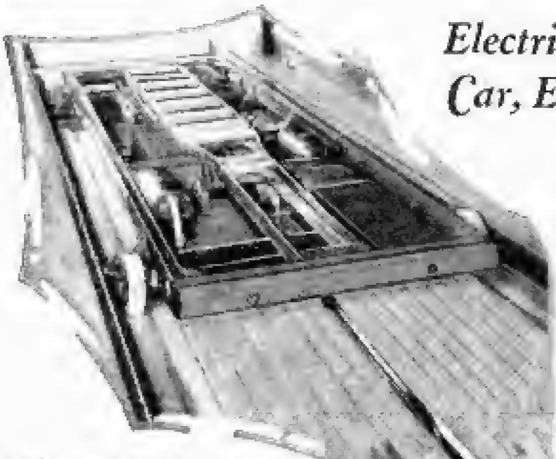
ARTHUR H. LYNCH Editorial Director

Is a College Education Worth While?
by WALTER P. CHRYSLER

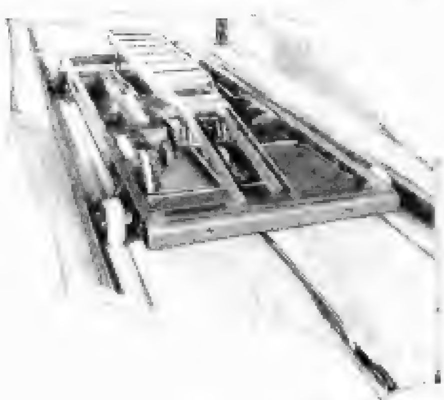
How I Broke the Women's Airplane Endurance Record
by ELINOR SMITH

Electric Parker Runs Beneath Car, Engages It, and Hauls It Away

Automatic Garage



This photograph shows the automatic parker which runs beneath your car to haul it on or off elevator



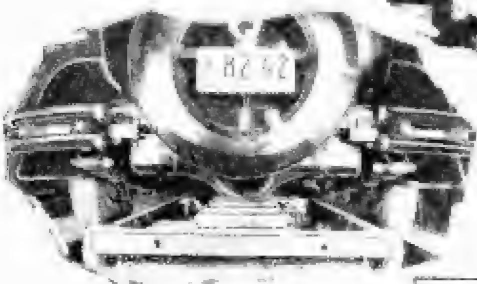
A motor operates the rack, lifting it up and engaging it with the differential housing

IN New York City there is a garage known as the Kent Automatic Garage, wherein you leave your car, head on, with motor stopped and doors locked, in front of an elevator door, and receive a claim check. When you call for it, you present your claim check at the cashier's office, and in less than two minutes from the time you deliver your claim check your car is waiting for you, even though it may have been parked all day on the twentieth floor of the building. Here the cars are handled entirely by electricity.

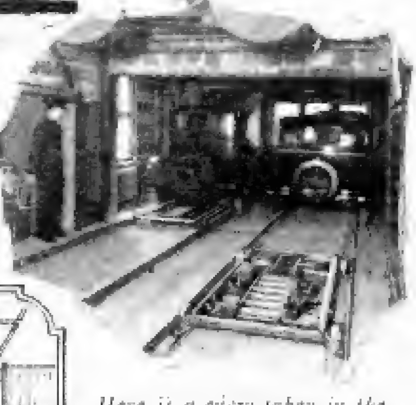
An electric parker, a low, rubber-tired towing unit runs beneath your car, engages the rear axle, pulls the car on the elevator and then out again on the floor, where space for it has been allotted. The instant that you present your claim check at the cashier's desk, a telautograph notifies the elevator operator where your car is. By the time this has finished writing, he has arrived at the floor. The doors of the elevator automatically open, the parker runs out under the car, tows it on the elevator, which in turn carries it down to the ground floor, and delivers it ready to drive away. Two cars can be handled by each elevator at one time.

(Continued on page 263)

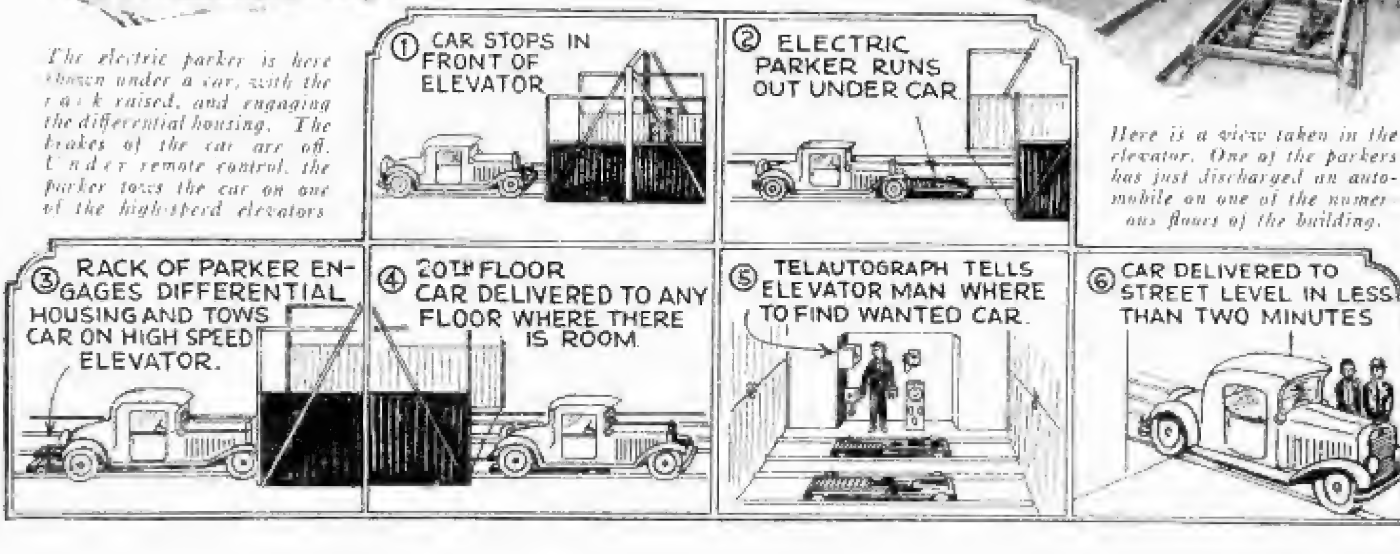
Above: The layout of the thousand-car garage. Below: How the system operates. The motorist stops his car at the elevator. The elevator man sends out the parker, which tows the car on the elevator and pulls it out on the floor allotted to it. See story for further details.



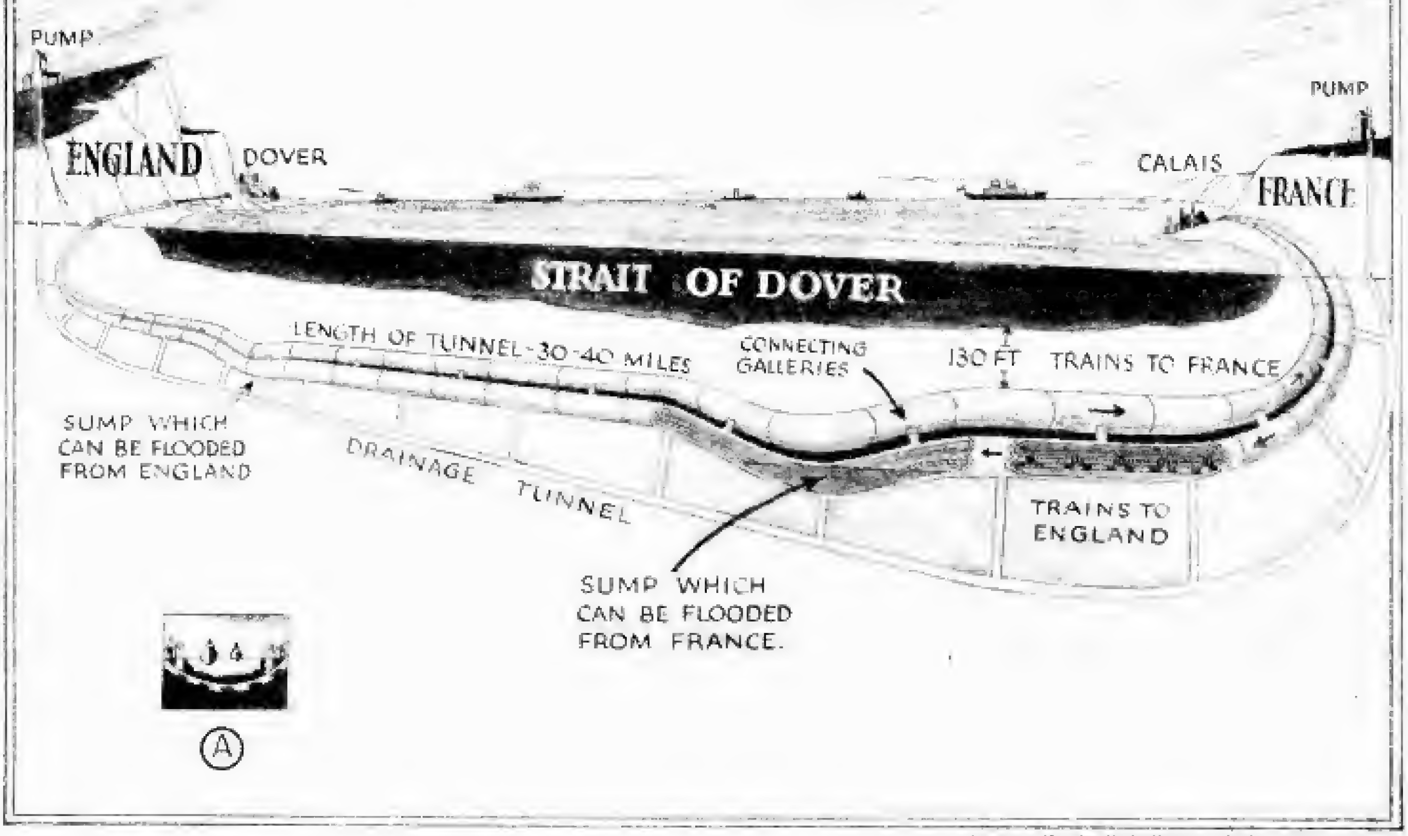
The electric parker is here shown under a car, with the rack raised, and engaging the differential housing. The brakes of the car are off. Under remote control, the parker tows the car on one of the high-speed elevators



Here is a view taken in the elevator. One of the parkers has just discharged an automobile on one of the numerous floors of the building.



TUBE OR BRIDGE FOR



Courtesy "London Daily Mail" Redrawn by our artist

The above illustration shows the tube under the Strait of Dover. Longest present-day all-under-water tube shown at A.

A Channel Tunnel or a Bridge to Join France and England and a Tube to Connect Africa with Europe

TWO monumental ideas have been advanced for connecting France and England. The first proposes the building of a tunnel under the Strait of Dover and the second proposes a bridge across the English Channel. A tunnel or tube under the Strait of Dover would have to be 30 to 40 miles long, which is a far greater length than has ever been tunneled before. It is the intention to locate the English entrance in the hollow known as Winless Downs, under the western heights of Dover. From this place the tunnel would sink in a wide curve, straightening out to pass under the channel beneath the western end of Shakespeare Cliff. On the French side it has been planned to leave the main Paris-Calais line at Marquise, halfway between Boulogne and Calais, and to carry the approach line to Wissant on the coast.

The illustration given here shows a section of the proposed channel tunnel. The present plan calls for two tubes, with connecting galleries and sumps so that the tunnel could be flooded in time of war.

Bridge

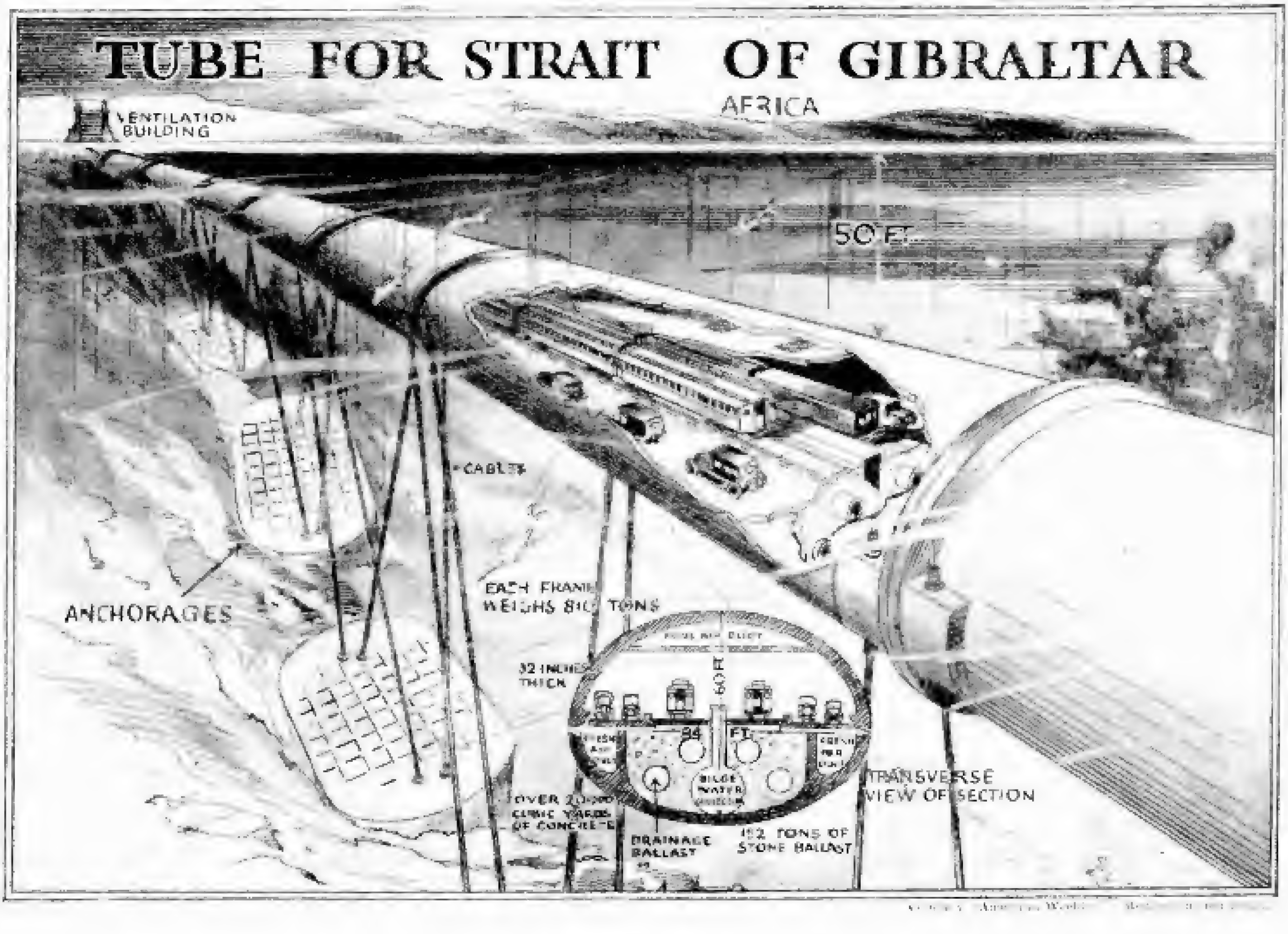
THE bridge proposal is more daring and necessitates the creation of two artificial islands upon sand bars. The total cost of this project would amount roughly to $410,000,000. This would be met by the sale of land on the islands constructed from the sand bars which now are situated at a point 9.6 miles off the coast at Cape Gris Nez. The illustration shows the approximate size of the islands when completed. The first island would be 9.6 miles long and the second 4½ miles long. It is claimed that the depth of the channel is not too great to make the construction practical.

Anchored Tunnel for Africa

THE joining of Europe to Africa by a tube across the Strait of Gibraltar is now being seriously considered. The cost is estimated at about $60,000,000, which is trifling enough, considering the results such a tunnel would achieve.

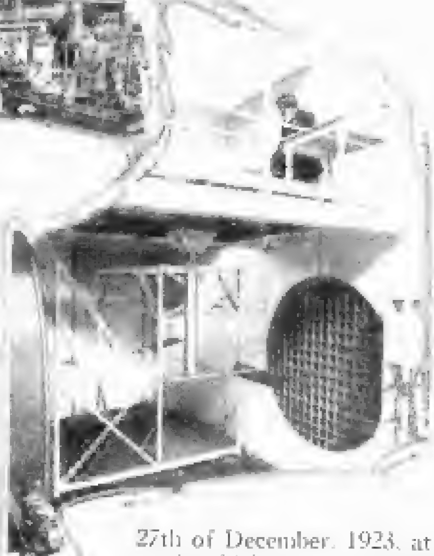
The scheme is in accordance with up-to-date engineering methods. An elliptical tube would be laid diagonally across the strait at a depth of 50 ft. below the surface of the water. This avoids the difficulty of laying a tunnel beneath the bottom of the strait, which in some places is 3,000 ft. deep. The Gibraltar tunnel design comprises steel sections, each 650 ft. in length with a width of about 84 ft. and a height of 60 ft. The entire structure will consist of 75 of these elliptical cylinders. The designer estimates that there will be a flotation force of 80 tons for each linear three feet. Each individual section floated to position and sunk will be anchored to the bottom by means of heavy steel, rust-proof cables. The cables will be attached to huge anchorages of reinforced concrete, each of which will displace 10,000 tons of water while afloat. It is calculated that the cables will not stretch more than 10 inches under the pull of buoyancy and the influence of the currents. The completed tube will be nine miles long and will contain two railroad tracks and four roadbeds for vehicles. The approach to the tube is designed to be nearly 1¼ miles in length with a 2 per cent grade. It is estimated that by 1935 the tunnel could be ready for traffic.


FRANCE
ENGLISH CHANNEL··WHICH?
ENGLISH
CHANNEL
96 MI.
84 MI.
42 MI.
42 MI.
6 MI.
9.6 MI.
LONGEST PRESENT SUSPENSION BRIDGE
HOTELS, SUMMER RESORTS, ETC.
ENGLAND

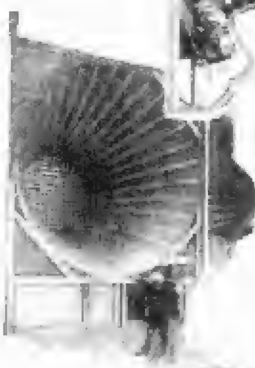

TUBE FOR STRAIT OF GIBRALTAR
VENTILATION BUILDING
AFRICA
50 FT.
CABLES
ANCHORAGES
EACH FRAME WEIGHS 810 TONS
32 INCHES THICK
60 FT.
84 FT.
TRANSVERSE VIEW OF SECTION
OVER 20,000 CUBIC YARDS OF CONCRETE
DRAINAGE BALLAST
152 TONS OF STONE BALLAST

Alexandre Gustave Eiffel *and the* Eiffel Tower

Eiffel was the first one to use the style of bridge construction indicated in the photograph here. This photograph is from the original files and was taken in April, 1887.



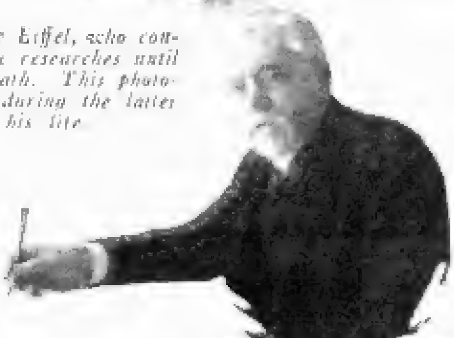
A view in the experimental laboratory of M. Eiffel. This shows the room containing the wind tunnel with an air-foil surface directed against the wind and the pressure on the surface being measured by him on the platform above.



A rare photograph taken in the laboratory where he measured the efficiency of propellers. This shows Eiffel at one end of his wind tunnel.

ALEXANDRE GUSTAVE EIFFEL, the eminent French engineer, was born at Dijon, December 15, 1832, and died on the 27th of December, 1923, at the age of 91, after a magnificent life's work which brought him world fame. Although Gustave Eiffel is noted more because of the famous Eiffel Tower, one of the great wonders in engineering which was erected by him, his work in other fields has been as monumental. In 1858 he constructed the Iron Bridge over the Garonne at Bordeaux, and later the lofty and graceful bridge over the Douro at Aporto. The viaducts of Garabit and of Montluçon were also built by him.

How many of us know that it was this same genius who built the framework for Bartholdi's statue of "Liberty Enlightening the World," which welcomes those coming into New York harbor? Thereafter the Eiffel Tower was built by him, and at its completion he was made an officer of the famous Legion of Honor.

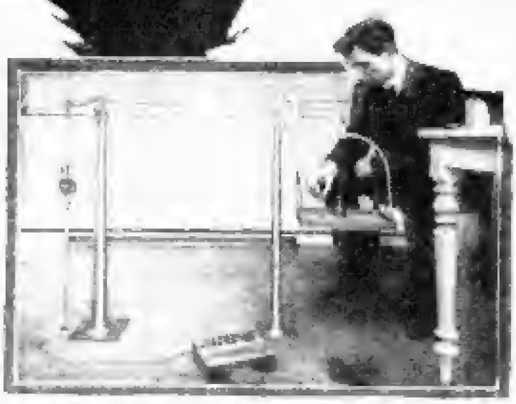


Alexandre Gustave Eiffel, who continued his scientific researches until the time of his death. This photograph was taken during the latter years of his life.

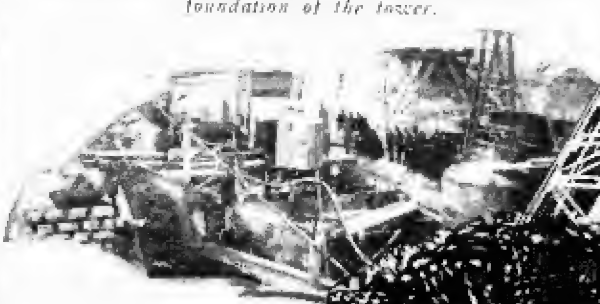
Eiffel's Memory to Be Honored

ON the 29th of April the city of Paris honored the memory of Gustave Eiffel by erecting a bust of the builder of the tower on a huge pedestal of granite masonry. This monument was placed at the foot of the north pillar of the tower.

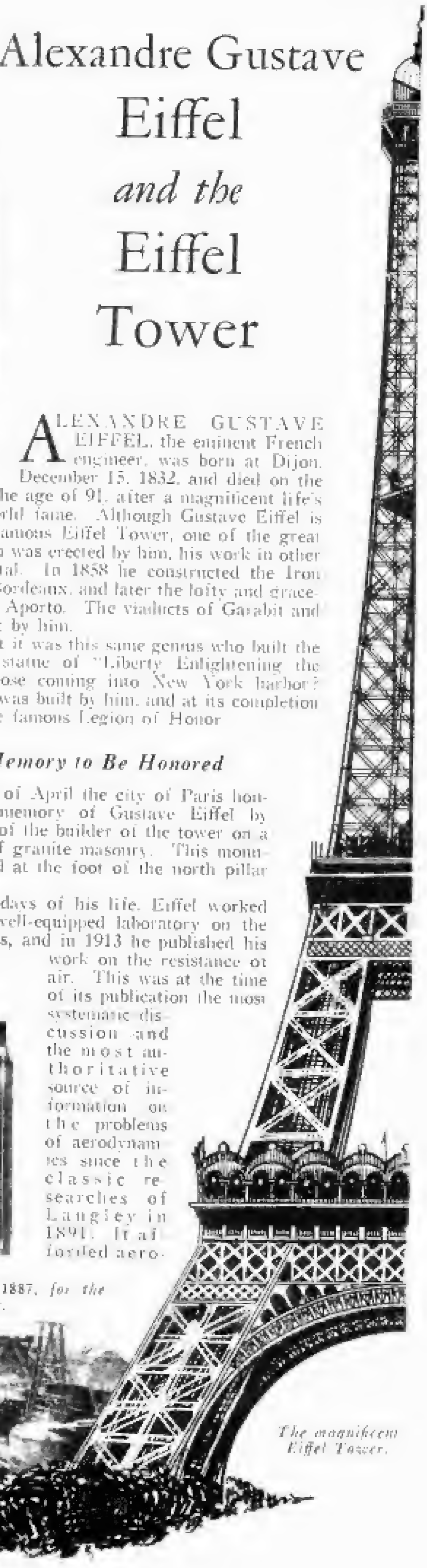
In the latter days of his life, Eiffel worked tirelessly in a well-equipped laboratory on the Champs de Mars, and in 1913 he published his work on the resistance of air. This was at the time of its publication the most systematic discussion and the most authoritative source of information on the problems of aerodynamics since the classic researches of Langley in 1891. It afforded aero-



Here Gustave Eiffel is seen at the age of 26 at work with his aerodynamic balancer, which he invented. This balancer assists in the calculation to a small fraction of a pound of the pressure against an air-foil surface mounted on another portion of the apparatus and acted on by the wind.



Sinking the huge caissons in May, 1887, for the foundation of the tower.



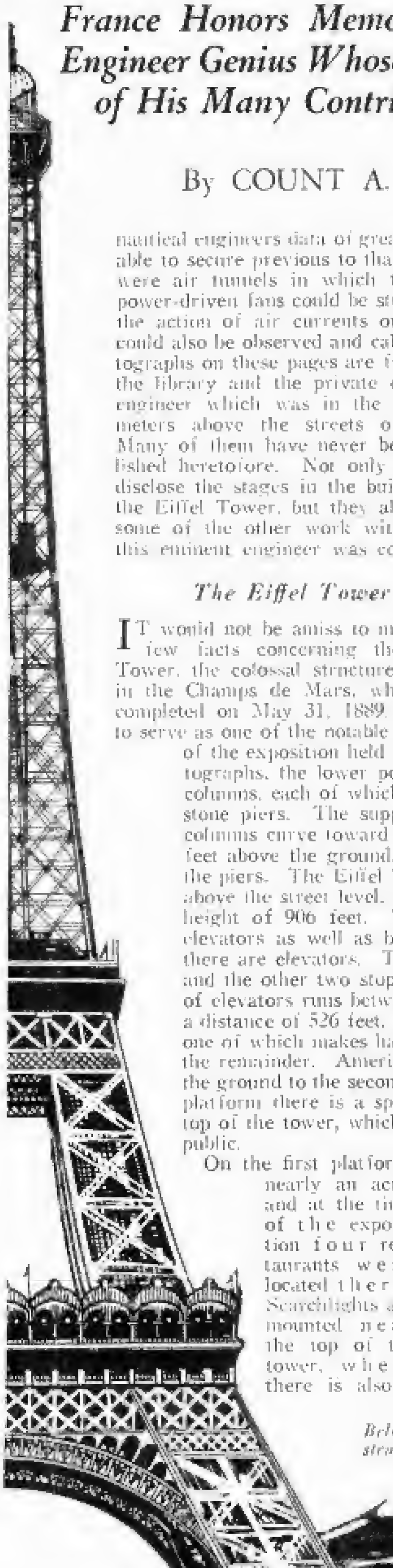
The magnificent Eiffel Tower.

FRANCE HONORS EIFFEL

In memory of their beloved engineer, who was responsible for the building of the Eiffel Tower in the face of great odds and public ridicule, France has just erected a fitting monument, dedicated to Alexandre Gustave Eiffel, at the foot of the Eiffel Tower.

France Honors Memory of the Famous Engineer Genius Whose Tower Is Only One of His Many Contributions to Science

By COUNT A. N. MIRZAOFF



nautical engineers data of greater accuracy than they were ever able to secure previous to that time. In this laboratory there were air tunnels in which the effect of air current from power-driven fans could be studied and in which the action of air currents on air-foil surfaces could also be observed and calculated. The photographs on these pages are from a collection in the library and the private office of the great engineer which was in the Eiffel Tower, 285 meters above the streets of Paris. Many of them have never been published heretofore. Not only do they disclose the stages in the building of the Eiffel Tower, but they also show some of the other work with which this eminent engineer was connected.

This photograph shows the first platform under construction. Note the temporary braces to support the arch

In July, 1888, the second platform was finished. This is the way the Eiffel Tower looked at that time. The arch braces have been removed.

The Eiffel Tower

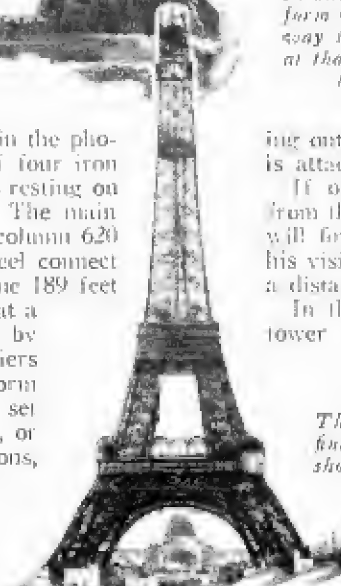
IT would not be amiss to mention a few facts concerning the Eiffel Tower, the colossal structure erected in the Champs de Mars, which was completed on May 31, 1889, in time to serve as one of the notable features of the exposition held in that year. As can be observed in the photographs, the lower portion of this tower is built up of four iron columns, each of which consists of four smaller columns resting on stone piers. The supporting base is 330 feet square. The main columns curve toward each other and unite in a single column 620 feet above the ground. At the same time, arches of steel connect the piers. The Eiffel Tower contains three platforms, one 189 feet above the street level, the second 380 feet and the third at a height of 906 feet. These platforms may be reached by elevators as well as by stairs. In each of the four piers there are elevators. Two of these run to the first platform and the other two stop at the second platform. A third set of elevators runs between the second and third platform, or a distance of 526 feet. This set is divided into two portions, one of which makes half the distance and the other the remainder. American-made elevators run from the ground to the second platform. Above the third platform there is a spiral stairway running to the top of the tower, which staircase is not open to the public.

On the first platform there is a floor space of nearly an acre, and at the time of the exposition four restaurants were located there. Searchlights are mounted near the top of the tower, where there is also a meteorological observatory, a physical and biological laboratory, and where the radio antenna for sending out the daily time signals is attached.

If one should look out from the top of the tower, he will find that on a clear day his vision is unobstructed for a distance of about 85 miles.

In the construction of the tower about 7,000 tons of steel were used and the expense of its construction was considerably over a million dollars. The French Government voted about $292,000 and the remainder was of course supplied by M. Eiffel. Reimbursement was to be obtained by the charging of admission to the tower, and he was entitled to the profits of such sales for a period of 20 years. The profits for one year alone nearly paid for the total cost of the tower.

As with other famous inventors, Gustave Eiffel found that considerable objection was raised to his scheme when it was first proposed, and even while the work was going on there was much opposition to the construction of the great tower.



The three platforms were finished in 1889. The top is shown as not yet completed.

This photograph shows the construction of the piers and the first portions of the metallic work

Below: The great masonry foundations under construction. These support the pillars of the tower. This photograph was taken in April, 1887

A structure which interests all tourists.

UNDER the ICE

Captain Sir Hubert Wilkins intends to use a sub-

Captain Sir Hubert Wilkins, the well-known polar explorer, who will use a submarine in his next adventure.

SUBMARINE exploration of the polar seas is the latest adventure upon which Captain Sir Hubert Wilkins, the well known polar explorer, intends to embark. The submarine "Defender," owned by Simon Lake, the eminent designer and builder of sub-sea craft is the only privately owned submarine in the world. It was built in 1906 at Mr. Lake's plant at Bridgeport, Conn. Captain Wilkins recently visited Bridgeport and looked over the submarine "Defender," and expressed his satisfaction with it for his contemplated trip to the polar seas. In a recent interview, Mr. Lake explained to the writer that with the proper redesign or rather reinforcement of the top of the submarine, this type of vessel is very seaworthy, especially in the polar waters where ice of various kinds is encountered. Mr. Lake showed the writer a photograph taken some twenty years ago in Narragansett Bay, which showed a submarine just after it had broken upward through ice approximately eight inches thick. Where the ice is of the variety known as slush ice, a vessel built with a strong steel tapered ridge, similar to that shown in the accompanying illustration, can pierce its way upward through a far greater thickness than eight inches, yet this is not the limit.

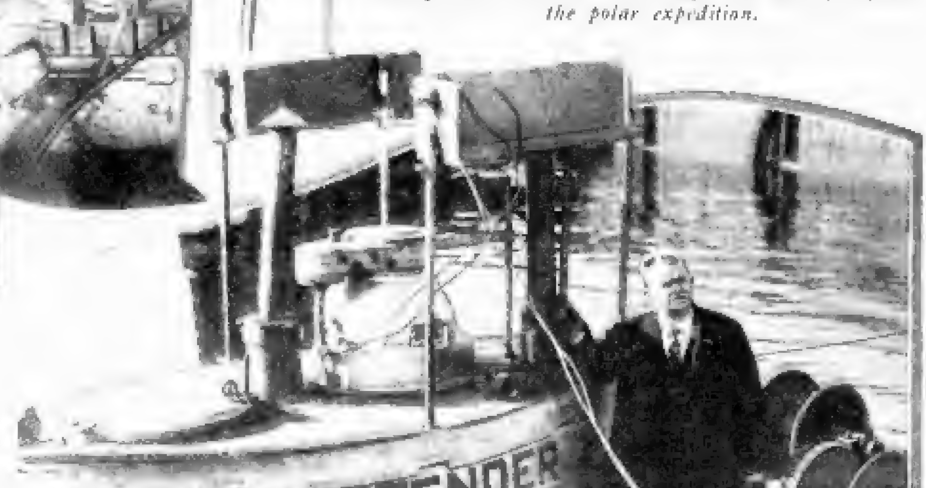
One of the objects of carrying out submarine explorations and tests in the polar seas is that this will help to demonstrate the possibility of utilizing submarines for opening up trade routes in northern Canada and northern Siberia. Mr. Lake pointed out that quite a large number of navigable rivers flowed northward into the Arctic in both regions, and grain as well as minerals and oil, abounding in these regions could be barged northward to the river mouths, and from these points it could be brought, by specially built submarines, to more southerly points.

Changes Required in Polar Submarine

THE submarine "Defender" has a beam of 11 feet compared to that of present-day submarines which is 20 feet, and the length of the "Defender" is 98 feet compared with 300 feet the average length of modern submarines. The "Defender" has quarters for eight men, but four more bunks can be installed by removing the torpedo tubes; thus raising the passenger-carrying capacity to 12. The crew will comprise a navigator, two quartermasters, two engineers and two electricians, and several scientists will go with them.

The hull of the "Defender" is made of ⅜-inch thick steel plate, and the accompanying drawings show how the top of the hull will be reinforced with a steel prow, so as to cut through the ice either longitudinally or vertically. This steel prow reinforcement will comprise a series of steel beams, with proper bracing members, and the beam structure will then be covered with steel plate about ⅛-inch thick. This deck reinforcement will run from bow to stern and cover the

At the left is a photograph of the interior of the under-sea boat with a diver ready to enter the water.



Mr. Simon Lake is shown below with his submarine, "Defender," which was built at Bridgeport, Conn., in the year 1906. This boat is the only privately owned submarine in the world. The design will have to be changed to a certain extent before it can be used on the polar expedition.

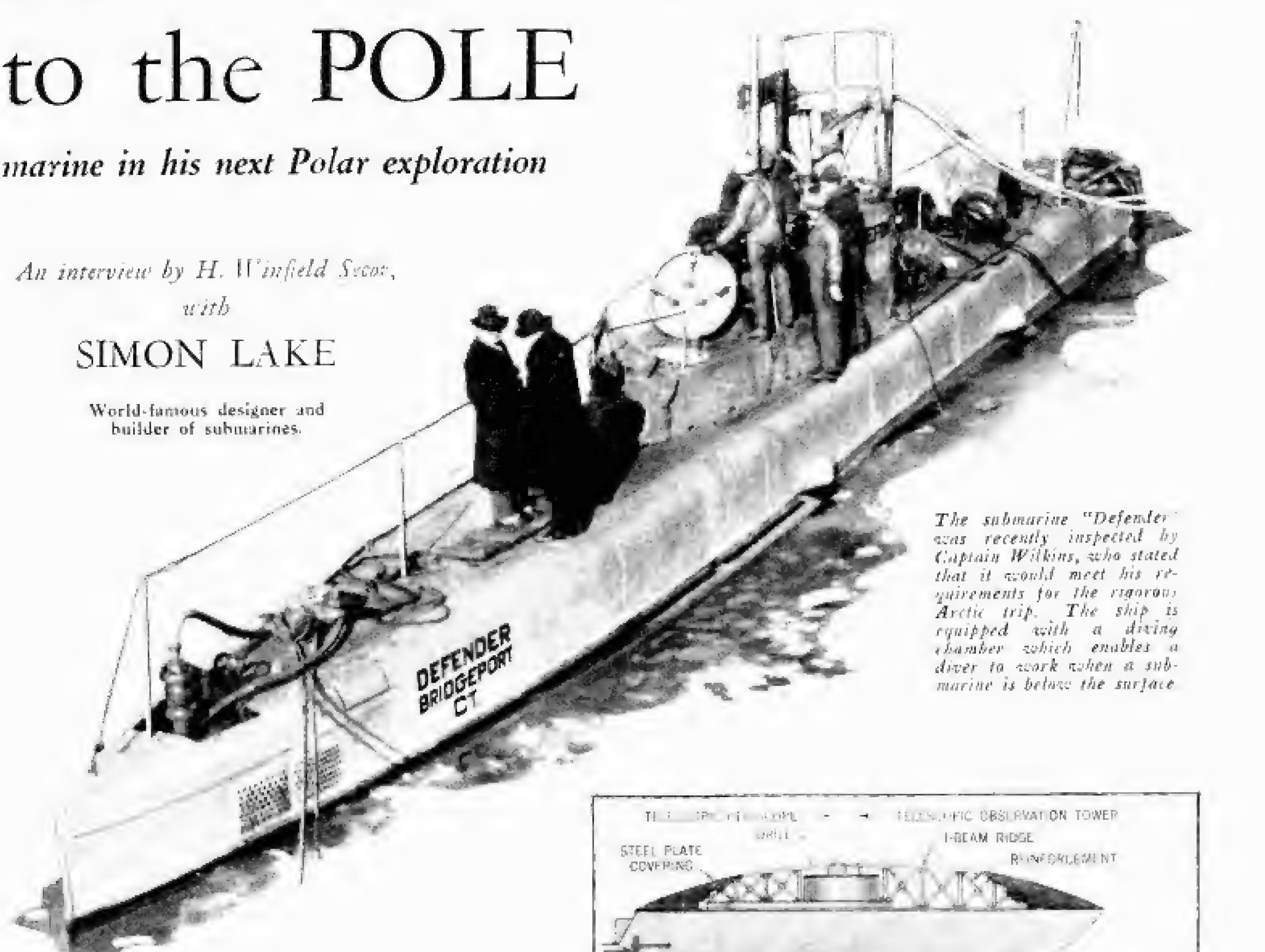
to the POLE

marine in his next Polar exploration

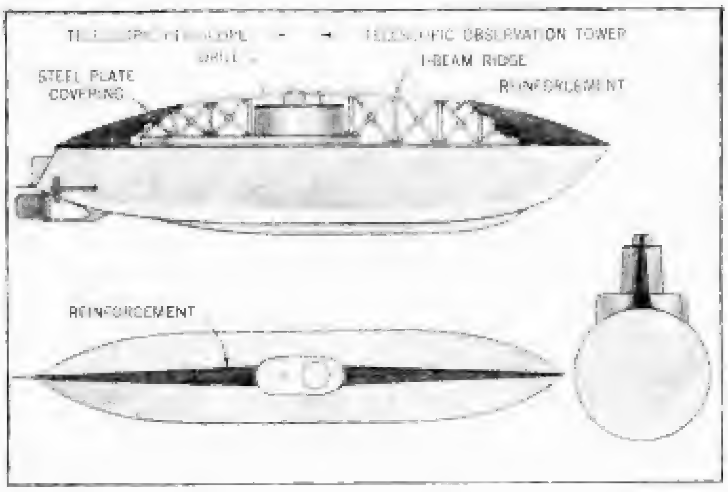
An interview by H. Winfield Secor, with

SIMON LAKE

World-famous designer and builder of submarines.

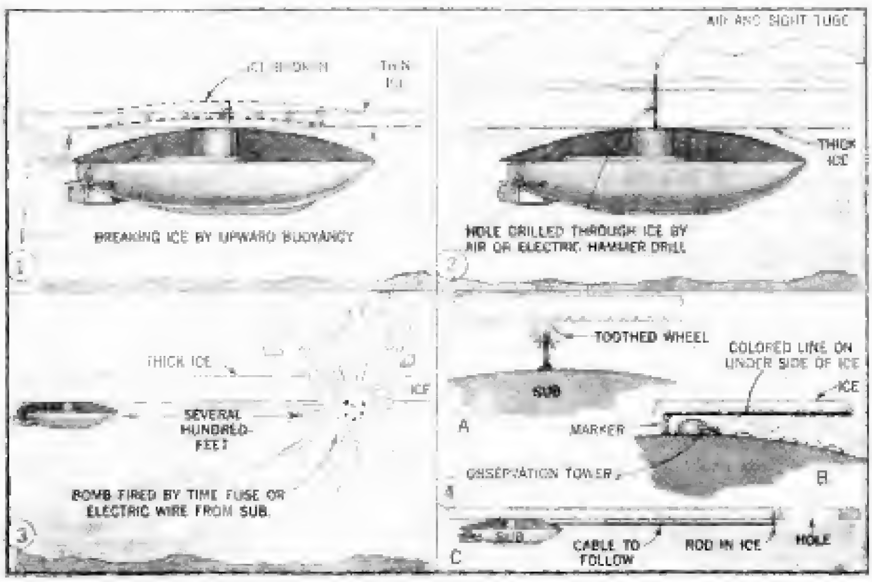


The submarine "Defender" was recently inspected by Captain Wilkins, who stated that it would meet his requirements for the rigorous Arctic trip. The ship is equipped with a diving chamber which enables a diver to work when a submarine is below the surface.



The illustration at the right shows a side, top and front view of the submarine. The top of the ship will be strongly reinforced and covered with a heavy steel plate.

The drawing below shows a number of ways in which the ice blanket could be broken. Thin ice might be crushed merely by allowing the submarine to rise, relying upon the upward buoyancy to break the ice, as illustrated in figure 1. Figure 2 illustrates the manner in which a hole can be drilled in the ice, so that the air and sight tube may be used. Thick ice would have to be blasted. The bomb could be fired from the ship as shown in figure 3. After the ice had been broken, the submarine could find its way to the hole by one of the methods shown at A, B and C, figure 4.



conning tower. The periscopes and observation tower, Mr. Lake enlightened me, will be made telescopic, so that when the submarine has to buck upward through ice, she will present a smooth contour and no delicate parts will be exposed which might be broken off.

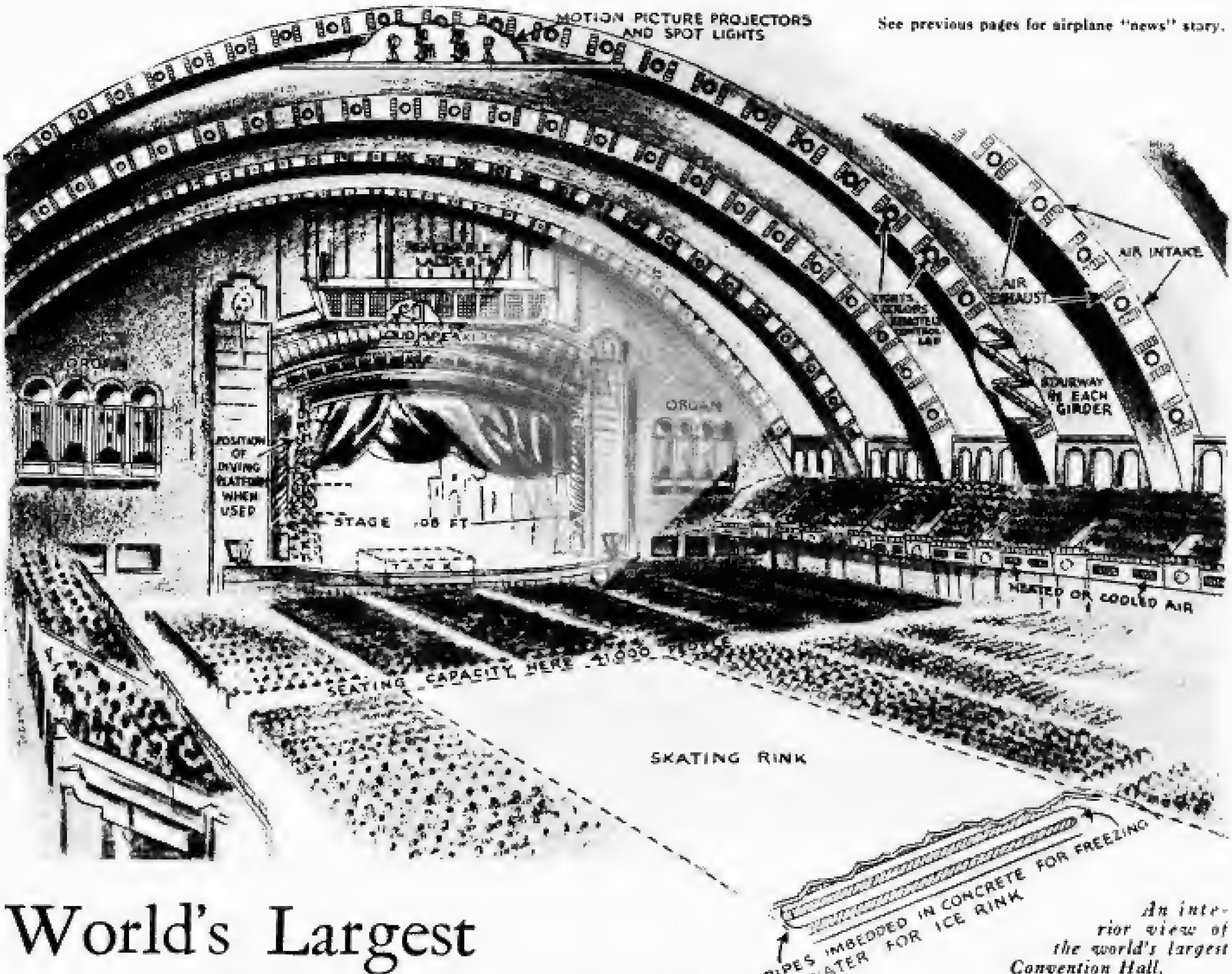
Diesel Engines to Be Used

AMONG other changes in the equipment of the "Defender" for the polar exploration trip contemplated by Captain Wilkins, her present gasoline engines will be taken out and Diesel engines substituted. As the veteran designer and builder of submarines explained this change in engines will give the "Defender" a cruising radius of approximately 3,000 miles at a speed of four or five knots while the installation of a new set of storage batteries will give her a submerged cruising radius of 100 miles and possibly more, at a speed of three knots.

It is contemplated to install an up-to-date radio transmitter and (*Continued on page 276*)


AUGUST
25 CENTS
Science and Invention
ARTHUR H. LYNCH
Editorial Director
$2,000,000
SHAM BATTLE
DIESEL ENGINES
FOR AIRCRAFT
MAKE A CONTRACT
TO BECOME WEALTHY
Says John J. Raskob

See previous pages for airplane "news" story.

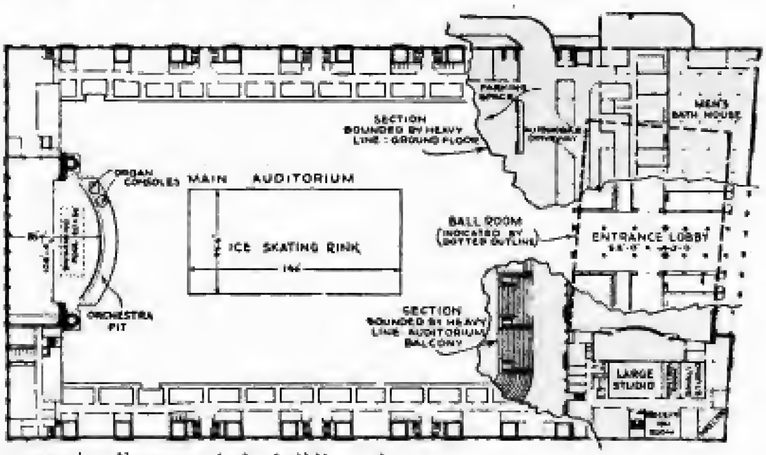


An interior view of the world's largest Convention Hall.

World's Largest Convention Hall

Story "Covered" by Airplane

FRONTING the board walk at Atlantic City there is a new Convention Hall, built by the city at a cost of $10,000,000 and operated by the Municipal Government. This hall is 350 feet wide and 650 feet deep. The main auditorium alone seats 40,000 people, and the entire building can seat 66,000 and still leave standing room. In addition to the main auditorium, where the seats are removable and where the world's largest stage is located, there is a large ballroom, measuring 130 by 185 feet, with a seating capacity of 5,000 persons. This is also provided with a stage. In the concrete floor brine pipes have been imbedded where an inch layer of water will be placed and will be frozen for ice-skating. There is no column in the building. The massive structural steel girders have stairways in them for replacing the lamps, which shine out through either side of the girders. A diving tank is placed underneath the stage for diving contests. Provision has been made for voice and music amplification.

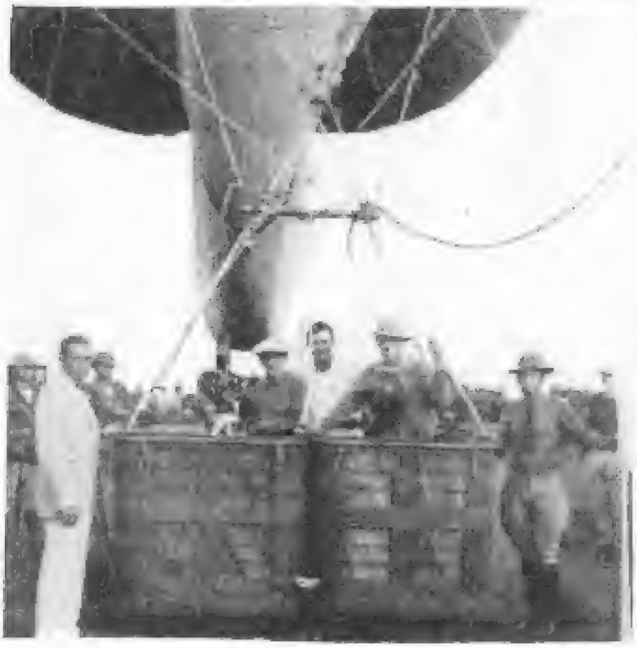


A composite diagram of the building, showing parking space under the building, main auditorium, ballroom, and the radio transmitting studio found in the Atlantic City Convention Hall.

Allowing but one foot per person, the 66,000 people that can be seated in the building would form a single line 12½ miles long.

An air view of the Convention Hall at Atlantic City.

$2,000,000 Sham Battle



The above photograph shows the baskets attached to the blimp from which aerial scenes were photographed. The author of this article may be seen at the right-hand side of the picture holding the flags.

By
Captain E. P. Ketchum,
Corps of Engineers, U. S. Army,
WHO ENGINEERED THIS PROJECT

"Wings"—War Movie—Cost $182.00 Per Second to Produce. In One Battle 5,000 Soldiers, 1,100 Mexicans, 50 Airplanes, 20 Tanks and 100 Tons of Dynamite Were Used

A TOUR of duty at Fort Sam Houston from the military standpoint is always interesting, but when in addition to the normal life of the Second Division one is detailed as sort of a consulting engineer for a moving picture, it becomes particularly interesting and perhaps justifies recording in some fashion.

The author had only recently joined the 2nd Engineers at Fort Sam Houston when he was detailed to Camp Stanley to insure the military correctness of some fortifications that a movie company was to build there. Having just completed a three-year detail at Wilson Dam or Muscle Shoals where the engineering work was of a very high order, the movie engineering to follow proved to be not of such a high order, but certainly as interesting.

A conference with the representatives of the Paramount people was held at Division Headquarters. The theme and sequence of the picture was gone over. Much stress was placed upon photographing the battle scenes from the air. This latter plan meant to me and all concerned that less "faking" could be resorted to because a camera from the air always reveals (as we learn in camouflage) footpaths, etc.

At the right is a photograph of one of the scenes in the screen production "Wings." Fifty airplanes and 20 tanks were used in this stupendous movie "sham battle."

Before proceeding further it should here be inserted that "Wings" originally was to be purely an air picture and it was only at the insistence of the division commander

that the ground *battle scenes* were inserted. How well and wisely they were added is attested to by the length or footage allowed these scenes in the completed picture.

The picture people having always in mind photographing the battle scenes from the air desired a very extensive battlefield and at first and until a rough estimate of labor and material was furnished them they were speaking in terms of miles! As finally constructed the battlefield was perhaps the largest ever constructed in peace times for any purpose. Full depth trenches were executed for the American front; support and battalion reserve lines with communication trenches, dugouts, etc., for a width of 200 yards with an additional 100 yards on each flank that tapered from the full depth trench up to the virgin soil. The same lines were constructed for the German position. The German front line was in ordinary earth, but the remainder of the position was on a rocky hill! Air compressors and drills were used in the German position!

The author in laying out the trench design with tracing tape, used no standard "trace" (such as the traverse, wavy, zig-zag, etc.), but some of all known traces, with the hope that the completed system would resemble the *actual front* and not a *training camp* layout.

Men Divided in Groups

THE Army had intended my work to be that of a consultant for correct military engineering detail only, but here was quite an engineering problem, and after watching the futile efforts of the picture staff to handle the labor, material, etc., necessary for this construction, I volunteered to organize and direct the work. At the peak of construction there were eleven hundred Mexican laborers employed on the battlefield and most of these were employed on trench construction. These eleven hundred laborers were placed in gangs of about fifty men, each under a foreman. These foremen were nearly all ex or retired soldiers. These gangs were then grouped under general foremen for the following work:

Trench construction; trench accessories (dugouts, revetment, etc.); demolition; wire entanglements.

The general foremen were all army sergeants, and too much credit cannot be given them for their efficient work.

It is one thing to lay out and construct an entrenched position for training and another and more difficult task to lay out and construct one that, when photographed, would resemble the western front. This latter task required the following:

Numerous and varied shell holes; the demolition and burning of trees and foliage; the aging of the trenches; the aging of the wire entanglements; the "dressing" of the battlefield. (Continued on page 376)

At top is one of the "battle scenes" in the picture. The pontoons for the bridges are of real German design, having been brought from the other side for use in the photoplay. Center is another "shot," taken on the battlefield, and at the bottom of the page is a scene in one of the "French villages," built for the filming of the picture.

If a GIANT METEOR Hit a MODERN CITY!

By Professor Wm. J. Luyten
OF HARVARD COLLEGE OBSERVATORY

Such a modern city as New York may some day be knocked flat as a pancake in a few seconds by a meteoric shower, such as that which visited Siberia on June 30, 1908, says Prof. Charles P. Olivier, Director of the Observatory, University of Penn.

OUT in the wilds of Southwest Africa a new meteorite has been discovered, one of these mysterious messengers in the cosmos, that come to us, bearing evidence that space is not altogether empty, but populated with a vast multitude of small fragments. The new addition to our captive part of this stray population of the cosmos lies on "Hoba Wes," the farm owned by a Mr. J. H. Oosthuizen, near Grootfontein, the end of the narrow gauge railroad in Southwest Africa.

The first I heard of the new find was through a telephone call from the editor of the Bloemfontein newspaper, who had received a photograph from one of his readers, which photograph was supposed to be of a giant meteor. It undoubtedly was, the metallic structure of the "rock" could be seen even on the small snapshot taken with a No. 2 Brownie, and an investigation was decided on immediately. A cable to the New York *Times* brought authorization within twenty-four hours, and everything was ready. Everything except the trains, for these run only once a week, and I had just missed one.

However, I boarded the next "South West Limited," an express train that runs the distance of 1,550 miles to Grootfontein in the unbelievably short time of four days and four nights. An average speed of some 17 miles per hour, but then, one must remember, we are in Africa!

When I got to Grootfontein, I immediately drove out to where the meteorite lies, twelve miles due west, near the siding of Otjihaenene. As it lies there, unassuming, in its silent tomb of limestone, there is nothing dramatic in its appearance: a solitary block of metal, great and massive, lying in the desolate wilderness of the "veld." But if we only try to visualize the conditions under which it arrived we find it gave a spectacle surpassed by few in dramatic appeal.

"A black mass of iron, cruising through empty space invisible to all. Suddenly it enters the atmosphere of the earth; its great speed and the resultant friction heat it to incandescence in some seconds or less. Transformed into a gigantic fireball, white hot, it darts across the sky with lightning rapidity, and approaches the ground with an angry hiss. A terrific roar as it strikes the ground, a shower of sparks sand, rock, and metal, a cloud of dust, and soon all is quiet again. With its nose buried deep in the soft rocks, the meteor will soon be covered up entirely by the surrounding limestone, and its tomb will be sealed against the curious eyes of posterity. Thus it will lie in state in its grave, unwatched in its descent except perhaps by some awestricken primitive man who might well have believed that the prophet Elijah had returned to earth. After centuries of erosion have removed most of the protecting top layers, perchance some prospector may notice a small, black, metallic looking rock, and having become suspicious of this strange individual, begins to dig it out."

In this manner the meteor was actually brought to light, and a deep pit was excavated around it to show the full extent of its great bulk. By a fortunate coincidence the meteor seems to have landed in such a way that its thickest side encountered only soft limestone, while the thinnest side struck hard rock, thus leaving the upper surface almost horizontal. The whole of its present conformation is nothing less than remarkable: there is an almost flat, nearly level surface, practically square, nine by ten feet in size, and with almost vertical sides, about four to five feet deep on the northeastern side, and up to three feet on the southwestern side. Its position is so regular that it would be hard to improve upon it had it been designed for show purposes in a museum.

Though the first impression as it is seen there in the wide space of the veld, and in the pit dug around it, is not too overwhelming, this changes when one comes closer. Imagine such a huge block of solid metal, ten by nine by four feet, about as large as a room in a small city apartment. One may well be thankful that one wasn't too close when it fell. Still, I think, I should like to have watched it fall from a safe distance, a mile or so. Owing to the impossibility of finding out how much of the meteor is buried in the limestone it is difficult to make a good guess about its weight. From the outside measurements it is estimated, however, that it must weigh at least fifty tons. Fifty tons, one hundred thousand pounds of solid iron, truly a rock of ages!

The upper surface is smooth, and but slightly rusty, the only remaining evidence of the tremendous heat to which the meteorite has been subjected. A few shallow, circular holes, so typical of all meteorites, where the softer parts have been melted away, complete the description of the natural surface. Actually the upper surface is marred by several blue, slag-like places, scars left by the vandals, who operated on it with an oxy-acetylene flame, in order to obtain a few pieces for chemical analysis. In a few other spots one notices the shining silvery surface left by a hacksaw, marks from which one can judge the painfully slow process that accompanies such an inadequate tool when used on the tough body of a meteorite.

For tough it is, tougher than any but the very best steel we can manufacture, comparable only to the steel used in locomotive wheels. One can just (*Continued on page 365*)

OUR artist has graphically shown the effect of a shower of giant meteorites hitting the buildings of a modern city such as New York or Chicago. The photograph at the left, taken by Prof. Luyten, shows the Grootfontein meteorite, which he recently examined in South Africa; this is thought to be the largest meteorite known and measures about 9'×10'×4', weighing 50 tons, or 100,000 pounds. Meteorites may have a velocity of from 25 to 70 miles per second. Prof. Luyten thus describes a meteorite—"A black mass of iron, cruising through empty space, invisible to all. Suddenly it enters the atmosphere of the earth; its great speed and the resultant friction set it ablaze in a fraction of a second. Transformed into a gigantic fire ball, white hot, it darts across the sky with lightning rapidity, and approaches the ground with an angry hiss."

Filming *the* Future

Wonderful Presentation of Astronomical Exploration 2,000 Years Hence

The illustration at the right shows a striking scene taken inside of a spherical airship which leaves the earth on a journey into space. In this view the airship has traveled beyond the earth's gravitational influence. As a result, the passengers of the ship are standing in a position that to them appears to be vertical and erect. This view then indicates the relativity of position when in space.

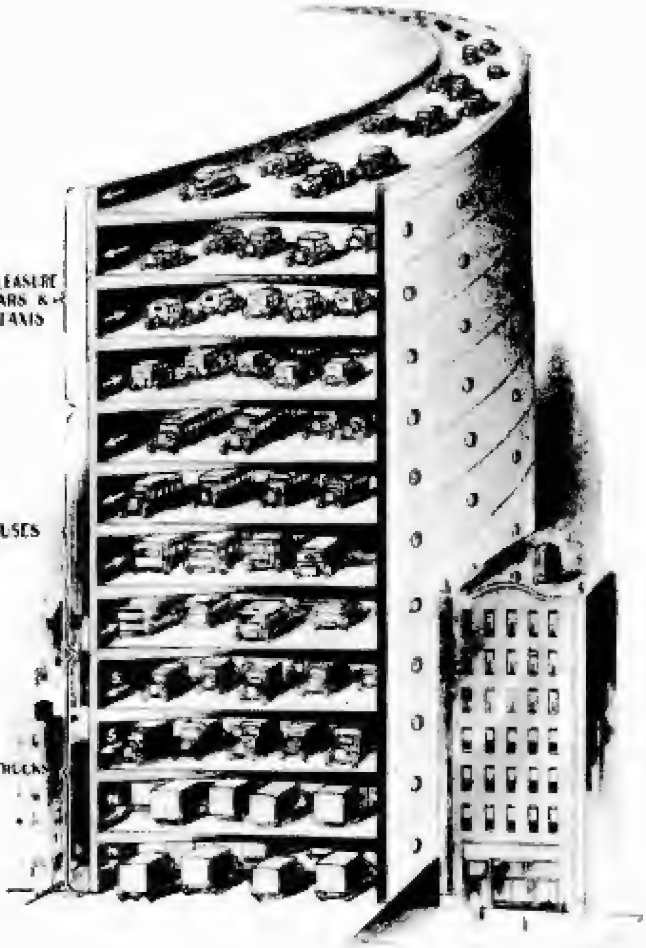
The structure across the sky is one of Saturn's rings.

The immense cloud surfaces of Saturn.

Above appears one of the scenes from new astronomical film. This particular view was taken from the moon and shows the earth at a distance. Note how the sun, shining on the earth, makes a moon of it to any who might be positioned on the surface of our satellite. Observe the rocky crags in the foreground, which are the mountains of the moon. Right: A striking polar view.

IF the atmosphere on this earth were as rarefied as it is on the moon, the inhabitants of this planet would see intense shadows and brilliantly lighted surfaces, as in the view of the moon above. It is the atmosphere which diffuses the light. Dust also aids. The film is replete with incidents based on strictly accurate astronomical data.

Multiple Highways for Traffic



The above illustration shows our artist's conception of the multiple highway of the future which will eliminate traffic congestion. Separate north bound and south bound roadways will be provided for pleasure cars and taxis, buses and trucks.

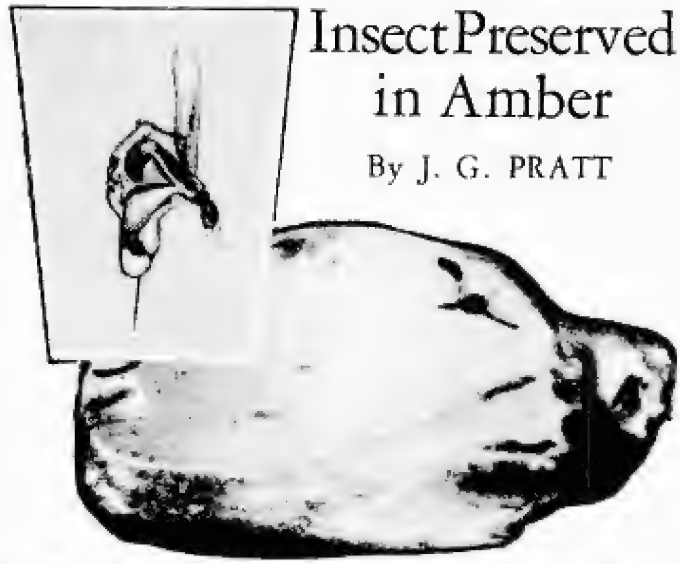
IN order to relieve traffic congestion in New York and other large cities, a multiple highway has been suggested. The first four decks or tiers on the bottom could be devoted solely to trucks providing two north and two south bound roadways. The next four decks may be used exclusively for buses and the next four tiers or road levels would be used only by pleasure cars and taxis. The multiple highways, except for the top deck, would be enclosed and protected against the weather. Enormous parking space would also be provided on each level. For each highway it would be necessary to sacrifice one north and one south thoroughfare. It has been suggested that Ninth Avenue, in New York City, be used for such a highway, because at present this street is undeveloped.

The elevated motor express highway on the west side of New York City has greatly helped traffic and its footings have been designed to permit the addition of a second deck or tier. However, at best, it can only furnish temporary relief and within a comparatively short time will doubtlessly be overtaxed. The cost of constructing an elevated highway would be small when compared with the yearly losses sustained by the increase in traffic congestion which is estimated to be $500,000,000 in New York City alone.

The cost of such a highway would be between $100,000,000 and $200,000,000.

Insect Preserved in Amber

By J. G. PRATT



The above photograph shows a species of white ant which was preserved for about 2,000,000 years in a piece of amber.

EXTENSIVE mining operations are conducted on the East coast of Prussia for Baltic Sea amber or succinite, which occurs in the Lower Oligocene strata, and appears to have been partly derived from an earlier Tertiary deposit (Eocene). In the Baltic Sea amber well preserved fossils of plant life and insects which existed on the earth between 2,000,000 and 4,000,000 years ago are often found. The accompanying photographs show a species of termite or white ant which was thus preserved. It is difficult to photograph these specimens because of the reddish color of the amber, and it was found necessary to employ a powerful spotlight from above and another from underneath which were used alternately during the exposure.

Noiseless Camera

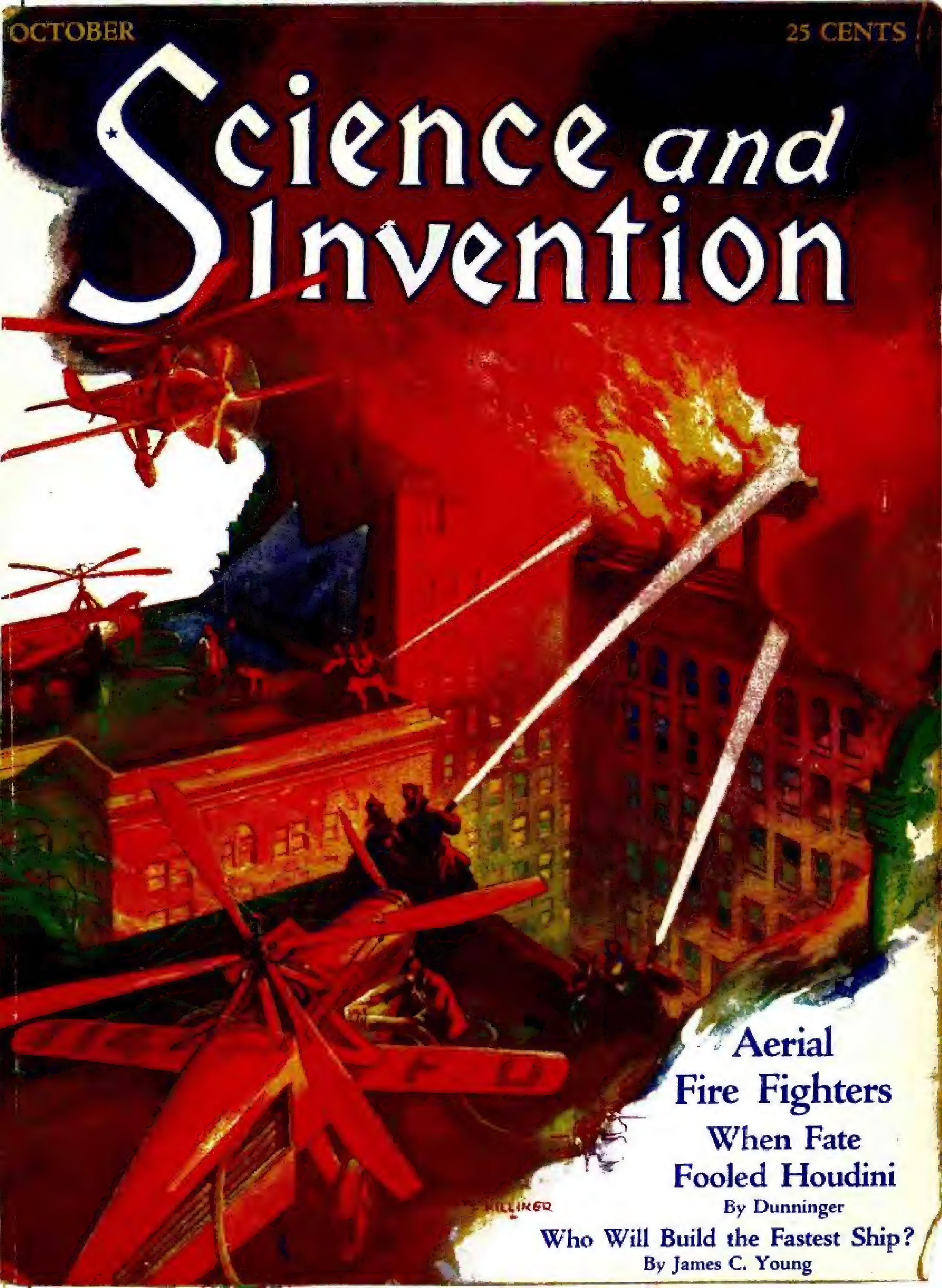
By DAYTON STEPP

A NOISELESS motion picture camera has been perfected at the Paramount, Hollywood studios, and is used in filming sound motion pictures. The camera is enclosed in a sound-proof casing and the mechanism and electric motor is encased in layers of rubber, cork, cloth and special fibre board to insure complete sound insulation. Thus, all clicking and noise is kept from the recording microphones. The stuffy sound-proof booths in which the camera men were previously compelled to work have been eliminated by the new noiseless camera. Placing the camera and operator in a booth was cumbersome.

The above photograph shows the noiseless movie camera in use, and at the left an interior view.

OCTOBER 25 CENTS

Science and Invention



Aerial Fire Fighters

When Fate Fooled Houdini

By Dunninger

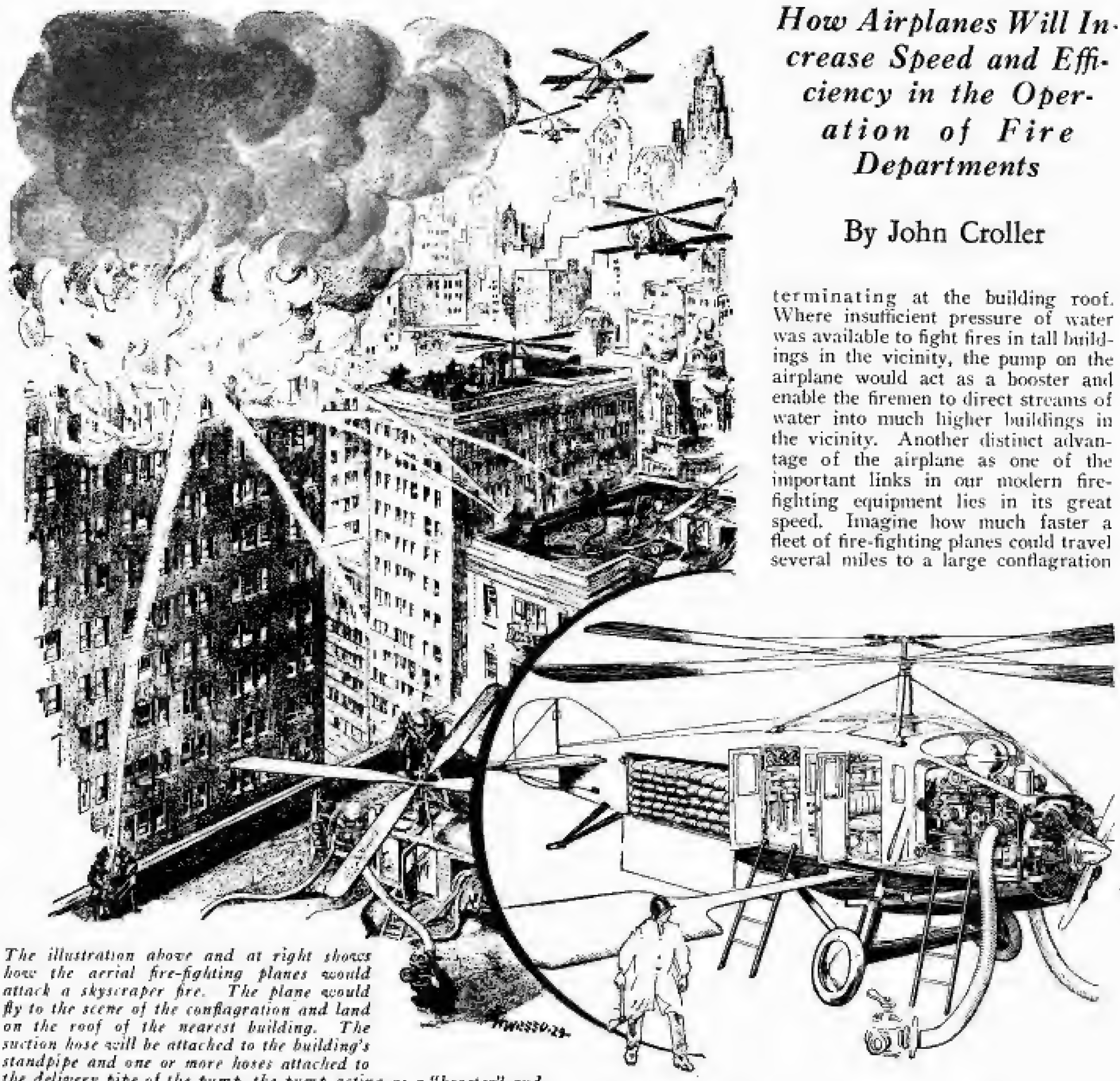
Who Will Build the Fastest Ship?

By James C. Young

Aerial Fire Fighters

How Airplanes Will Increase Speed and Efficiency in the Operation of Fire Departments

By John Croller

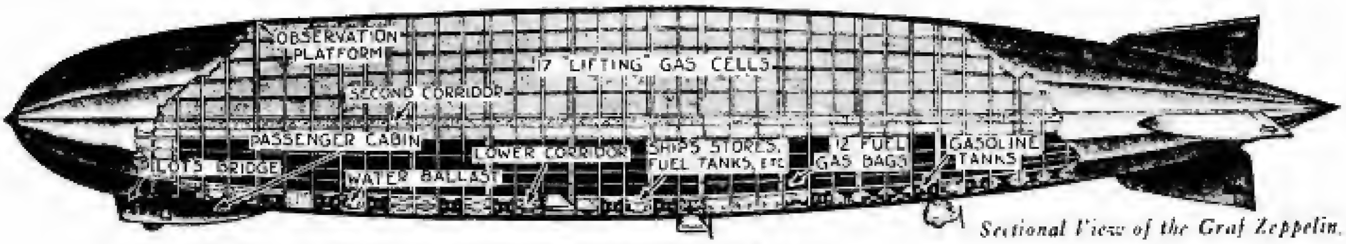


The illustration above and at right shows how the aerial fire-fighting planes would attack a skyscraper fire. The plane would fly to the scene of the conflagration and land on the roof of the nearest building. The suction hose will be attached to the building's standpipe and one or more hoses attached to the delivery pipe of the pump, the pump acting as a "booster" and serving to throw streams of water several hundred feet beyond the range ordinarily possible.

OUR front cover and the accompanying illustration also illustrate the very latest idea for fighting fires with the aid of airplanes. The airplane shown in the accompanying picture is a special new form of plane, known as the *autogiro*. The outstanding feature of this new type of aircraft is that it can ascend or descend almost vertically on the order of a helicopter. One of our leading fire-fighting experts, a member of the New York City Fire Department, recently declared that the city is on the verge of adopting the airplane as a part of its regular fire-fighting equipment.

The accompanying picture shows how the autogiro form of plane could be arranged to carry hose, as well as a fire pump and accommodations for several firemen. A special clutch would permit the airplane engine to be connected with the water pump, this pump taking water from a standpipe terminating at the building roof. Where insufficient pressure of water was available to fight fires in tall buildings in the vicinity, the pump on the airplane would act as a booster and enable the firemen to direct streams of water into much higher buildings in the vicinity. Another distinct advantage of the airplane as one of the important links in our modern fire-fighting equipment lies in its great speed. Imagine how much faster a fleet of fire-fighting planes could travel several miles to a large conflagration compared to a number of automobile fire engines making their way through the crowded streets of a large city like New York or Chicago. These fire-fighting planes would carry, in addition to hose and pump, a goodly number of hand-operated portable fire extinguishers, axes, scaling ladders and other equipment which readily permits its crew of firemen to put out any ordinary blaze. The cost of these fire-fighting planes would be quite reasonable, considering the great advantage of speed with which these planes could travel to a fire. These planes can also land on the water, if they are designed as amphibians, and in this capacity they will prove invaluable.

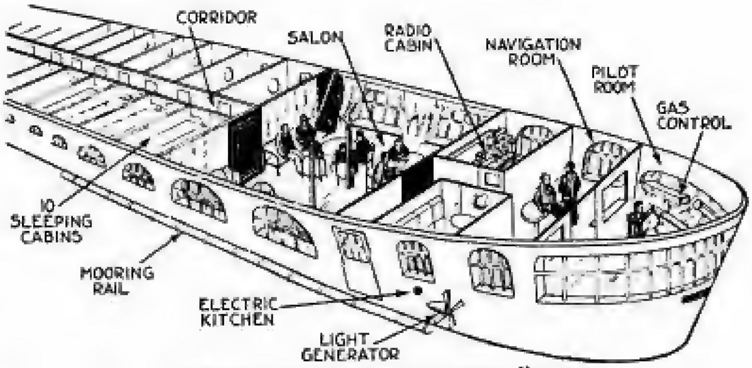
In fact it would not be unreasonable to assume that in ten to fifteen years from now a major part of our fire-fighting equipment may have "sprouted wings." As our cities keep expanding and our suburban sections multiplying, the principal desideratum will be speed, and the airplane seems to be the best answer to that problem. For the small town fire-fighting equipment, the airplane will soon prove indispensable.



Sectional View of the Graf Zeppelin.

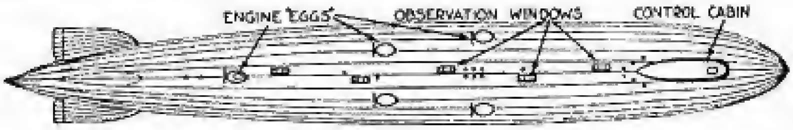
INSIDE THE Graf Zeppelin

THE sectional view of the *Graf Zeppelin*, shown herewith, gives some idea of the complicated internal structure of this large "grown-up" balloon, which carries two kinds of gas, hydrogen for lifting her huge bulk and Blau gas as fuel for her five Maybach engines. Gasoline is also carried as auxiliary fuel for the engines, but only a small quantity of this fuel is carried. A simple valve enables the engineers to instantly switch the engines from Blau gas fuel to gasoline, and vice versa. The Blau gas is carried in twelve bags along the bottom of the frame, just under the hydrogen "lifting" cells or bags. The *Graf Zeppelin* carried 22 passengers and a crew of 40 men, including three pilots and three navigators, when she left Lakehurst, August 8.



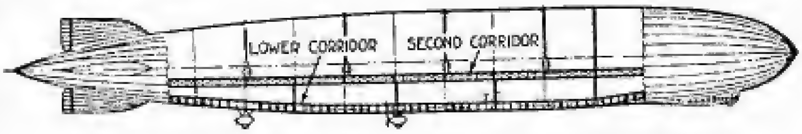
Where the officers and passengers live.

The passenger cabins, dining salon, radio room as well as the "bridge" are shown above. In stormy weather the commanding officer spends many hours on constant watch, together with his officers, at this important key position on the dirigible, where mechanical and electrical means are provided for opening and closing gas valves, ballast dumps, etc.

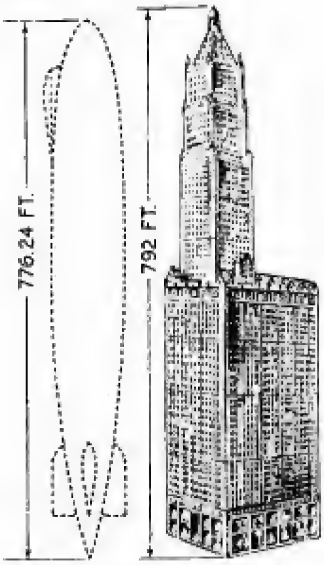


Unusual "bottom" view of modern dirigible, showing windows.

How the bottom of a modern dirigible such as the *Graf Zeppelin* looks is illustrated above; note trapdoor for lowering ropes and also the observation windows.



Note second corridor in Graf Zeppelin, for inspection purposes.



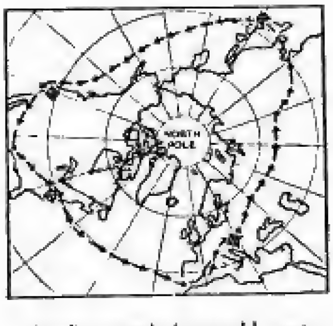
Graf Zep compered to Woolworth Building.

To inspect the 17 "lifting gas" cells, also the 12 fuel gas bags, the designers of the *Graf* provided a lower and a second corridor or catwalk.

Los Angeles, R-100 and Graf Zeppelin compared as to size.

If you saw the *Graf Zeppelin* stood up on its tail alongside the Woolworth Building, it would reach nearly up to the dome of that famous edifice. Imagine the bending and twisting stresses in a "balloon" of this size.

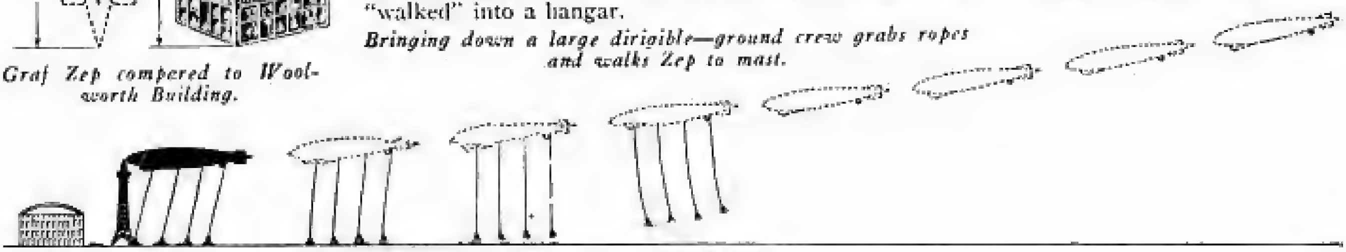
Round-the-world map at right shows path of *Graf Zeppelin* on her 25,000-mile air journey, on which she will make stops only at Friedrichshafen, Tokio, Los Angeles, and Lakehurst.



Graf's round-the-world route.

LANDING of a large dirigible such as the *Los Angeles* or the *Graf Zeppelin* is carried out as shown below. The airship steers downward under her own engine power and drops ropes down. When low enough, the ground crew grabs the ropes and pulls her down low enough to anchor on a mast, or still lower, when she is "walked" into a hangar.

Bringing down a large dirigible—ground crew grabs ropes and walks Zep to mast.



Thomas A. Edison

Dr. Lewis Perry Col. Chas. Lindbergh S. W. Stratton George Eastman

Board of Judges who chose contest winner

Henry Ford

Do You Resemble The Typical American Genius?

ONE chance in forty-nine! That was the odds facing young Wilber Huston, 16-year-old American genius and student of science, hailing from the State of Washington. Some time ago Thomas A. Edison conceived an idea which would put the young science students of the country on their mettle. Mr. Edison said he would give a free scholarship in any technical school or college the winner chooses, if he surpasses all the other entrants in the test.

Elimination tests were carried on for many weeks by high-school teachers and professors, so that in each case the boy finally chosen to represent his state would be found well equipped, both as to education and character, in the national tests to be conducted by Mr. Edison at his famous laboratory in West Orange, N. J. Mr. Edison had the able assistance of several eminent men, including young America's idol, Col. Lindbergh, in passing on the merits of the written answers to the questions. The judges finally decided that Wilber Huston, son of Bishop Huston, of Olympia, Wash., had expressed the highest quality of thought and judgment in his solutions of the problems presented. Some of the questions involved mathematics, some chemistry, while others were intended to bring out the character of the entrant in the test. All in all, we think the idea was a very fine one. Mr. Edison presented each of the forty-nine boys, one from each state and the District of Columbia, with one of his combination electric radio and phonograph cabinets. Wilber Huston, first prize winner, has elected to take up a chemical engineering course at Massachusetts Institute of Technology this fall. All his tuition and living expenses while taking this course will be paid by Mr. Edison.

This composite picture of the typical American genius embodies the features of 49 boys

Compare your face with this "ideal" study of 49 young scientists

Besides this *Edison Scholarship* awarded to Wilber Huston, four other scholarships were finally decided upon, and these were awarded to the four boys who attained the next highest marks to Mr. Huston. Photographs of these four young gentlemen, each wearing a pleased look, appear at the bottom of this page.

We congratulate Wilber Huston, his four associates who also won scholarships, and Mr. Edison. This contest has done a great deal to show the deep interest being taken in science by the youth of our country. Another fact demonstrated by the tests was that the forty-nine entrants all ran close together, the percentages all being high. This speaks well for our high schools.

THESE FIVE BOYS WON SCHOLARSHIPS

Charles H. Branissen, Connecticut, won scholarship

Bernard Sturgis, Indiana, also won a scholarship

Wilber B. Huston, Wash., Honor Man

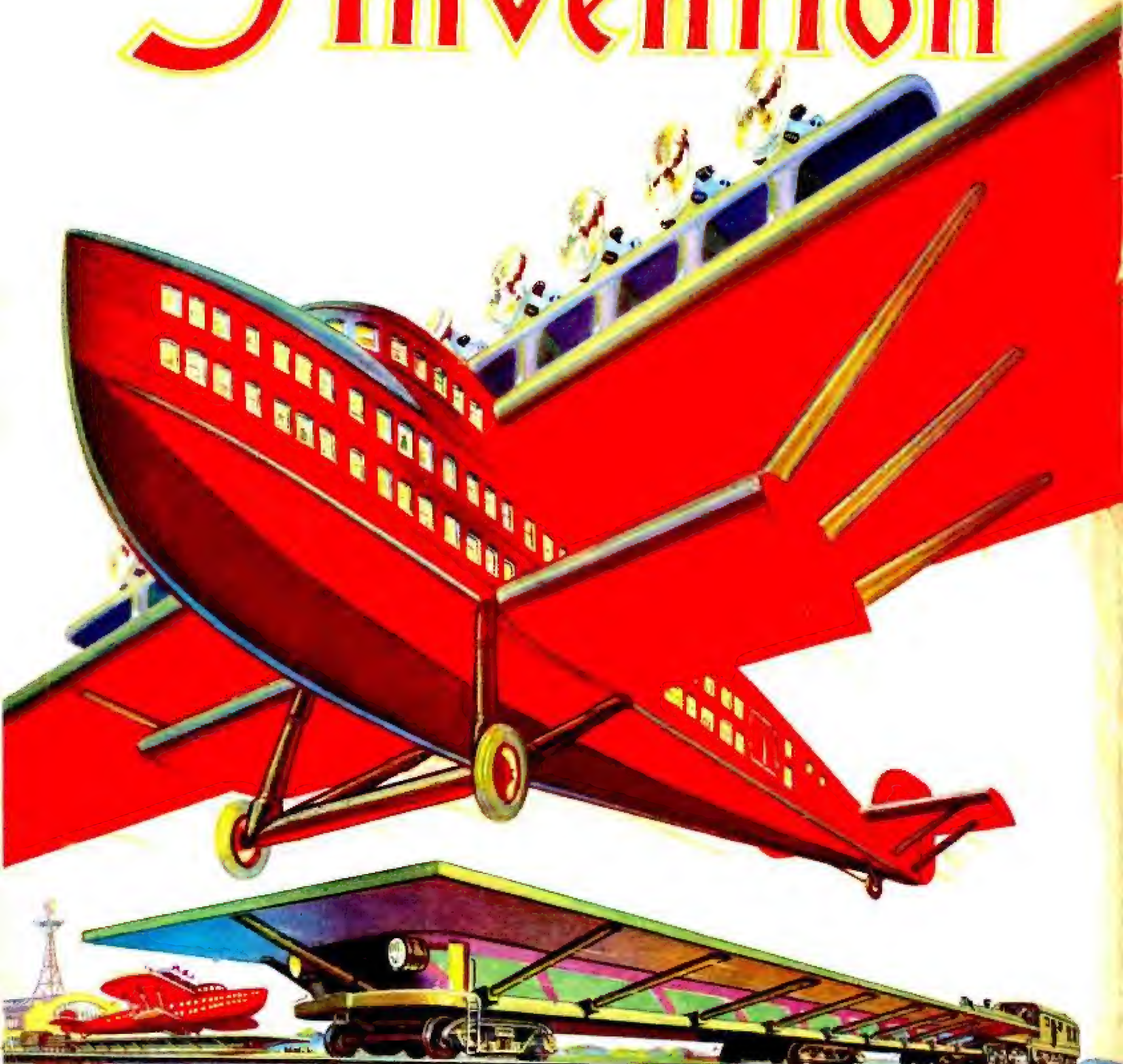
James Seth, New Mexico, also won a scholarship

As did Ivan A. Getting, representing Pennsylvania

NOVEMBER

25 CENTS

Science and Invention



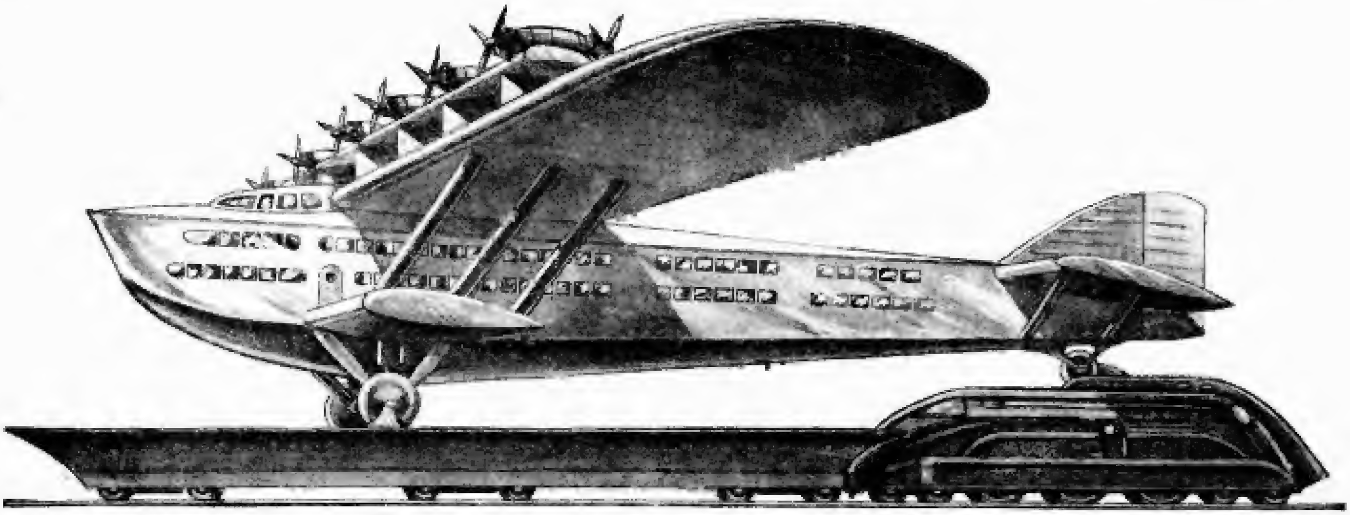
RAILWAY TO AIRWAY

Are Oil Burners Practical for the Home?

Sky-Hooks for Airplanes

When Inventors Become Air-Minded

Is Mediumship Based on Science?

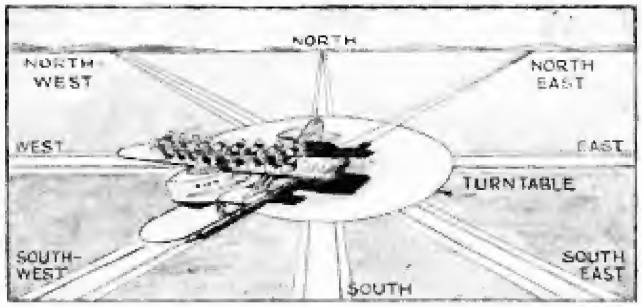


Side view of huge electric engine for launching giant planes.

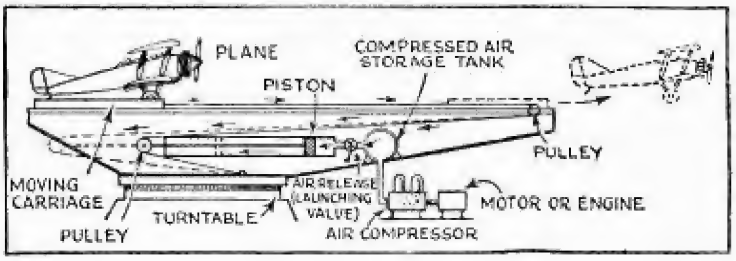
Railway to AIRWAY

Hurling Giant Planes Into the Air With Huge Locomotives

By Harold Donitz



Above we see motor-operated turn-table, together with tracks facing in various directions of the compass, thus enabling the pilot to take off into the wind at any time of the day or night.

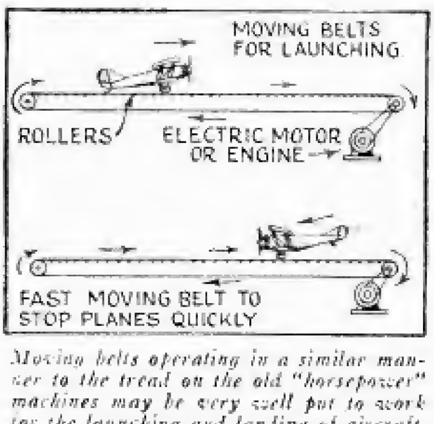


Above we see how the modern catapult hurls a plane into the air at a speed of 60 miles an hour.

COLONEL JAMES FITZ-MAURICE was recently credited with the opinion that the future transatlantic air commerce would be served by gigantic flying boats, and that while these usually take off from the surface of a bay or lake, it was not unlikely that some means would be devised to launch them from the platform of a railroad car. Clarence Chamberlin, famous American flier, stated in a letter to the author that the idea seemed entirely practical for heavily loaded planes about to start on long flights.

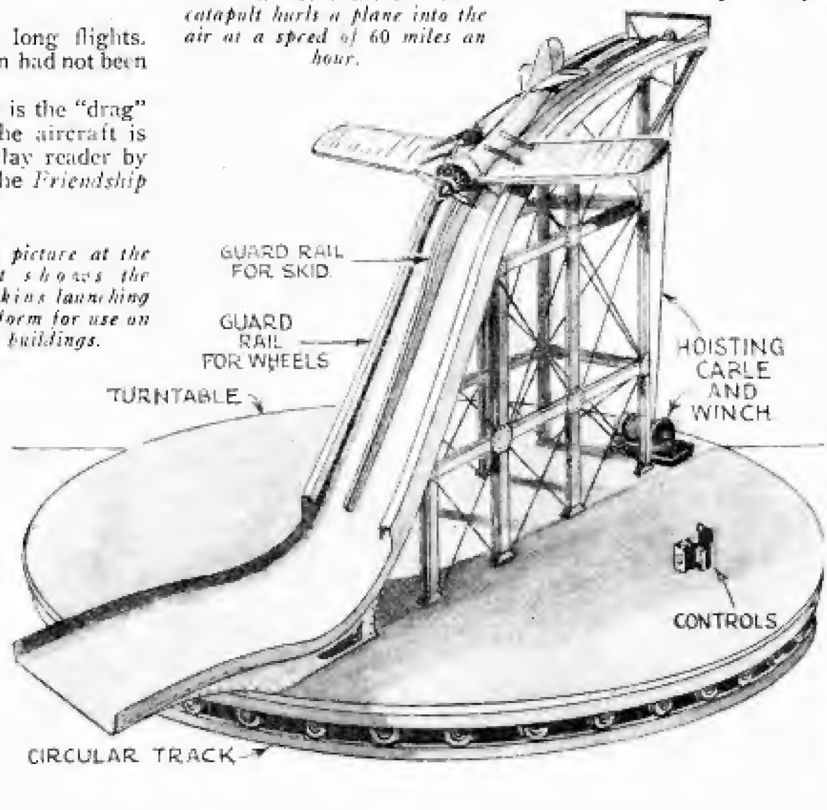
To the best of our knowledge, this proposition had not been voiced before and has not been stressed since.

One of the greatest difficulties of flying boats is the "drag" exerted by even the smoothest water when the aircraft is taking off. This drag was manifested to the lay reader by the many futile attempts to take off made by the *Friendship* before its transatlantic hop. Indeed, the drag was only overcome after the weight of the plane had been lessened by reducing (*Continued on page 640*)

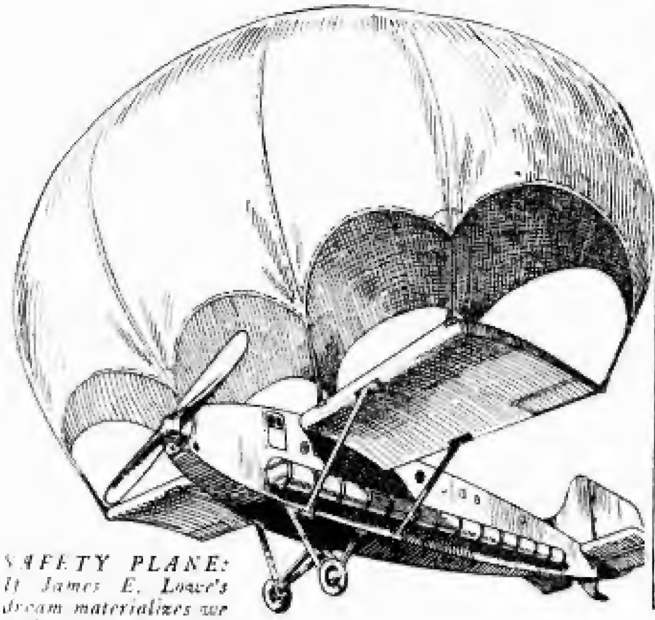


Moving belts operating in a similar manner to the tread on the old "horsepower" machines may be very well put to work for the launching and landing of aircraft, as shown in the diagram above.

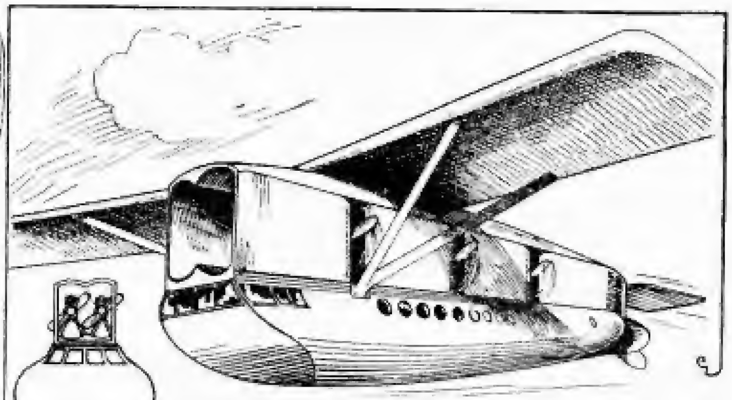
The picture at the right shows the Jenkins launching platform for use on buildings.



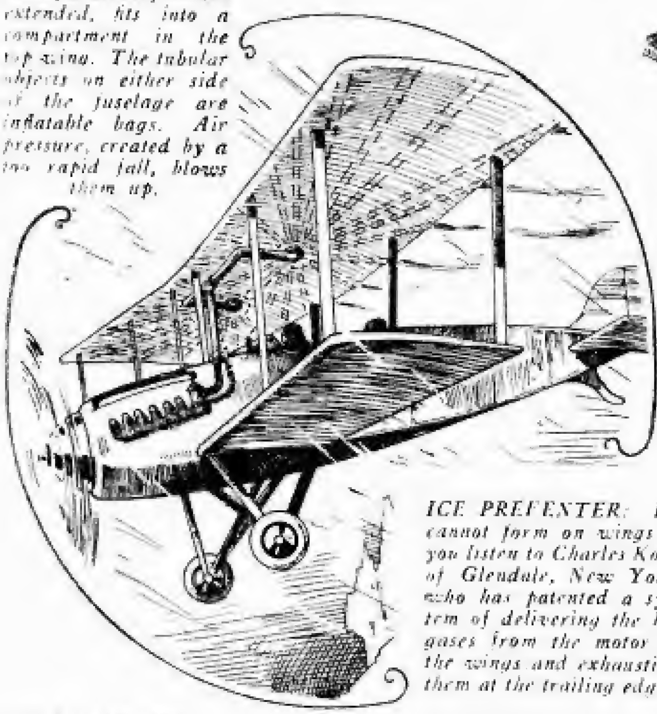
New Aviation



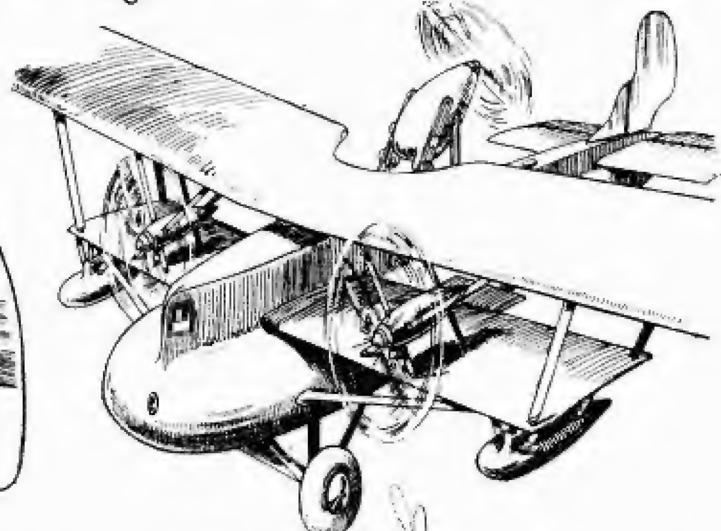
SAFETY PLANE: If James E. Lowe's dream materializes we will have a safe plane. The parachute, shown extended, fits into a compartment in the top wing. The tubular objects on either side of the fuselage are inflatable bags. Air pressure, created by a too rapid fall, blows them up.

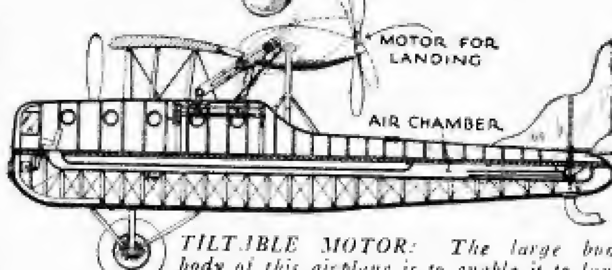


TUNNEL AIRBOAT: This peculiar craft has its propellers in a special tubular housing, to increase efficiency and speed. Its inventor is M. E. Zwinkel.



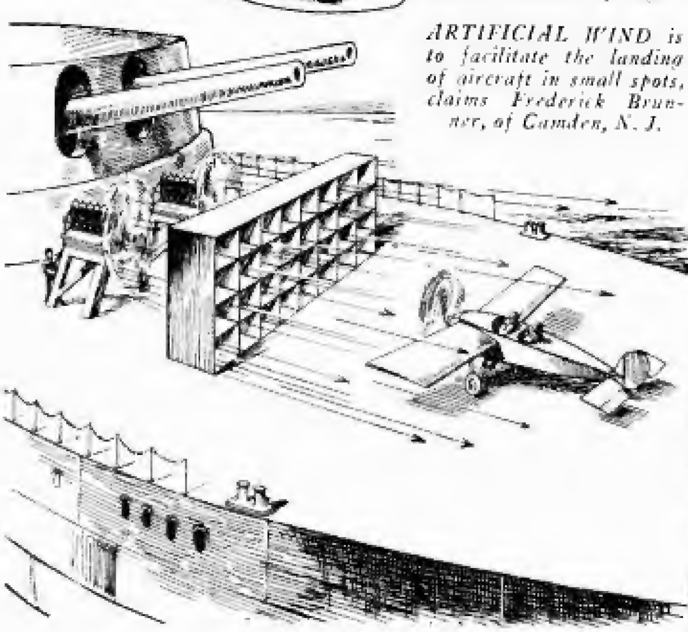
ICE PREVENTER: Ice cannot form on wings if you listen to Charles Koch of Glendale, New York, who has patented a system of delivering the hot gases from the motor to the wings and exhausting them at the trailing edges.

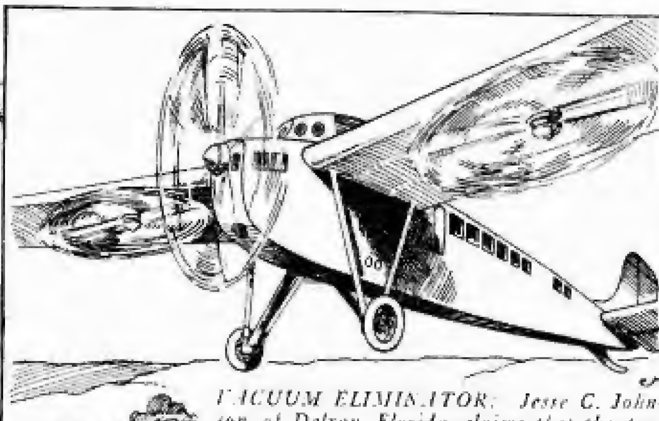




TILTABLE MOTOR: The large buoyant body of this airplane is to enable it to land on water. The body is filled with hot air from the engine exhaust. Giuseppe Cannistra suggests that the tiltable motor be used for landing.

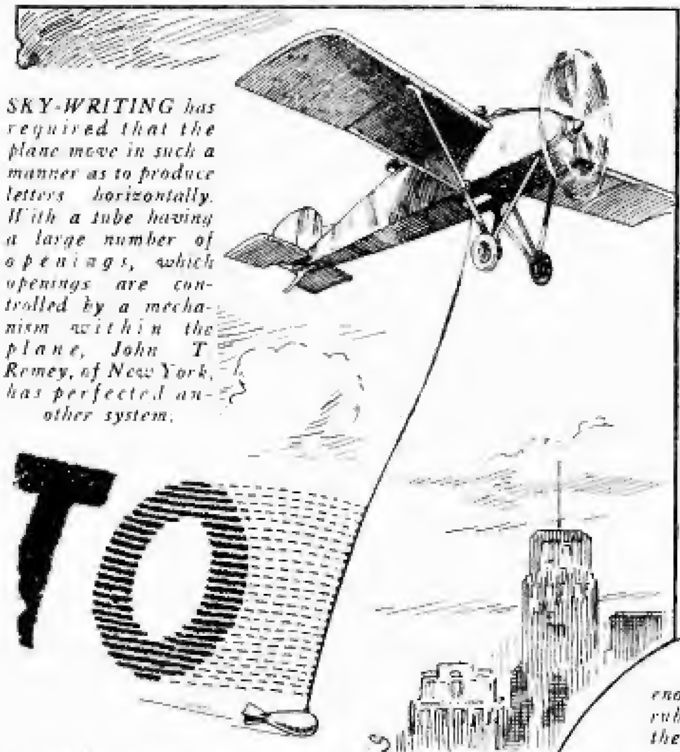
ARTIFICIAL WIND is to facilitate the landing of aircraft in small spots, claims Frederick Brunner, of Camden, N. J.



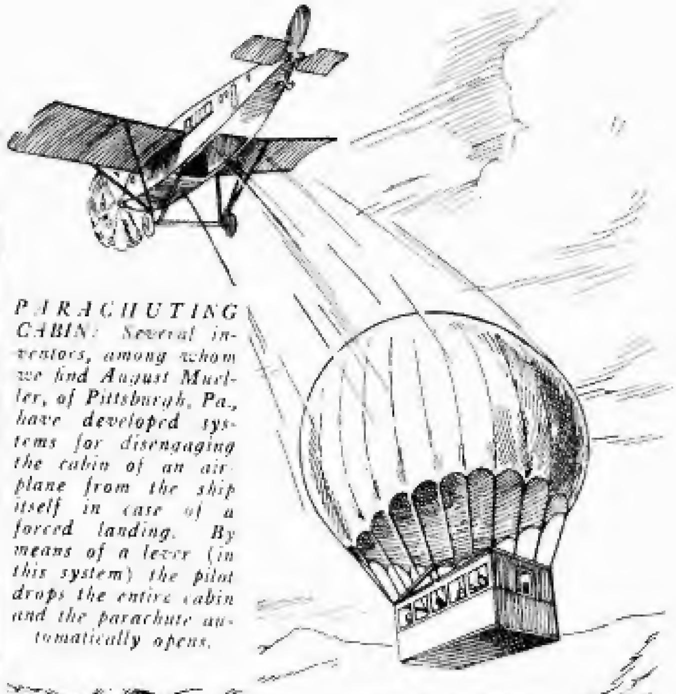


VACUUM ELIMINATOR: Jesse C. Johnson, of Delray, Florida, claims that the propellers at the bottom of the wings of this plane act to eliminate the formation of a vacuum beneath the wings.

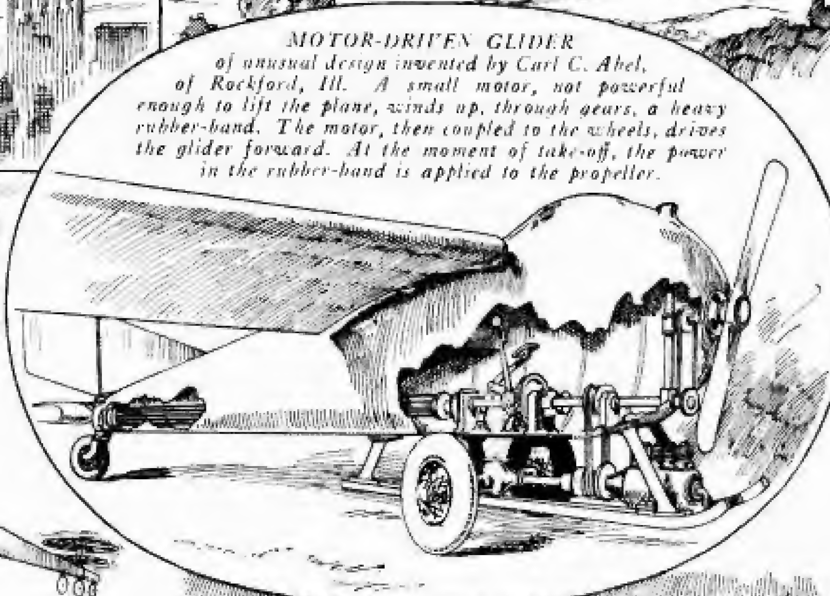
Inventions



SKY-WRITING has required that the plane move in such a manner as to produce letters horizontally. With a tube having a large number of openings, which openings are controlled by a mechanism within the plane, John T. Remey, of New York, has perfected another system.

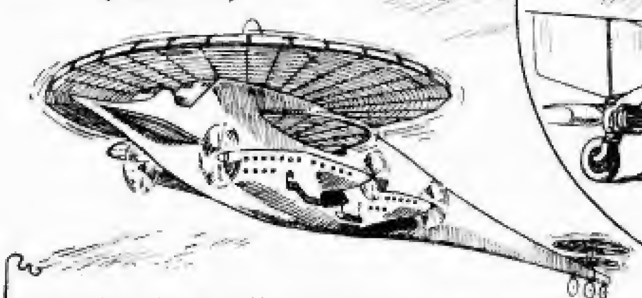


PARACHUTING CABIN: Several inventors, among whom we find August Mueller, of Pittsburgh, Pa., have developed systems for disengaging the cabin of an airplane from the ship itself in case of a forced landing. By means of a lever (in this system) the pilot drops the entire cabin and the parachute automatically opens.

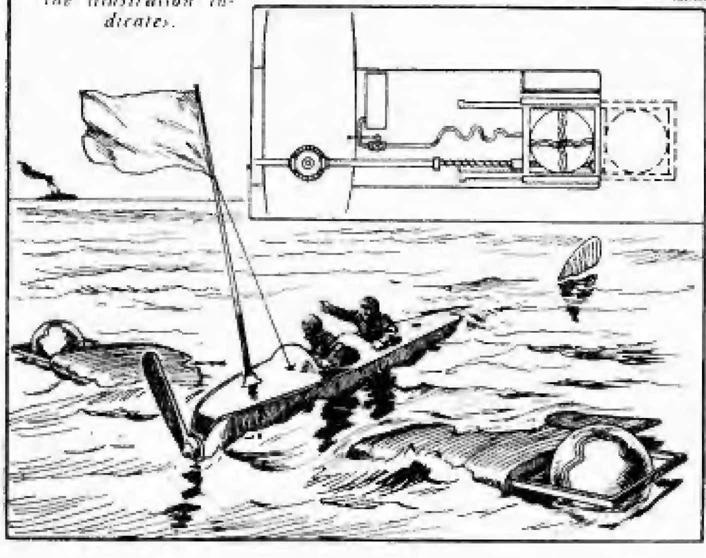


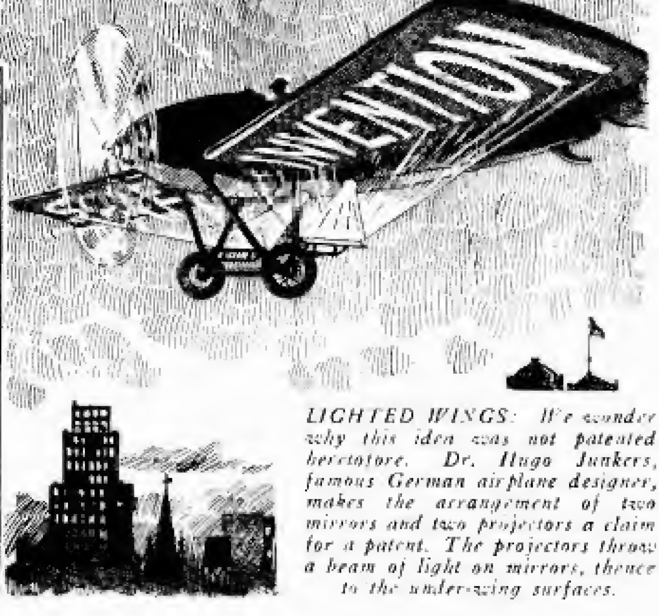
MOTOR-DRIVEN GLIDER of unusual design invented by Carl C. Abel, of Rockford, Ill. A small motor, not powerful enough to lift the plane, winds up, through gears, a heavy rubber-band. The motor, then coupled to the wheels, drives the glider forward. At the moment of take-off, the power in the rubber-band is applied to the propeller.

COMBINATION AIRSHIP AND DIRIGIBLE has large rotating disc-like air foils, filled with hot gases; its bird-like body is also so filled. Its inventor is Guido Tallei, of Rome, Italy.

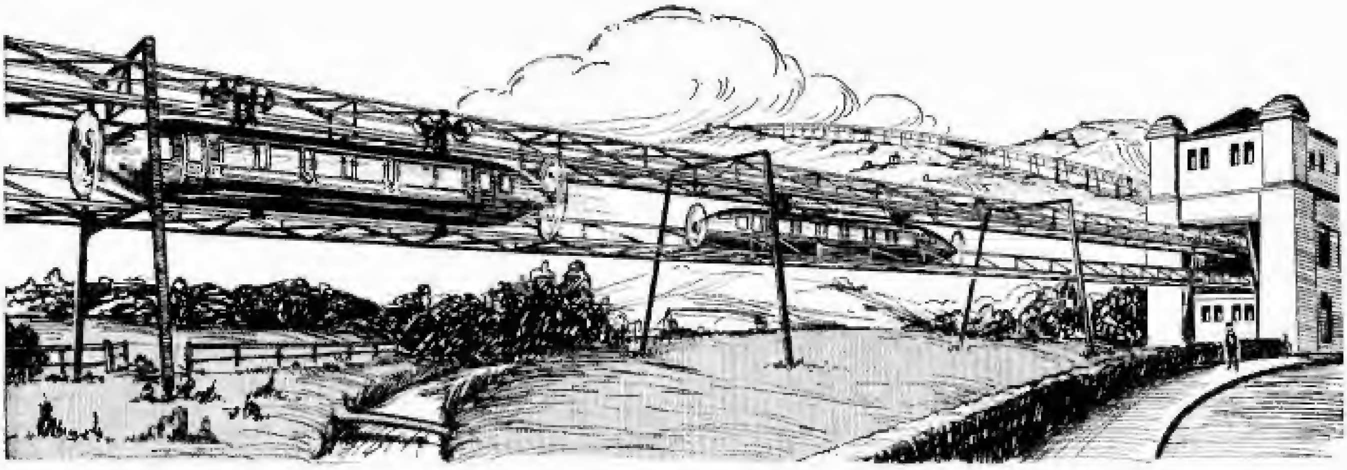


ANOTHER SAFETY PLANE for oceanic flights, patented by Domenico Pallaria, of London, Ont., Canada, each wing being fitted with a slide, housing an inflatable ball. These can be blown up by a source of compressed air supply, as the illustration indicates.

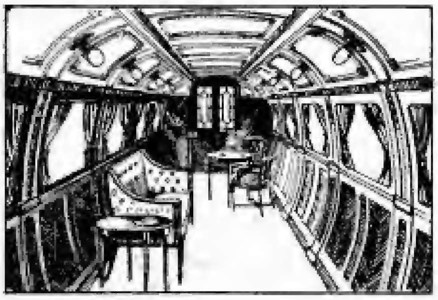




LIGHTED WINGS: We wonder why this idea was not patented heretofore. Dr. Hugo Junkers, famous German airplane designer, makes the arrangement of two mirrors and two projectors a claim for a patent. The projectors throw a beam of light on mirrors, thence to the under-wing surfaces.



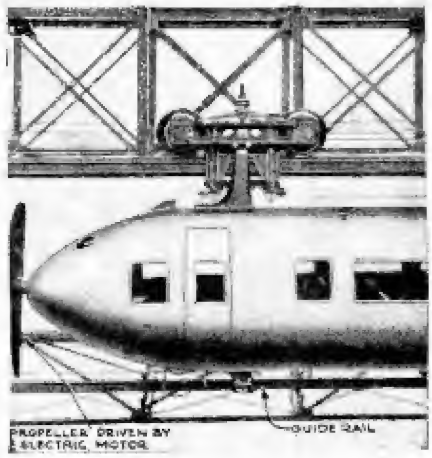
Railway Cars Take Wings



Interior view of the saloon of one of the railplane cars, showing a sumptuousness equal to a transatlantic ship's saloon.

A RAILWAY system with cars that will travel at speeds of 120 miles an hour is now being constructed for test purposes over a tract of the London and North Eastern Railway Company at Milngavie, near Glasgow. The cars of this system will be of light airplane type of construction and will be suspended from single overhead tracks. They will receive their motive power from airplane propellers. The design of the cars may be such that at high speeds they tend to rise slightly in the air, on the principle of an airplane, and thus relieve to a great extent the friction due to the weight of the car.

The overhead tracks are carried on trestles or columns placed at suitable intervals, and a rigid guide rail is provided under each car, to prevent undue swaying of the car. The design of the cars is such that their tendency to rise in the air beyond the amount required to relieve the weight is checked.



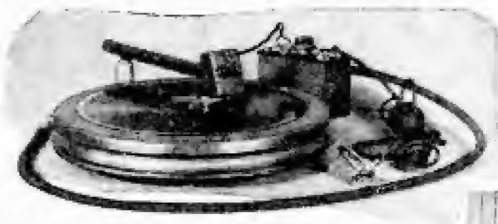
Fresh Sea Air Without a Fan

IN place of fans in the staterooms of the Ile de France, there are ventilating ducts as shown. Fresh cool sea air is distributed from a centralized ventilating system.

The arrow points to the outlet on the wall of the stateroom. The direction of the breeze may be changed by turning the nozzle.

Make Your Home Movies Talk

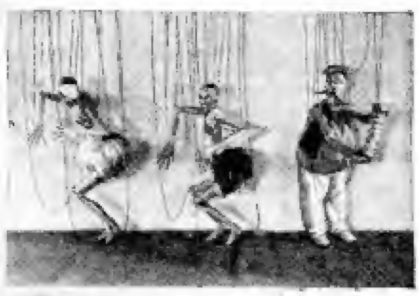
By Don Bennett

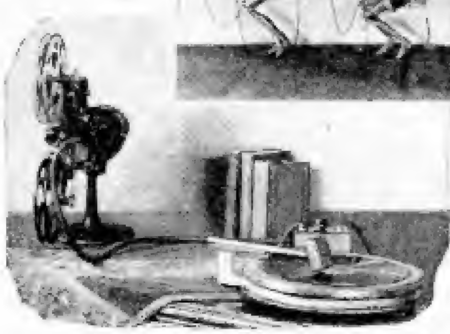


A NEW device has made its appearance in the home movie field that gives promise of increasing the entertainment of home movies. This device provides for the reproduction of talking pictures, such as are run in the theatres, in the home through the medium of the home projector, to which it is attached, and the radio set.

The device resembles a phonograph, with its turntable and electric pick-up, but it is connected to the home projector, regardless of type or make, by a flexible shaft and derives its power from the projector motor. It can be used as a phonograph without the pictures, running either kind of record.

The turntable is rotated by a friction wheel which is located under it. The speed is adjusted by sliding the friction wheel radially along its shaft. A gauge is provided so that the wheel may be instantly set to a predetermined position, control being located in a small knob on one edge of the machine.





The device is shown to the left and above. The marionettes were used in producing a home talkie sound film.

The films that are made for use on this new machine are made under the identical conditions by which theatrical talkies are made. All synchronization troubles are overcome in this device.

Skyhooks for Airplanes

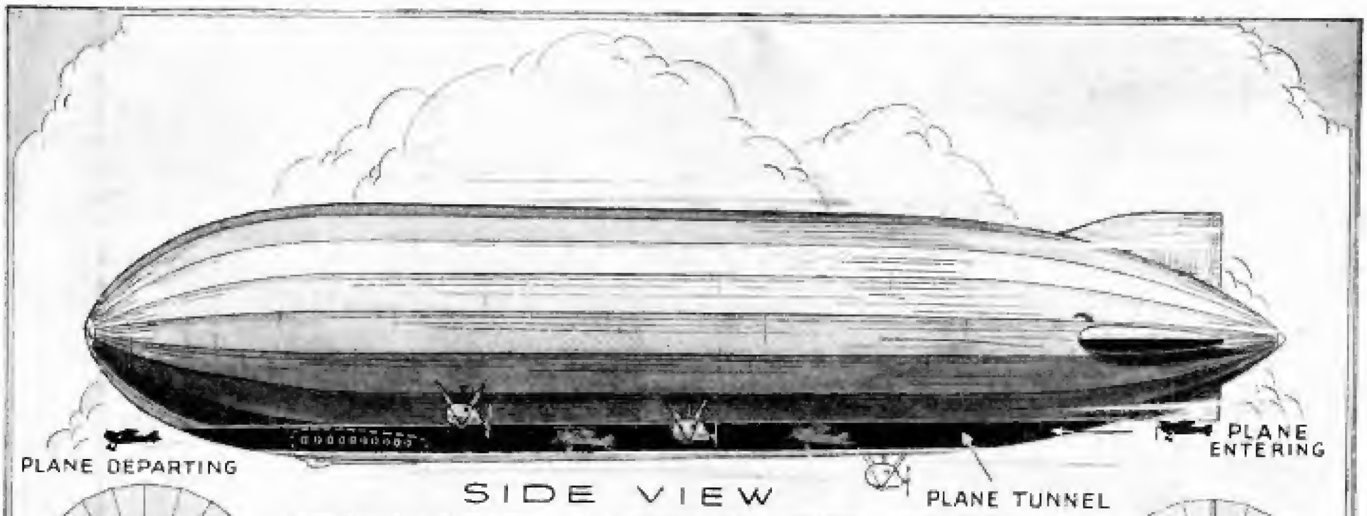
By Botho von Romer

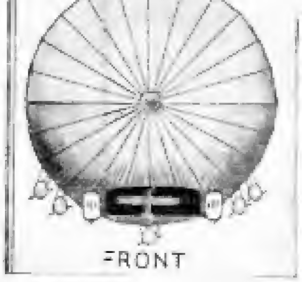
Los Angeles Makes Successful Tests in "Hooking" Planes in Mid-Air

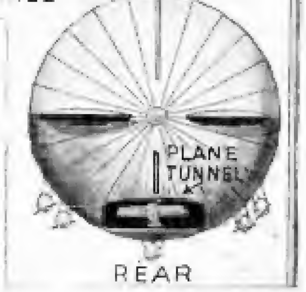
DURING the World War, military officials in Germany made tests with a flying airplane hangar. High speed planes used for delivering important messages were suspended from dirigibles. They were released while the carrier was in midair and in motion. Although these experiments were encouraging, little information regarding them was made public. After the war this problem was taken up in England and first practically carried out with a De Haviland light plane, type 53, and later with a Gloster pursuit plane on the dirigible R-33.

In America we have gone a step further and have been successful in recovering the planes after they have been discharged from the dirigible. The construction of one form of auxiliary apparatus employed in this feat is shown in the drawing appearing on this page. In order for the plane to engage with the dirigible, both must be traveling with the same approximate air speed. The pilot of the plane tries to reach the trapeze grappler, hanging from the dirigible with the grappling apparatus attached to the upper wing of the plane. In a similar way the attached plane is lowered, the motor of the plane is started and, when sufficient speed has been obtained, the plane is released and flies away. The dirigible *Los Angeles* recently carried on several successful tests with a standard size plane of average weight. The plane coupled itself to the dirigible trapeze gear three times, each time disengaging itself, then maneuvering into position and reattaching itself to the mother ship. Naval experts predicted extensive use of this liaison service between dirigible and plane in the future.

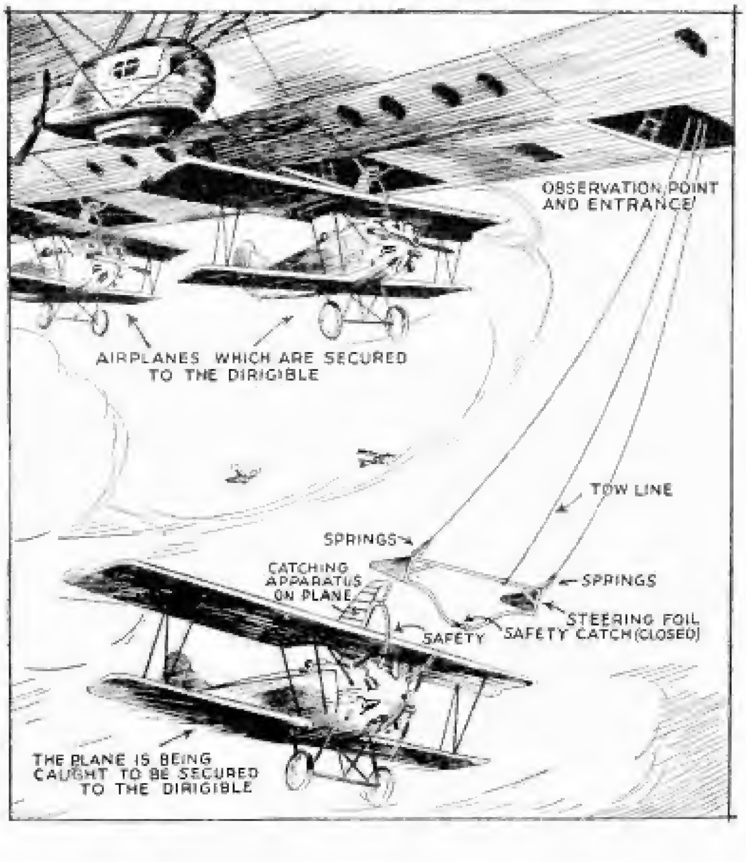
Naval and military experts are now considering flying airplane hangars. These are of unusual design and undoubtedly far better than those which make use of a grappling attachment. A tunnel extends along the entire bottom of the dirigible, with an opening at the front and the rear. The tunnel is fitted with a smooth floor, which forms a platform for the landing and take-off of airplanes. The landing plane flies through the rear of the tunnel and emerges from the front when launching. The tunnel provides a place for reserve planes and also holds them while they are being repaired.







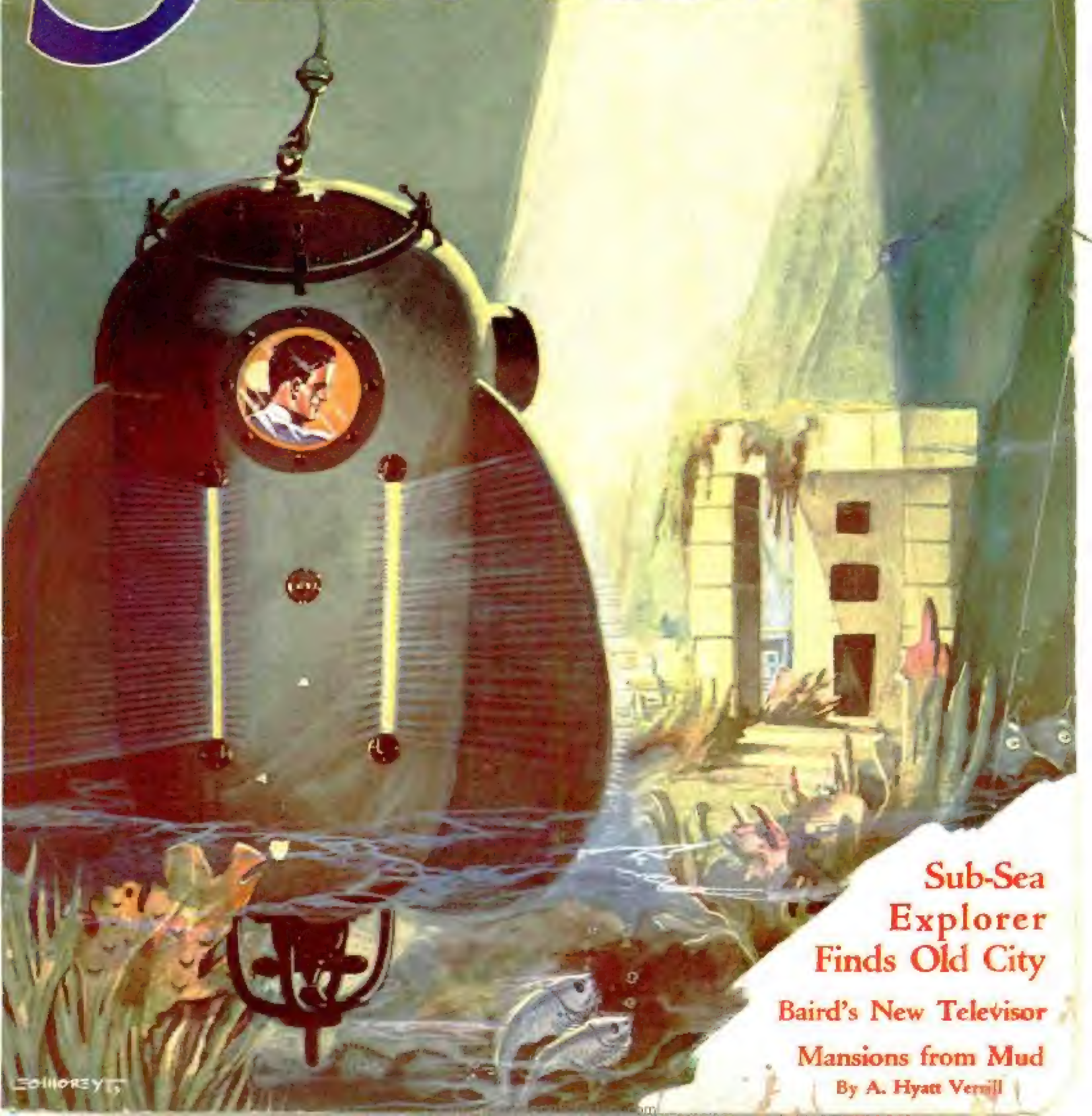
Above are a front, rear and side view of the flying airplane hangar. A tunnel is provided along the bottom portion of the dirigible and forms a landing and take-off platform for the airplanes.



The illustration at the right shows how planes are now caught and secured to the dirigible while in midair. In a similar manner, by using the grappling apparatus, planes are launched from the mother ship. The motor on the plane may be started electrically and when sufficient speed has been developed the craft is released.

DECEMBER 25 CENTS

Science and Invention

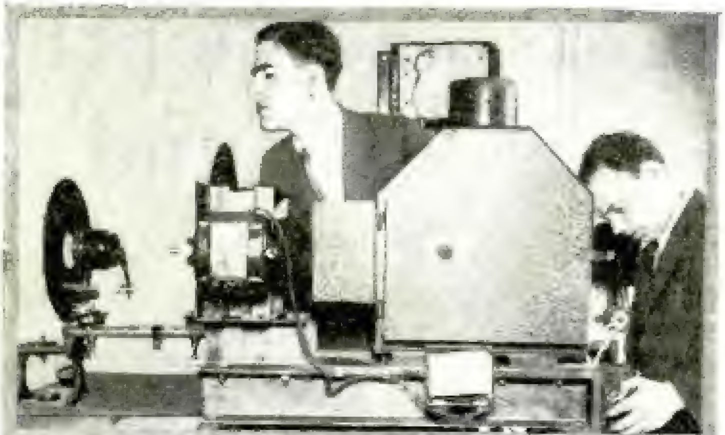


Sub-Sea Explorer Finds Old City

Baird's New Televisor

Mansions from Mud

By A. Hyatt Verrill



Baird's *Newest* Televisor

Designed to bring "Talking Movies" into your home

By H. Winfield Secor

VOICE and facial image were simultaneously flashed over the wires by means of the newest Baird experimental television system recently, in a demonstration to an audience of newspapermen given in New York City. The presentation was carried out under the direction (*Continued on page 732*)

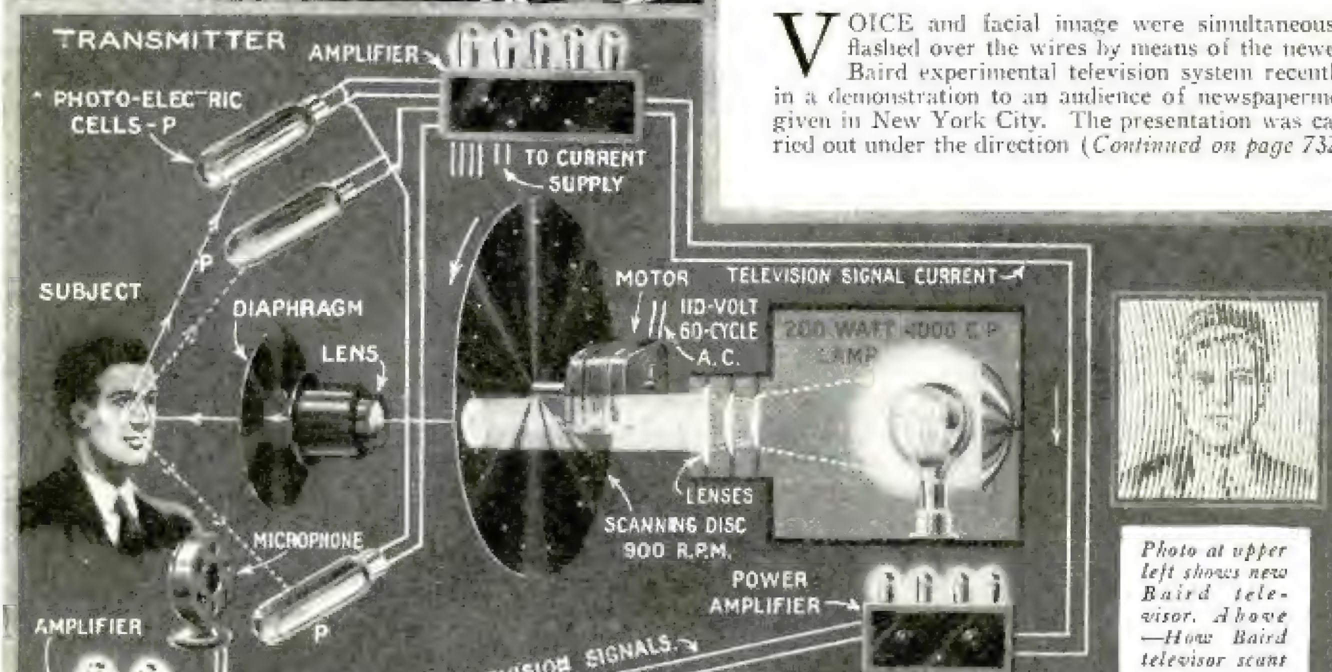


Photo at upper left shows new Baird televisor. Above—How Baird televisor scans image horizontally instead of vertically.

Photo-diagram at left shows new Baird combined voice and image system, adapted to either regular television or to talking movie broadcasting. Instead of using an arc at the transmitter, a 2,000 c.p. incandescent lamp is employed. The scanning disc passes the light pencil onto the face of the subject, the reflected rays falling on the photo-electric cells, P. The fluctuating television currents are amplified and affect correspondingly the brilliancy of the neon tube at the receiver.

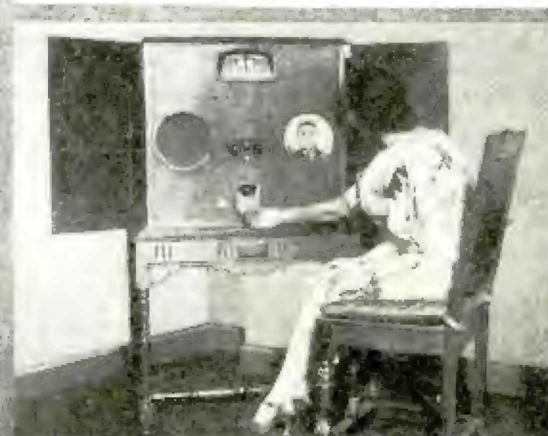
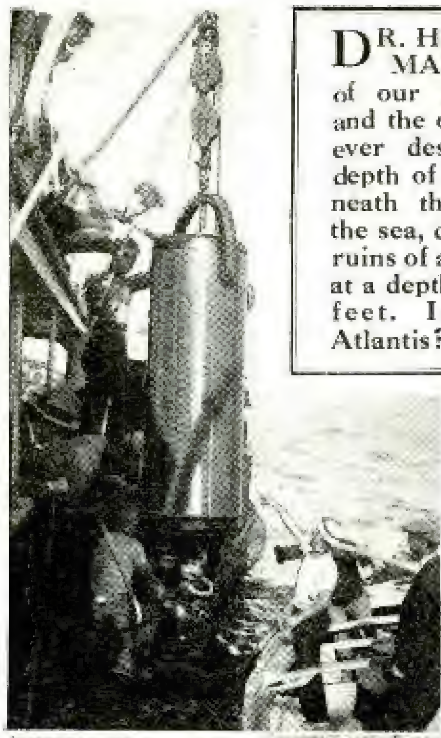
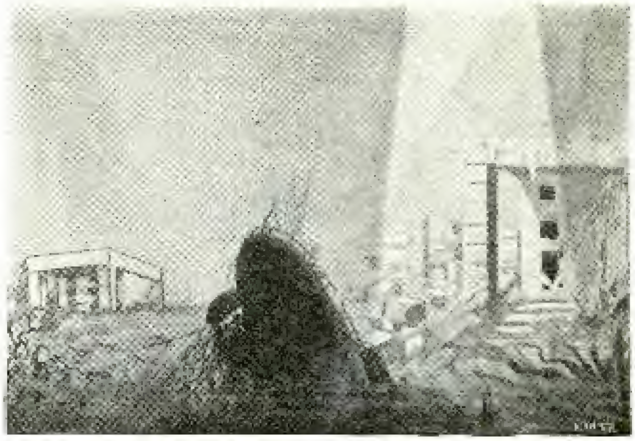


Photo at right shows the Baird experimental television receiver for both voice and image. The loud speaker is at the left while the lens and its television image are seen at the right. The observer is shown in the act of tuning in a station.



DR. HANS HARTMAN, the hero of our present story and the only man who ever descended to a depth of 2,500 feet beneath the surface of the sea, discovered the ruins of an ancient city at a depth of about 350 feet. Is it the lost Atlantis?



2,500 FEET UNDER *the*

American Scientist Breaks All Depth Sunken City in the Mediterranean.

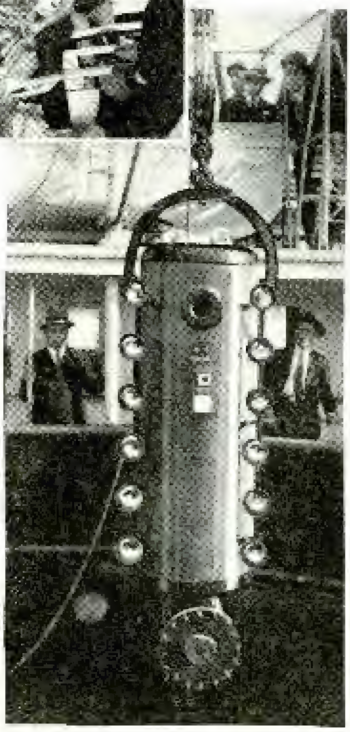
An Interview with

Dr. Hans Hartman

By H. E. Serner

Consulting Engineer

THE Hartman deep-sea exploring bell, in which he was later submerged to great depths never before reached by man, is shown being hoisted overboard in the Mediterranean in the photo above. In the model of diving bell here shown, the "movie" camera was enclosed in a separate steel bell fitted with a quartz glass window, and attached to the bottom of the bell with a magnetic coupling; if the main bell became fouled, the operator could release it, causing the bell to rise.



IN the photo above the special quartz high candle-power electric lamps are shown on either side of the diving bell. Dr. Hartman can be seen standing at the left of the diving bell in the photo above; while the photograph at the immediate left shows the diving bell being lowered into the waters of the Mediterranean. The top steel cover on the bell is bolted on, but in the newer design of bell quick-acting hand-screw clamps will be employed, the old design requiring too much time to open. In all such sub-sea work, it is imperative to be able to release the diver quickly in case he should collapse and have to be hauled to the surface.

COURAGEOUS men went to frozen poles, into tropical wilds and burning deserts in quest of knowledge. Others traced ancient culture, establishing piece by piece the earliest dawn of human civilization. The earth has now been explored and white spots on the maps have vanished.

And yet—the greatest veil lingers—a veil covering the mysteries of more than two-thirds of the globe. The depths of the oceans are still unknown. True, they have been sounded, and fragile nets brought up a few of the smallest luminous denizens of that mysterious abyss, proving that life extends far down into the greatest depths, into eternal darkness and tremendous pressure.

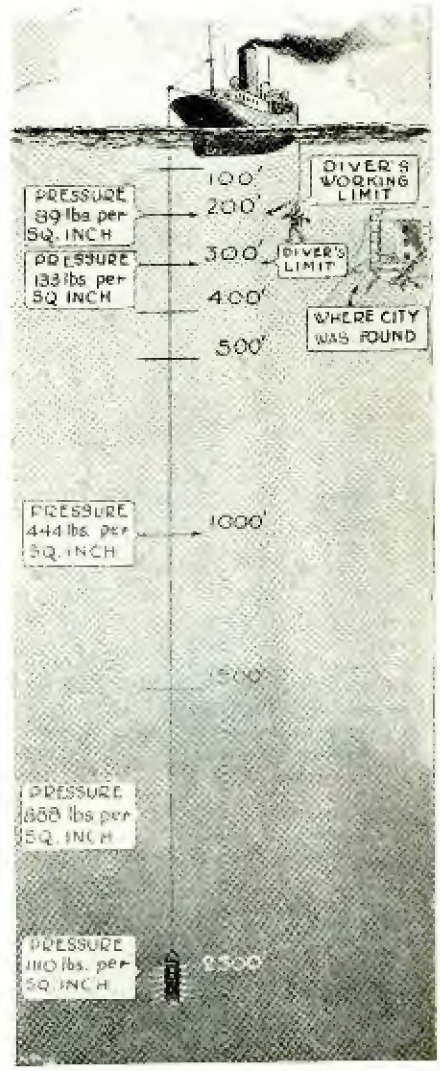
According to science all life began in the water. From microscopic forms in the flat shelves of the ocean it grew to gigantic types, the Saurians who probably were wiped out by the first ice-age, after some had emerged and lived on land while others went deeper and deeper during untold generations to the ocean floor. Those great depths were not affected by the ice which may have enveloped our earth for ages to be counted perhaps by many thousands of years. Are their monstrous descendants still down there and have any higher forms of life been gradually born in that unknown abyss? We do not know!

What are the obstacles in the way of exploring the ocean depths? Only pressure and darkness! Can they be surmounted by modern engineering science? Three hundred years ago the diving bell with open bottom was invented and much later diving suits; both exposing their users to the pressure of the water. Since then almost no real progress can be recorded. A few pioneers tried at the risk of life and fortune, to descend deeper with devices they invented. But they seldom found moral support, or financial

THE latest Hartman deep-sea bell: 1, magnet coupling; 2, clamps; 3, oxygen; 4, depth gauge; 5, window; 6, movie camera and window, 7; 8, air purifier; 9, propeller motor.

INTERESTING telegram received by Dr. Hartman from Mussolini appears at the left and reads as follows:
Dr. Hartman, Hotel Excelsior, Naples, SS Roma: Referring to your letter of the 21 of the present month, we give you authorization for submarine photographic operations for scientific purposes at Capri and the Pozzuoli Gulf, and Baia and Cape Miseno. This is by arrangement from the military authorities in Naples. Marine Minister, Mussolini.

SOME idea of the remarkable depth obtained by Dr. Hartman in his Mediterranean sub-sea explorations with his Krupp built steel diving bell will be gained by looking at the picture at the right. Here we see that a diver reaches his limit at about 300 feet below the surface where the pressure is 133 lbs. per sq. inch.



SEA Records and Discovers Is It the Lost Atlantis?

assistance. Some were ridiculed, others lost their lives. Some inventors constructed armored diving suits, which were very dangerous due to many joints which afforded possible leakage of water. Others built hermetically closed diving chambers.

One of the later pioneers in this magnificent and virgin field is Dr. Hans Hartman, an electrical engineer of New York City, who has worked and dreamed all his life to penetrate the depths and illuminate and photograph the secrets of the sea. Already in the December number of 1916, this magazine described and illustrated his automatic deep sea camera, for which the U. S. Navy Department placed the *U. S. S. Vestal* at his disposal, to enable him to make tests and experiments. Dr. Hartman soon found that he needed a diving chamber, wherein he could accompany his camera down on its perilous way.

After several years of work following the close of the World War, Dr. Hartman had developed a deep sea diving cylinder, organized a small expedition to the Mediterranean sea, where he conducted, handicapped by limited finances, interesting research work in and around the Gulf of Naples, photographing submerged ancient ruins of Roman palaces, of the sunken city of Paleopolis and also the subaqueous arch which illuminates the famous Grotto of Capri. Premier Mussolini himself overruled obstacles made by local authorities in Naples, by telegraphing from Rome to Dr. Hartman his special permission. Europe became interested in the American submarine explorer's work (*Continued on page 738*)

The Man Who Found the Sunken Prehistoric City Off the Coast of Africa

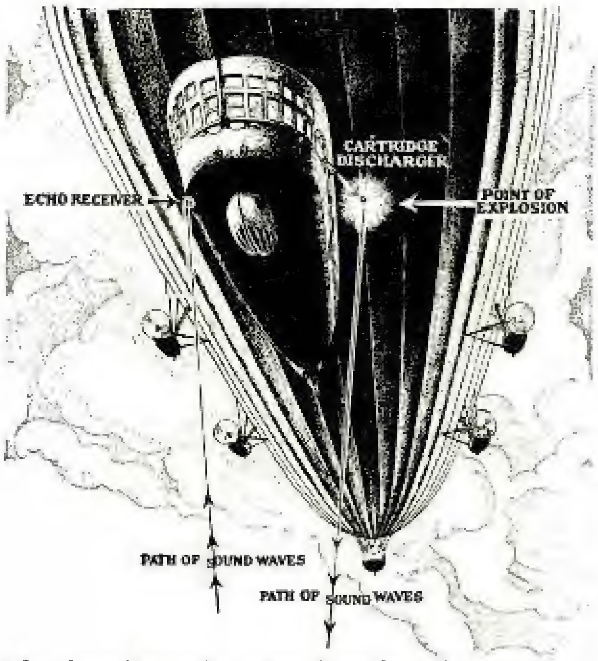
IN conjunction with his consulting engineer, Mr. H. E. Serner, the author of the accompanying article, Dr. Hartman designed the steel cylinder shown in the accompanying pictures. The editors have inspected the final construction blue-prints made by the famous Krupp steel experts in Germany, who built the seamless steel bell used in these remarkable explorations at great depths. The Krupp built steel bell was designed to stand a pressure of 2,500 pounds or a sub-sea depth of about 5,000 feet. Dr. Hartman descended to a depth of 2,500 feet. Dr. Hartman and his colleague, Mr. Serner, deserve the highest credit for their energy and courage.

Dr. Hans Hartman has just returned from Europe and this exclusive story tells of the wonderful discoveries he has made in the Mediterranean, off the coast of Sicily.

The map reproduced above shows the point between Sicily and the coast of Africa, where the prehistoric city was discovered.

Measuring Heights *and* Depths *with* Sound

By Botho vôn Romer

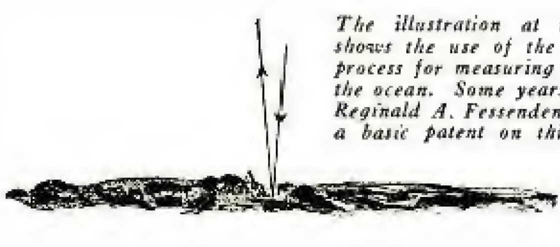


The above illustration shows how aircraft may determine their height above the ground by means of an echo measurement system. The sound reproducer is fastened to the fuselage from which the cartridge is discharged. The sound waves go to the surface of the earth, as shown below, and are reflected back to the craft.

FORMERLY the measuring of the depths of the sea was restricted to the seaman's lead with its measured rope or wire. In the most modern times an entirely new method for measuring depths has been developed. The system of echo measurement here described is that devised by the well-known physicist Behm, who, after lengthy research, has succeeded in bringing his experiments to a brilliant and successful conclusion. The illustration appearing here shows how the sounding process is used for measuring depths. The solution of the echo-sounding problem was obtained when Behm used the damping agency, which the hull of the ship provides, to prevent the echo receiver from being affected by the direct action of the sound signals when they are discharged on the other side of the ship.

On one side of the ship, by means of a cartridge, an explosion signal is given, through which agency it is quite possible to measure slight depths of the channel. After the cartridge is released, an explosion occurs when it has penetrated 3 to 6 feet below the surface of the water. The sound waves which are first received by the so-called discharge receiver go down through the water until they reach the bottom and are then reflected back to act upon the echo receiver.

By means of a time-measuring device, the interval from the starting of the sound waves, after the cartridge has exploded, until the sound wave is received by the echo receiver, can be measured accurately and produces a visible record. The exact time which has intervened can then be read off on a scale, which may either be used for depth measurements or for height measurements.



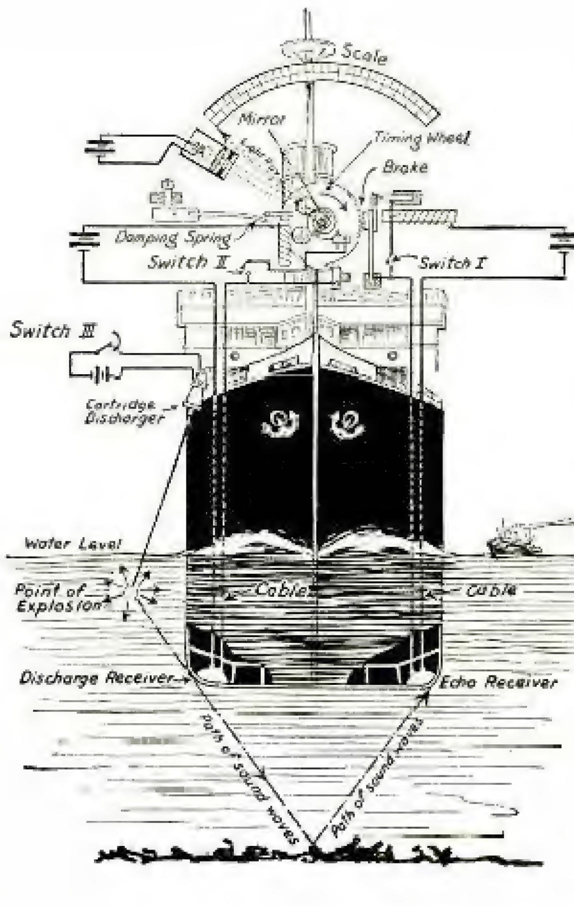
The illustration at the right shows the use of the sounding process for measuring depths in the ocean. Some years ago Dr. Reginald A. Fessenden obtained a basic patent on this system.

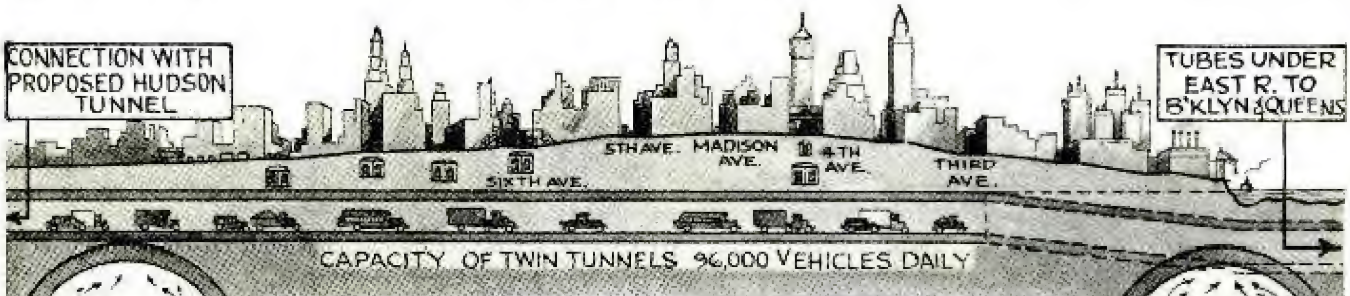
When the measuring system is to be used by a dirigible or airplane, the sound producer is fastened to the fuselage from which the cartridge is discharged. The point of explosion is thus clearly defined. The sound waves go down to the surface of the earth and are reflected back to the echo receiver. Behm has succeeded in measuring heights in airplanes using this method which gives an extraordinarily rapid estimation of the height of the elevation of the airplane or dirigible within an accuracy of about one foot.

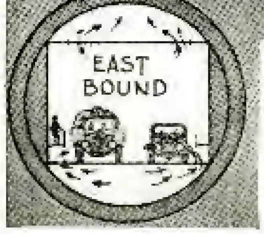
Measuring by Radio

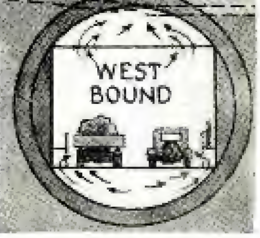
FOR the last five or six years the United States Coast and Geodetic Survey have employed a method called "Radio Acoustic Ranging." It is used to determine exactly the position of the survey ship during hazy or foggy weather or when the ship is out of sight of land. The purpose of the survey is to chart the coast lines at regular intervals out to a certain depth. In using the radio method there are two shore stations set out by the ship about 35 miles apart. Each of these is equipped with a radio transmitter, receiver and a three-stage bomb audio amplifier. About a thousand yards off shore is a box containing three hydrophones. At a given signal a bomb is dropped overboard from the ship and the exact time and log reading are taken at that instant.

In the ship's radio shack is a chronograph which records seconds with one pen and under-water sounds and radio signals with another pen. As the bomb explodes, the chronograph pen makes a dash on a tape. *(Continued on page 757)*









Gotham Plans *New Tunnel*

Above, diagram of the proposed tri-borough tunnel, showing various exits to New York's main traffic arteries. Left to right, cross-section of twin tunnels under East River.

NEW YORK has seen in the rapid growth of the automobile merely one more transportation problem. The task of keeping commercial and pleasure traffic moving has been the greatest dilemma the city fathers have been faced with in some time.

To aid in the solution of this commercial conundrum, a new tri-borough tunnel has been proposed, which will link the boroughs of Queens and Brooklyn with Manhattan. This tube will be similar in construction to the Holland Vehicular Tunnel, which connects New Jersey with New York, except that it will be larger and embody several improvements. One of these improvements is the proposed double-decked tube under Manhattan. It will consist of twin-tubes passing under the East River and having numerous exits in all three boroughs. In Manhattan it will be connected with all the main arteries of traffic, passing up 38th Street to Lexington, Fourth and Fifth Avenues, and in Queens and Brooklyn it will have one main exit leading to a strategic point of distribution.

This tunnel, in spite of its high proposed cost ($100,000,000), has been looked upon with much favor and with serious thought on account of the huge success of the Vehicular Tunnel under the Hudson River. Its capacity will be 4,000 vehicles per hour, which is 200 more than that of the Holland Tunnel. It will provide an easily accessible outlet for the large amount of traffic which daily plies between these home boroughs and the business borough of Manhattan.

New Ways to Detect *Icebergs*

By Dr. Howard T. Barnes

McGill University

I HAVE recently returned from an Iceberg Expedition, which was made for the express purpose of finding some method of detecting icebergs by means of illumination. As the use of searchlights has been abandoned, since the fog reflects back the light and blinds the eyes of those on the bridge, it was my hope to develop some powerful lights which could be thrown sufficiently far ahead of a ship, to enable the light to penetrate the fog and silhouette the iceberg. In case the fog was too dense, it was my intention to adapt a photo-electric cell sensitive to the infra-red rays; so that the shadow of the iceberg could be made audible, through one or two stages of amplification. We used parachute flares, but they do not seem practical, as they are too much at the mercy of the four winds of heaven. Fortunately I was able to stumble upon a simple method of detecting icebergs by using a low-pitched submarine microphone, which gave loud and distinct sounds of the melting iceberg six miles away. Temperature changes are also noted in the water at considerable distances.

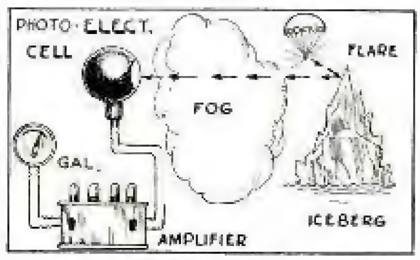
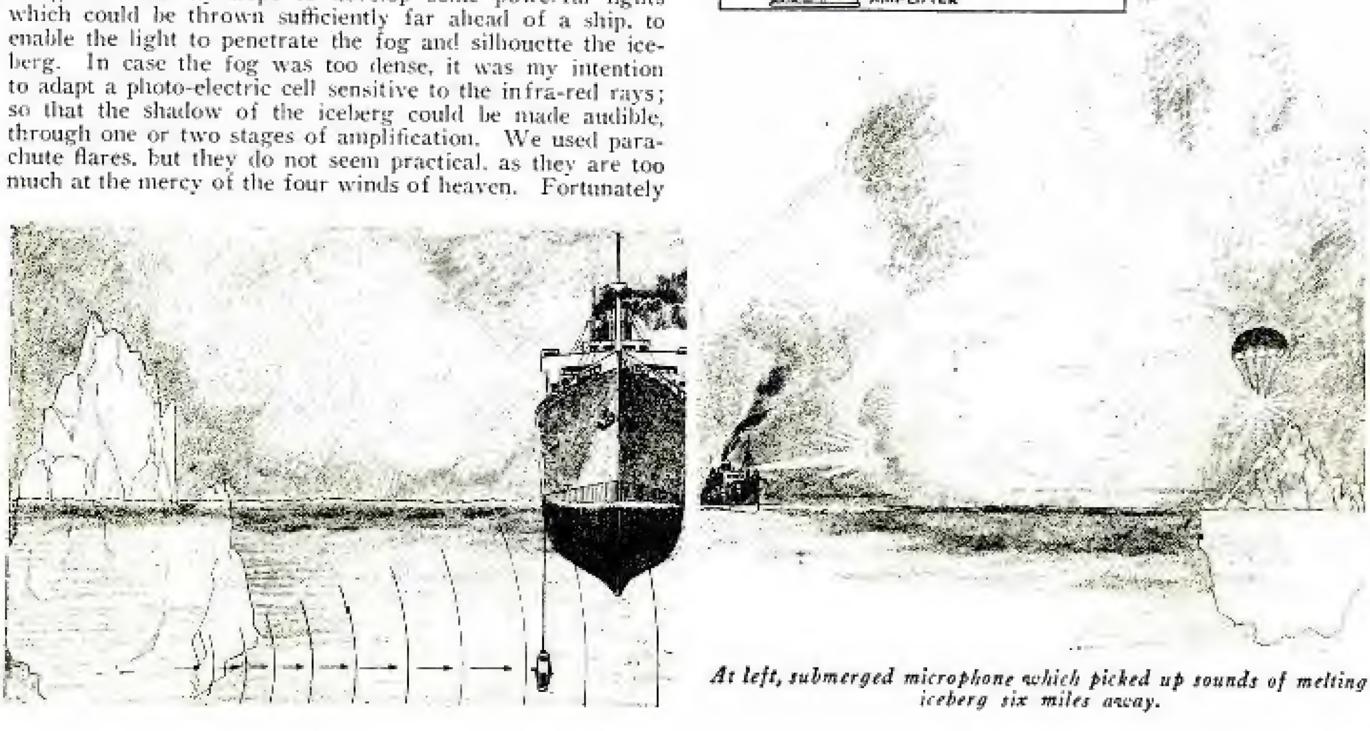


Diagram showing parachute flare and light effect on photo-electric cell.



At left, submerged microphone which picked up sounds of melting iceberg six miles away.


FEBRUARY
25 CENTS
Science and Invention
SKI PLANING
By Dr. T. O'Conor Sloane
DIRIGIBLES OR PLANES?
By Augustus Post
When Fate Fooled "Ching Ling Foo"

Let's Go Ski-Planing

by DR. T. O'CONOR SLOANE

The ski-plane taking off.

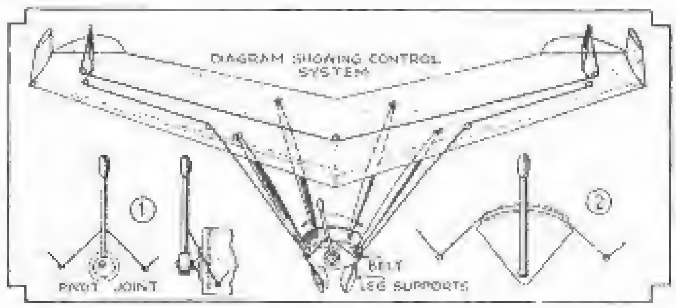
A Distinct Novelty In Winter Sports Is Here Presented And Combines The Art of Gliding With That of Skiing.

GLIDERS have been flown in various ways, such as by running down a hill until the glider attains sufficient flying power to lift its occupant along with it; in other cases gliders have been towed by an automobile until its wings found sufficient lifting power in the air to sustain its pilot, the tow rope then being cast loose, after which a considerable distance can be negotiated by the glider.

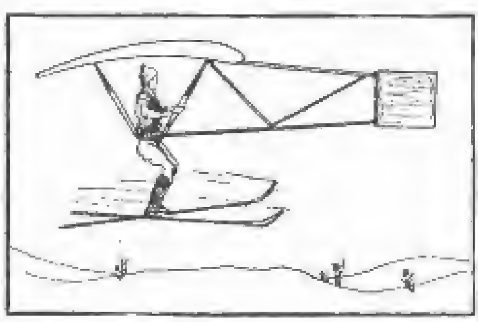
This new sport of ski-planing which I am here presenting should find great favor with all devotees of outdoor winter sports. Almost any kind of glider will do, but the tailless type here illustrated most prominently is ideally suited to this new sport, as there is no tail to drag down on the ski-slide. Another way of obviating the tail difficulty, if a straight-wing glider of the orthodox type is to be used, is to place the tail in front of the glider, as one of the accompanying illustrations shows—on the same order as the early airplanes which frequently had the tail or stabilizer in the front instead of behind.

One of the pictures herewith shows a German tailless glider of the power type: that is, it is fitted with a small engine in the rear, together with a propeller, so that once the glider is launched into the air, the pilot can negotiate a much longer flight than he could with an engineless glider. The picture at the bottom of this page shows the increased span which can be jumped with skis after coming down when the glider is used. In other words, this scheme amounts to a new way of launching a glider. Recently an airplane was launched from a special framework built up around a sedan automobile, and this is another suggestion for glider enthusiasts. Working drawings for building gliders have appeared in past numbers of this magazine, notably in the June, July and August; also in this issue.

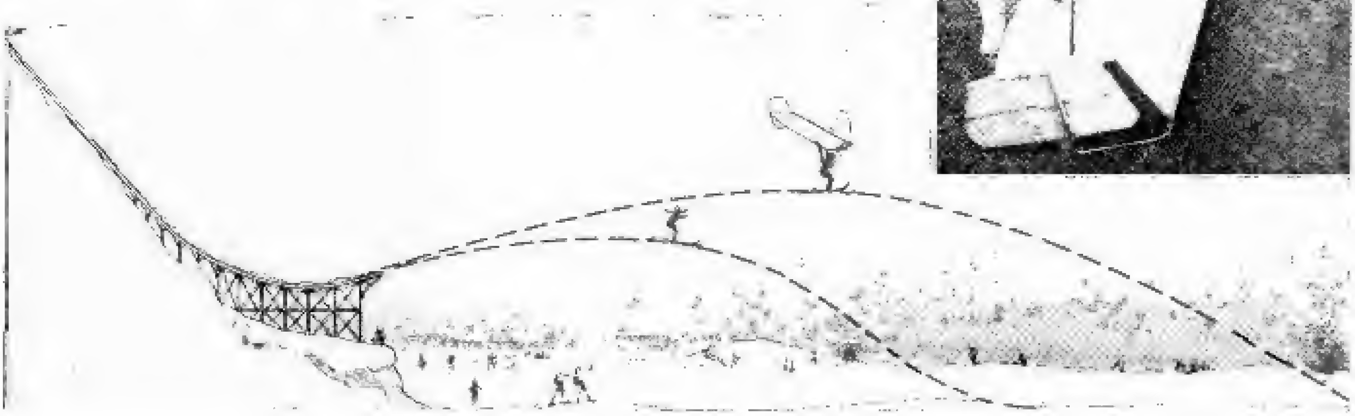
For the purpose of ski-planing the glider does not necessarily need to have a very large wing spread as is the case (*Continued on page* 949)

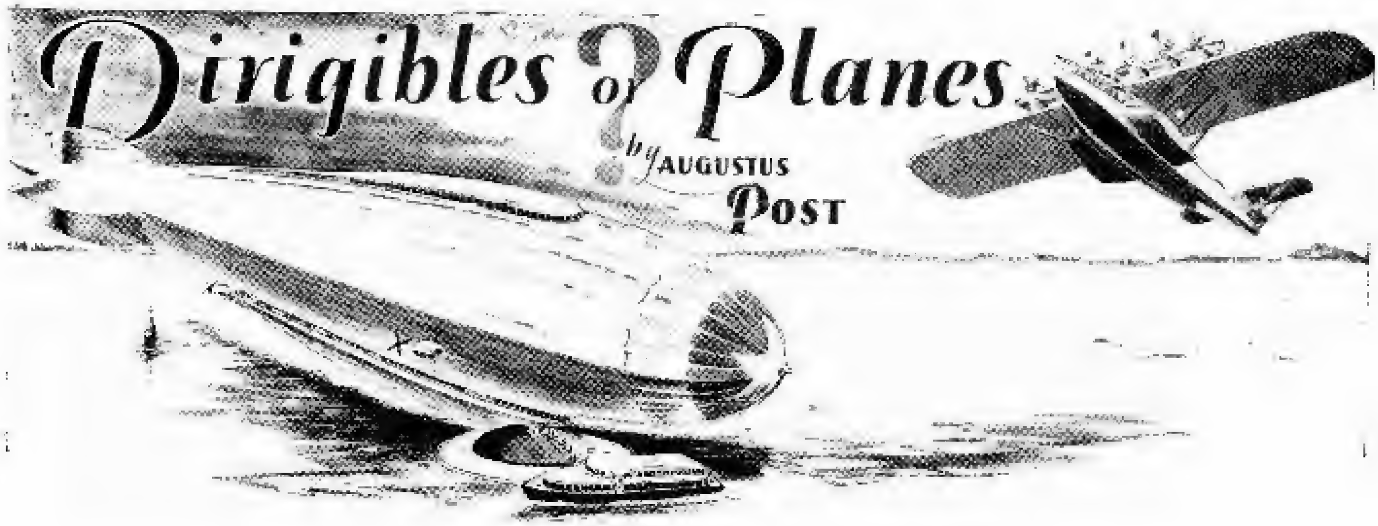


Above—Arrangement of simple controls on the ski-plane. Photo at right—tail-less German power glider



Glider tail may be in front. Greater jump attained with ski-plane shown below.





Dirigibles or Planes

by AUGUSTUS POST

The dirigible landing station shown above is one of the newest German ideas—note the equalizer hanging from the stern.

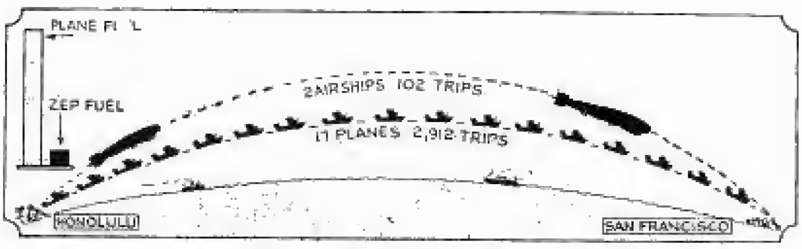
THE perennial question "Which is the better, airship or airplane?" was never more important than at the present moment and the advantages of both are rapidly falling into definite channels and taking shape in commercial form.

Stating the situation in its broadest, simplest form, the airplane has speed on its side while the airship possesses great radius of action. The airplane, of course, must be considered in two types; the land machine and the flying boat. In the matter of speed we have seen that the airplane has far outstripped landing-facilities. The Schneider Cup Race machines, going 368 miles an hour, require landing areas offered only by broad stretches of water. In the same way, the largest airplanes are flying boats (for example; the DO-X, carrying 169 passengers) because it seems impractical to have such tremendous weights taking off and landing from the ground, and if concrete landing fields are essential, a forced landing would be fatal, whereas of course, a flying boat can negotiate an emergency landing anywhere over the water, lake, ocean or river. Speed needs water, and size needs water, so the development of the gigantic commercial transport airplanes is toward the flying boat, as would seem to be the logical procedure.

This, however, is comparatively limited in its range of action. The main reason why the plans of the German Lufthansa for the establishment of regular trans-Atlantic airplane service between Europe and South America have been delayed, is that the longest leg—between Cape Verde and Fernando Noronha, a distance of about 1500 miles—cannot as yet be covered by a large commercial plane, for the radius of the present machine is not sufficient. A range of less than 500 miles for a machine of 60,000 pounds weight is estimated by no less an authority than Dr. Rohrbach, builder of some of the largest German airplanes. The only existing machine that could be depended upon to cover the Cape Verde—Fernando Noronha lap would be the DO-X, which would probably have to be altered for the purpose by adding an extra tank for fuel, which would also reduce the useful load. It is generally admitted that the percentage of useful load will tend to decrease with increase in size. This decrease may be arrested for the time being, by increasing the wing loading per unit of area as the size increases, but it cannot be quite done away with. A five hundred mile range for the 60,000 pound flying boat is all that some authorities predict. With the airship, on the other hand, the efficiency increases with the increase of the size, up to between ten and fifteen million cubic feet size and about 300 tons lift. On the occasion of the launching of the R-101, the editor of the English review *Airways* said: "By its very nature, the airship is a long-distance, weight-carrying aircraft, proving most efficient and economical in the commercial sense when engaged on long journeys and traveling continuously by day and by night." Commander Burney, designer and builder of the R-100, says, "Over long distances, the airship is safer, more economical and more comfortable than the airplane. For short distances—up to five hundred miles—the airplane is, and always will be, superior to the airship."

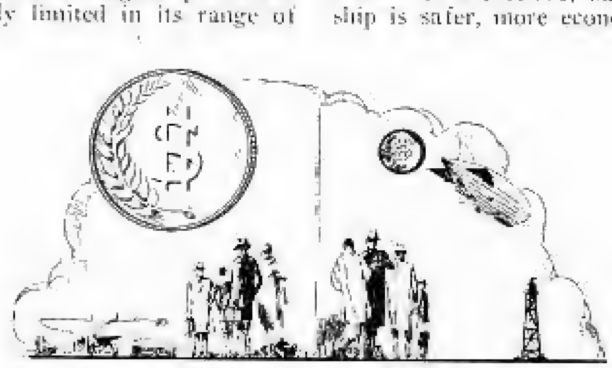
In Europe it has been found that airplane travel at 100 miles an hour, at a fare slightly greater than that of the railway, will attract traffic from the railways. The tendency is to make the machines carry more passengers rather than to make them go faster; this means increasing the paying load rather than increasing

(*Continued on page 951*)

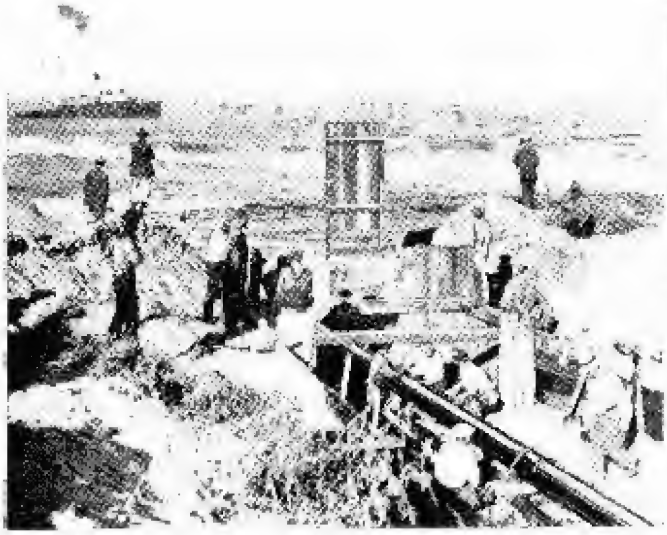


To transport 2,912,000 pounds per annum from 'Frisco to Honolulu, would require but 2 airships making 102 trips one way; 17 57-ton flying boats would be required to make 2,912 trips one way per annum.

FOR trans-oceanic and other long flights where passengers and freight are to be carried, the dirigible would seem to be superior. The pay load for a seaplane is 2 2/3 ounces for each horsepower and 3½ pounds in the airship. The fuel cost per pound of mail carried by plane is $1.85 for trans-Pacific service and 10c by airship. The efficiency of an airship increases with size; for planes the efficiency rises but little with greater size.



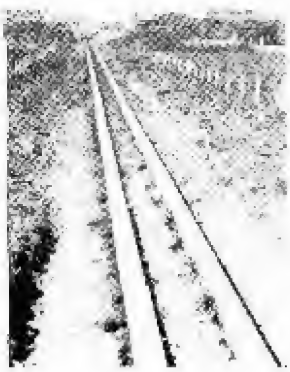
Interesting comparison between the freight rate by airship of $3.50 per pound for trans-Pacific service and airplane rate of $11.12 per pound. Passenger rates, same ratio.



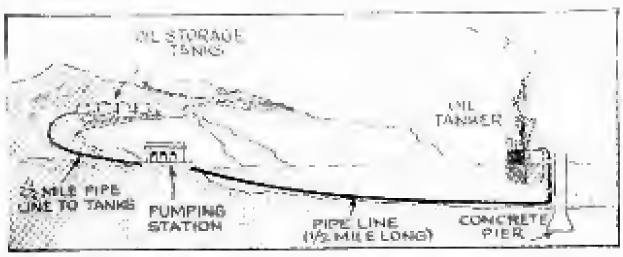
Oil Pumped From One-Half Mile Off-Shore

A "PLUS ULTRA" in sales service was developed in Santa Cruz by the General Petroleum Corporation of California to supply fuel to the giant Santa Cruz Portland Cement Company's plant 17 miles from that city. A pipe line one-half mile long and solidly welded into a single line was laid on the floor of the Pacific Ocean. This unique project, the only one of its kind in North America, permits tankers to discharge cargoes to a shore pumping station which will force 3,000 barrels per hour into storage tanks with a capacity of 7,434,000 gallons, located two and a half miles inland. To lay the pipe line, it was necessary to build it complete on shore, mount it on sleds and, over a thickly greased runway, tow it to sea with the aid of a tug. At a distance of about three thousand feet from the shore the pipe was connected to the storage tanks of the ship delivering the oil. The operation was finished in an hour.

Sleds under the huge pipe were cut away as it slid down the runway, which, as may be seen in the photo to the left, looks like a long railroad track. The photo shown above illustrates the method of bringing the pipe-line to the bed of the ocean. A tug towed the pipe one-half mile out from this spot to connect it to the tanker lying off-shore.



Below — sectional view of pipe line ½ mile out to sea.



An oil tanker lying one-half mile off-shore, by means of a flexible connection, can pump oil through the underwater pipe line to the shore stations.

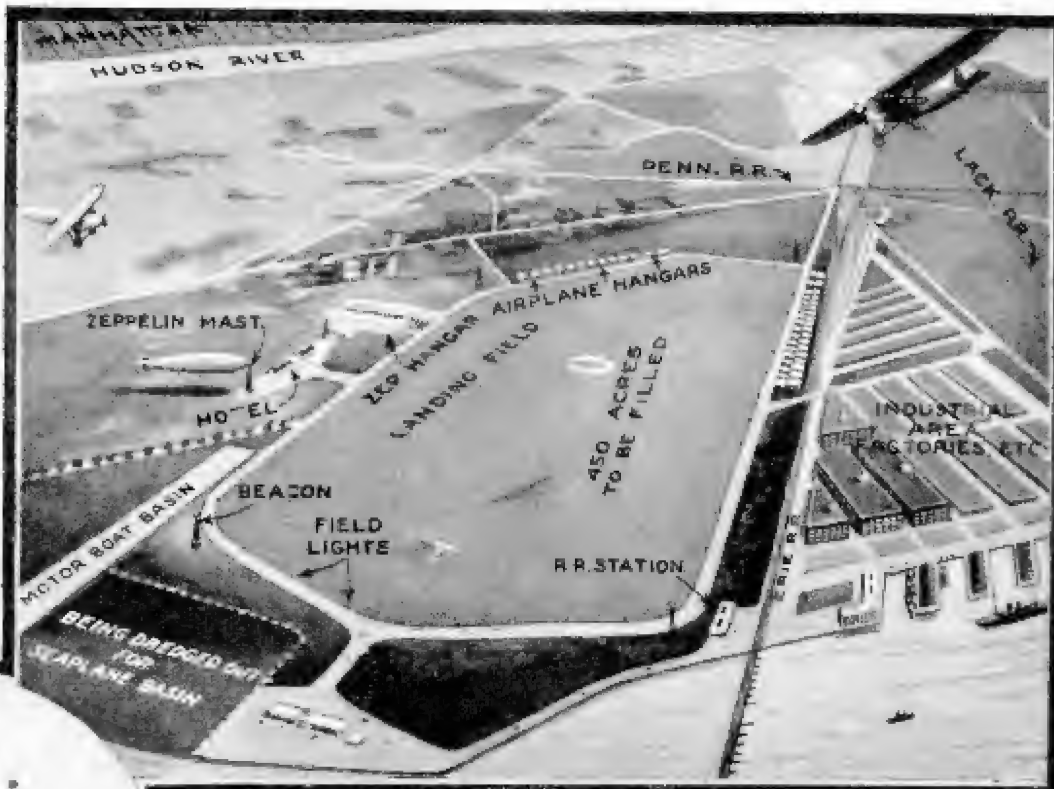
Planes *May* Land *on* Covered Bridges

IN our rapidly growing cities the problem of transportation is most difficult to solve. Commuting facilities and those for freight traffic fail to meet the requirements of the modern city. At present the roads are hopelessly overcrowded with vehicles of every description, and those who daily commute to some large center of business know only too well the deplorable conditions existing in our subways, elevated roads and trains. Elevated walks and highways have been suggested as a means for eliminating congestion both pedestrian and vehicular.

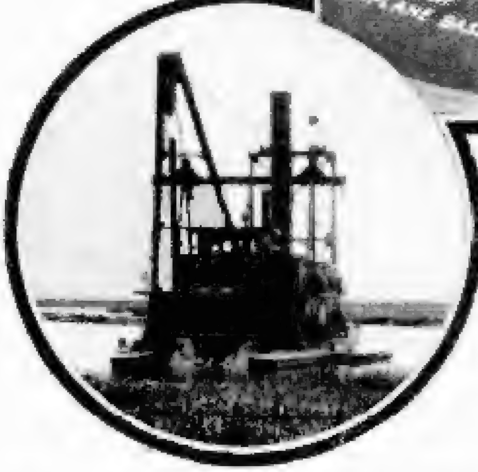
The illustration reproduced here shows an elevated covered bridge spanning a waterway. Such a structure would provide tracks for trains and trolleys as well as roads for automobiles and pedestrians. The top would be covered over and offer a smooth runway for landing and taking-off airplanes. It would also be possible to land dirigibles on the top of the bridge, as shown in the artist's conception of the future city.

Covered bridges may serve as landing platforms for aircraft in the city of the future.

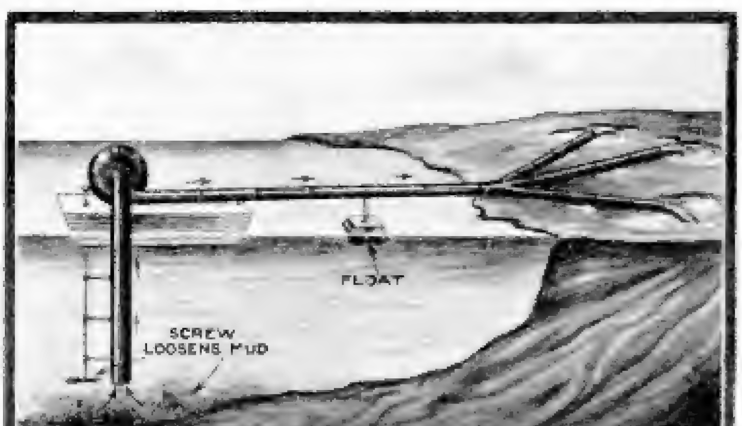
Five Million Cubic Yards of Mud—1000 Acres of Land—450 Acres Field Space Compose Secaucus, N. J. Airport.



Below is shown one of the two huge dredges having a pipe line 20 inches in diameter and a half a mile long. This dredge pumps 25,000 to 30,000 cubic yards of mud per day of 24 hours.



MAKING AIRPORTS

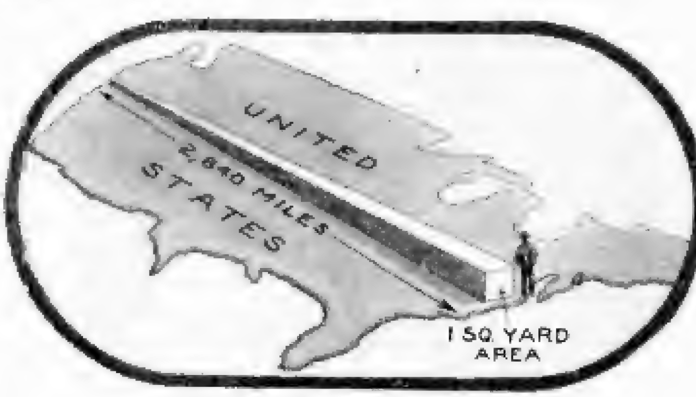


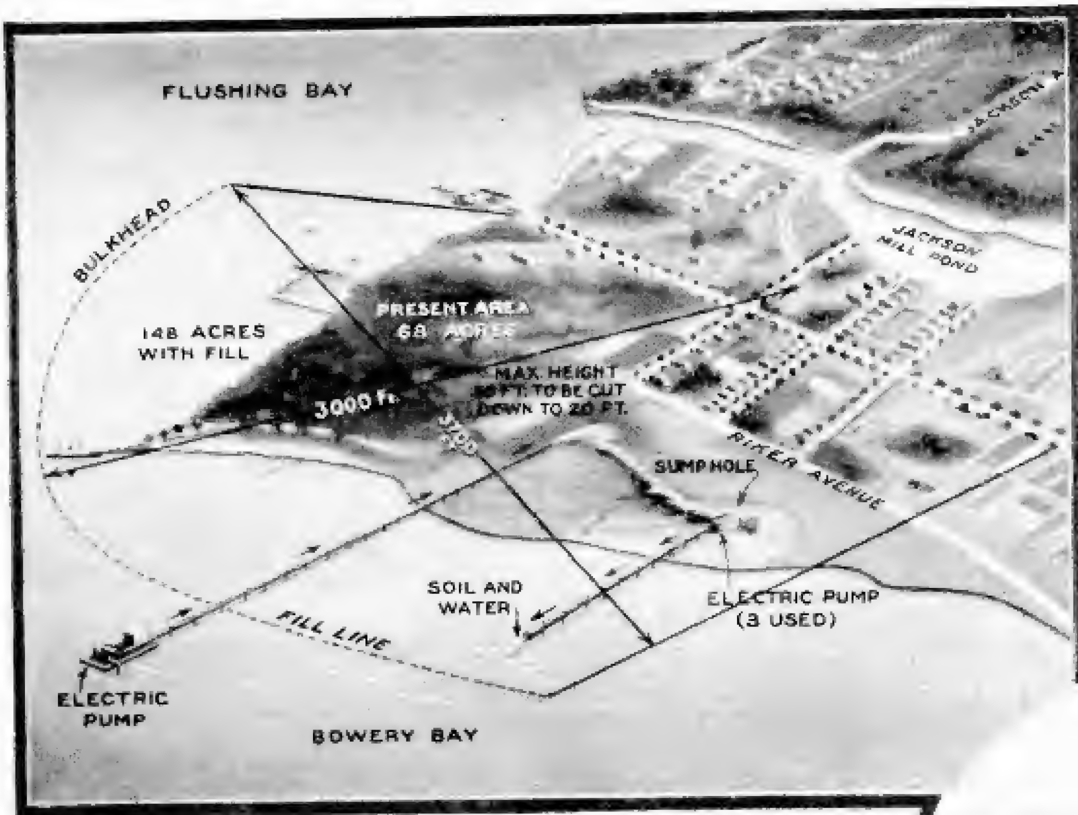
Above—The method of loosening the mud from the bed of the bay, and the means of carrying the silt to the land by centrifugal pumps. A screw loosens the mud and a centrifugal pump mounted on a float sucks this semi-liquid material through the suction pipe and delivers it to the distributing pipe lines.

By H. Winfield Secor.

TWO great engineering projects are now being undertaken by the New York Air Terminals, Inc., which, when completed, will place New York City among the leaders in airport facilities. Think of mud, ordinary mud, to which we only attach the significance of discomfort, being used to reclaim marsh land on which these airports will be located! Imagine a wall of silt, one square yard in cross-section, stretching from New York to Los Angeles, and then you will have some idea of the enormous mass of material used in making one field of a thousand acres and using quantities of mud sucked from a river bed, and one of 148 acres by the same process and also by hydraulic grading and filling. The "wall" is shown below.

These two airports are planned on a huge scale. Their facilities will include a permanent show-room for airplane builders and dealers, display space, service space and storage room for accessory manufacturing firms. One of the fields provides for complete hotel facilities, railroad connections, and automobile highway facilities, which make it the logical airport for the congested City of New York. In other words, these airports are planned to be huge centers of aviation, where everyone from the manufacturer to the passenger may be taken care of.



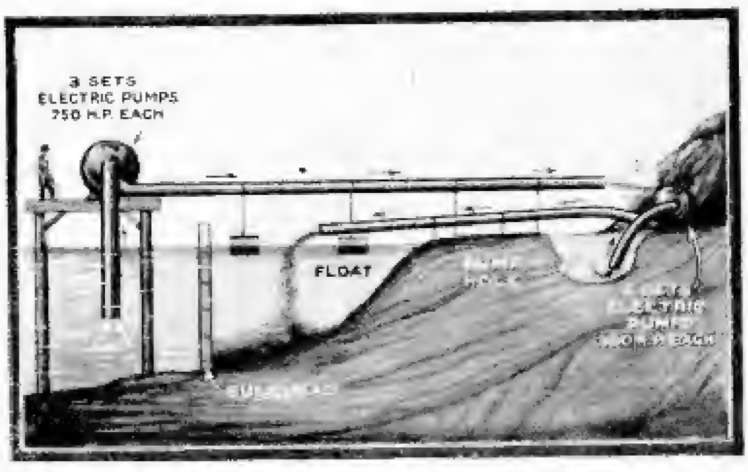


North Beach, N.Y.—Streams of Water Cut Elevation of Hill in Half and Mud is Pumped into Bay to Provide 148 Acres of Landing Space for Planes.

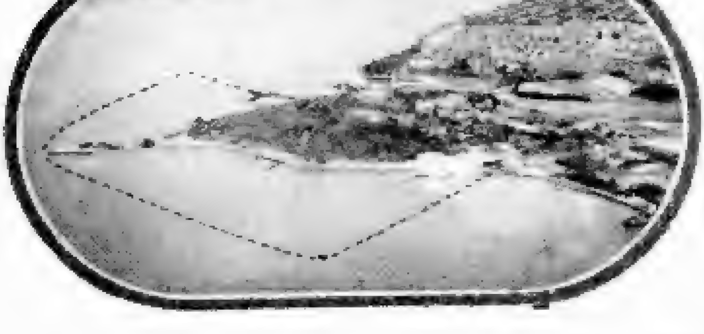
Below is shown one of the pipe lines which distribute the mud and silt to the marsh land used on the site of both airports.

from MUD!

The Secaucus Airport is located in New Jersey, just three and a half miles in a straight line from the center of New York City. Previous to this project it was nothing but a huge field of marshland, utterly useless, and without apparent value. A thousand acres of this huge plot has been reclaimed by dredging the Hackensack River and pumping a stream of mud through a 20-inch pipe for a distance of half a mile and more to the field. The entire reclaiming process requires 5,000,000 cubic yards of mud. Already more than 2,500,000 cubic yards of mud have been dredged and pumped into the field over a foundation of broken rock. The layer of mud found on the river bottom consists of 12 feet of soft mud, 14 feet of tough blue clay, and the balance in red to yellow clay. This combination has been found to settle very quickly and dry very rapidly on the surface. Huge dredges and centrifugal pumps of enormous size, distributing 25,000 to 30,000 cubic yards of liquid material every day for 24 hours, are rapidly completing the Secaucus Airport. When finished it will open to the aviation industry one of the world's greatest markets, and will offer to passenger transportation facilities which heretofore have been impossible.



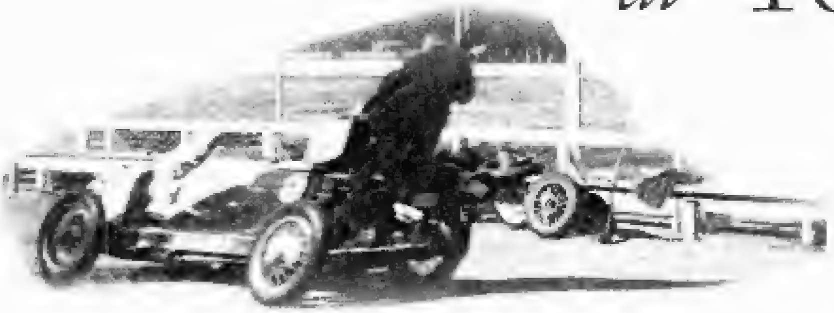
At North Beach, N. Y., the 55-foot hill was sprayed with a concentrated stream of water, which washed the earth into a sump hole, from which it was sucked and piped into the bay behind a bulkhead, to extend the airport area.



The North Beach Airport on the shore of Long Island is a seaplane base for the coastwise aviation service, which has grown to huge proportions in the cities along the Atlantic seaboard. This seaport, shown on left, represents a finer piece of (*Continued on page 958*)


Science and Invention
25¢
MARCH
Goddard on Rocket Flight
Make Your Own Glider
by Lieut. Reynolds
Have a Basement Playroom

They Made Talkies *at* 100 Miles *an* Hour!



Precariously perched behind cameras and sound-recording equipment, Director Sutherland hung on for several laps of the course.

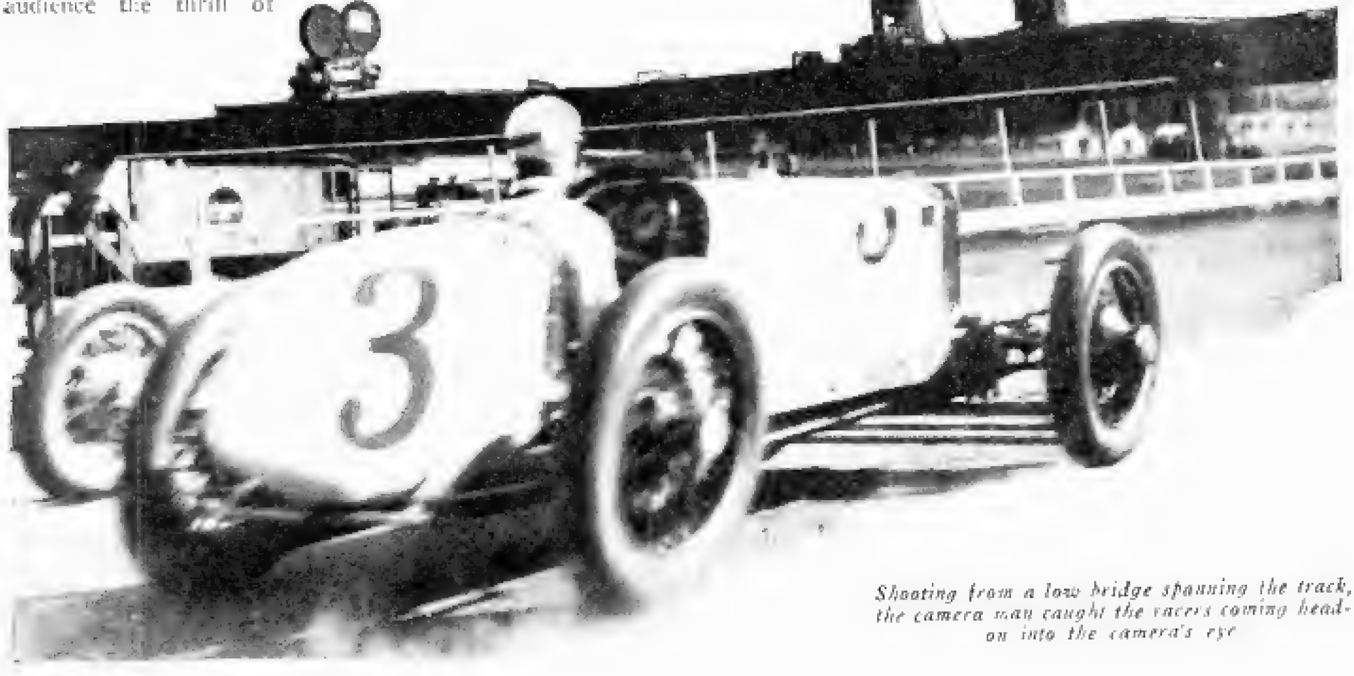
When it was all over, Richard Arlen, star of "Burning Up," autographed his driver's helmet in the presence of Harry Hartz, 1927 racing champion and one of the best known "knights of the roaring road."

MANY a motion picture thriller has been filmed of the "knights of the roaring road." But it remained for the talkies to sound-film a pilot of the racing track from the head-end of his machine—and at a speed of 100 miles an hour!

The film appropriately is named "Burning Up." The place was Riverside, California. The track is of the dirt variety. Piloted by Richard Arlen, star of the film and Francis McDonald, the cars burned up the track. On special fixtures mounted at the forward ends of the cars, automatically operated cameras and sound recording apparatus registered an accurate visual and aural impression of how it feels to tear off lightning miles on a half-mile oval. Projected, with the features of the drivers shown in close-ups, the film affords the audience the thrill of race driving carried out with a realism extraordinary on the screen.

Another thrill for the film was achieved through motion- and sound-shots made from a bridge spanning the track. The clearance between track and bridge was merely sufficient to permit the squat racing machines to get under it by inches. Picking up the oncoming cars as they skidded around a distant curve, the cameras recorded their progress down the straightaway. A microphone suspended above the bridge recorded the roar of the automobiles as they thundered into the eye of the camera.

Intent on getting the utmost out of the situation, Director Sutherland took his place behind the automatic cameras mounted on the Arlen car and delivered instructions to the star for several fast laps.

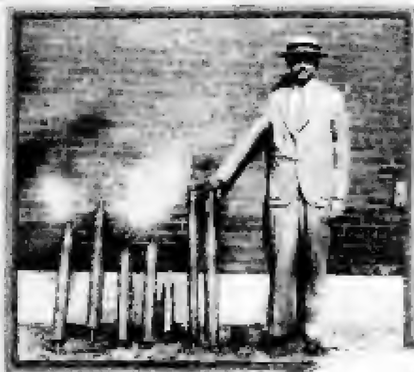


Shooting from a low bridge spanning the track, the camera man caught the racers coming head-on into the camera's eye

Passengers, fuel and a parachute are provided for in a rocket planned by Professor Robert Oberth, of Germany, a model of which finds place in the UFA film, "The Girl in the Moon." Professor Oberth was awarded a prize by the French government for advancement in aeronautics.

Shall

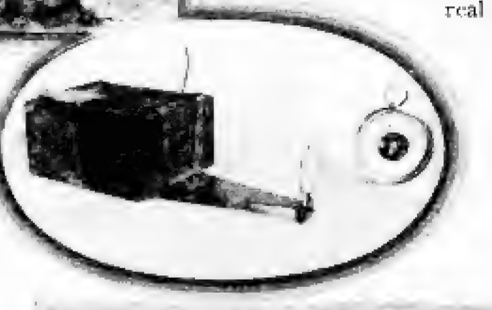
Liquid Propellant Rocket Will Make Earth-to-Moon Flight Possible, Says Dr. Goddard



With these liquid propellant rockets Dr. Goddard has conducted many experiments at Clark University. A rocket of this type may ultimately reach the moon!

"WHAT may be expected of the new rocket-propulsion scheme for aircraft?" If one limits the question to include only those planes already equipped with rockets, or bundles of rockets, the answer is *nothing*. If, however, the question includes the adaptation of my liquid-propelled rocket to airplanes, the answer may well be *everything*.

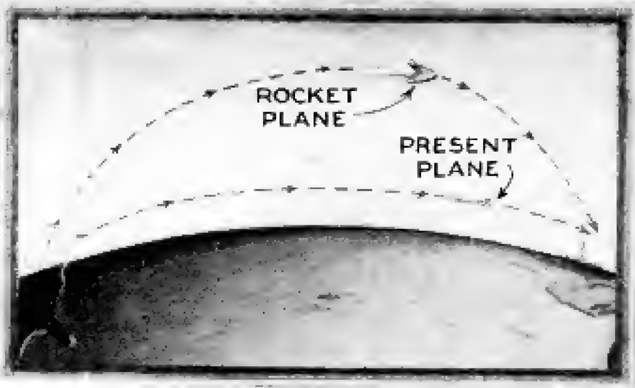
First, the question arises as to whether or not rockets will supplant the present gasoline and Diesel engines for propelling aircraft. Black powder rockets, such as have been used in the recent rocket flights in Germany, cannot supplant present engines. Even hundreds of tons of such rockets would not be sufficient to send a small craft across the Atlantic. This is quite obvious to all trained engineers and has, I believe, prejudiced them against the whole rocket problem, and possibly retarded the development of the rocket's real contribution to human progress—that of the use of liquid propellants for rapid transportation.



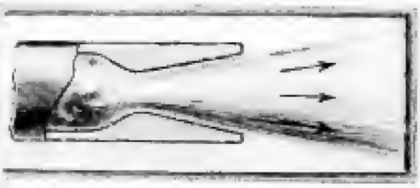
A special camera and barometer were attached to Professor Goddard's rockets to record the actual altitude reached at the limit of their flight. Parachutes enabled them to land without harm to the instruments.

Today, if a rocket were to consist of a large proportion of liquid propellant material of greater heat energy per pound than powder, and this were burned efficiently, that is, if most of the heat energy of the material were converted into energy of motion of the ejected gases, then very great distances could be covered with a rocket of moderate size.

Most engineers do not yet realize that a rocket consisting chiefly of liquid propellant can be very efficient. The rocket usually considered is the black powder

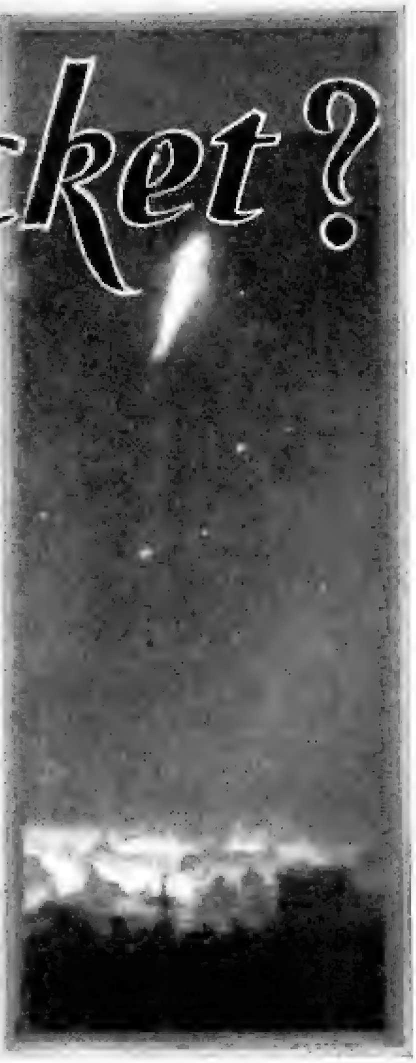


The nature of the rocket plane would enable it to fly at an altitude of slight atmospheric resistance.



Hurled through the air by the reaction of expanding gases, the rocket reaches a flying efficiency far higher than that of today's airplane, and the liquid propellant rocket has proved itself definitely superior to the rocket in which powder forms the fuel.

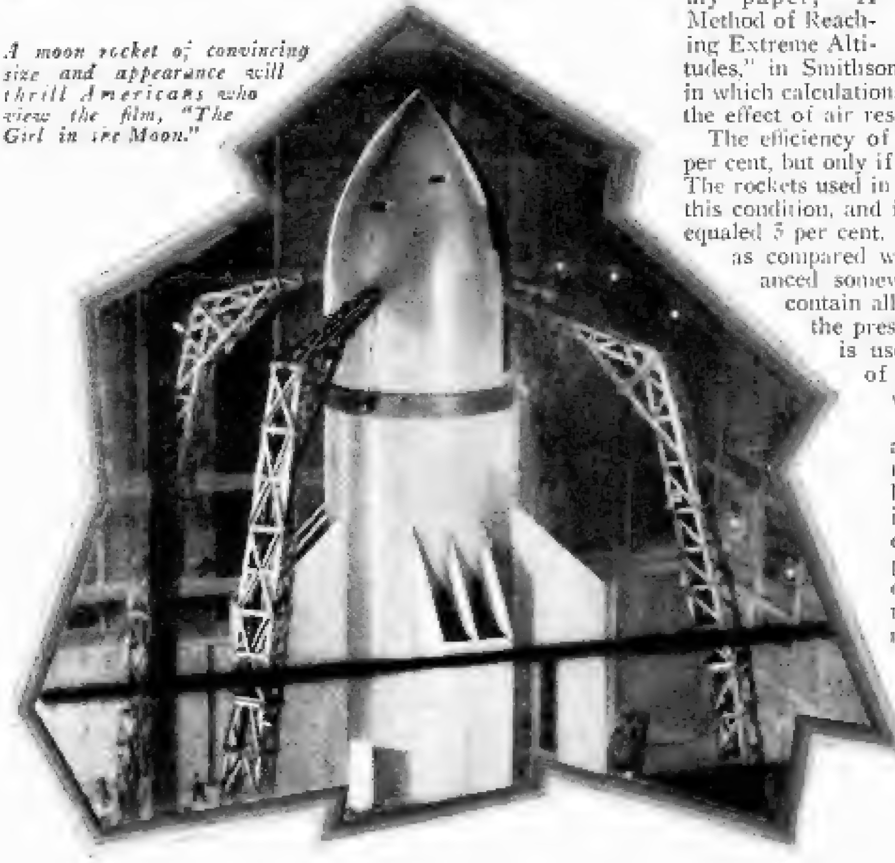
we Fly by Rocket?



By Prof. Robert H. Goddard

PROFESSOR GODDARD'S extensive experiments with rockets at Clark University have made him known as the foremost authority on the subject in this country. You will find his discussion of liquid propellant rockets especially interesting, for he has made an intensive investigation of this type.

rocket. Very little of the mass of such a rocket is ejected as gas, and this gas has such a high speed relative to the rocket that it takes with it most of the energy of the charge. With a rocket composed largely of liquid propellant, on the other hand, the speed of the rocket itself becomes very high, so that the gases, after ejection, possess a speed that is the *difference* between the rearward speed of ejection and the forward speed of the rocket, and this resulting speed will be low after the rocket begins to travel rapidly. When this happens, much more of the energy of the charge will go with the rocket than with the ejected gases.



A moon rocket of convincing size and appearance will thrill Americans who view the film, "The Girl in the Moon."

The possibility of covering very great distances by such a rocket as above mentioned was first shown theoretically in my paper, "A Method of Reaching Extreme Altitudes," in Smithsonian Miscellaneous Collections for 1919, in which calculations were made for various propellants, with the effect of air resistance taken into account.

The efficiency of a liquid-propelled rocket can exceed 50 per cent, but only if it consists largely of propellant material. The rockets used in the German rocket planes did not satisfy this condition, and it is very improbable that their efficiency equaled 5 per cent. This high efficiency of the rocket plane as compared with the ordinary airplane is counterbalanced somewhat by the fact that the rocket must contain all of its propellant material, whereas with the present airplane engines a large mass of air is used along with the gasoline, the weight of this air not, of course, being included with the plane.

This utilization of air by the ordinary airplane engine, while an advantage in regard to weight of propellant at rather low elevation, is the very factor making it entirely unsuitable for travel at high elevations. It cannot possibly be a competitor of the rocket above a certain air density. As to the matter of speed, the rocket, and also the rocket plane, has much greater possibilities of high speed than has the ordinary airplane. The slowing of the rocket, or rocket plane, at the end of its course can be accomplished by air resistance and need require no extra fuel.

And now we come to the question which fascinates so many all over the world—How long will it be before a rocket (*Continued on page* 1033)


Science and Invention
The Marvelous "Eyes" of Science
Detroit Builds Super Motorways
Make Your Home Proof Against the Elements
New York Schools Police to Outwit Criminals
25¢
APRIL
Tesla Maps our Electrical Future

SCIENCE *and* INVENTION

Volume XVII. Number 12

APRIL 1930

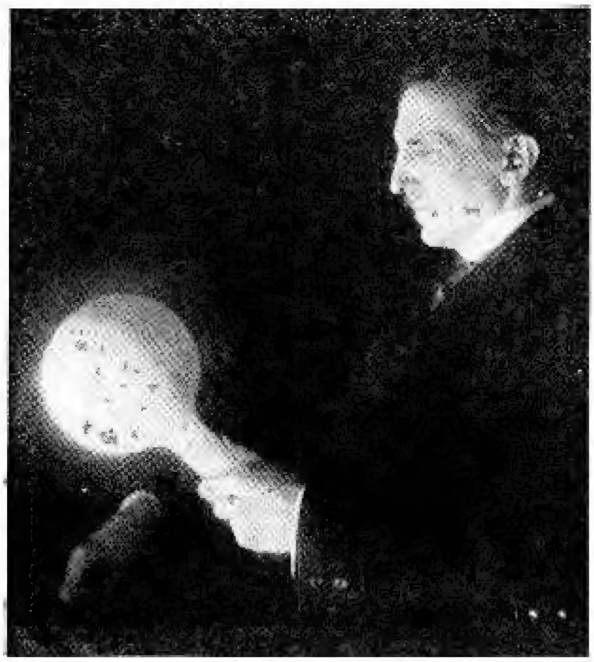
Tesla Maps Our Electrical Future

Simple Daylight Television, Baby Electric Planes, Cosmic Rays of Tremendous Intensity Foreseen by Scientific Wizard

By H. Winfield Secor, E. E.

DO you use an alternating-current induction motor? A high-frequency coil? A filamentless vacuum lamp (such as the neon lamp)? . . . At least you know these things and benefit by their use, as most of us do who live in this modern age of wonders. And you will be interested to know that not only these but many other modern electrical methods and appliances are conceptions of the brain of Dr. Nikola Tesla, perhaps the greatest master of electricity alive today.

Fundamental—that is the word that tells best why Dr. Tesla's name is less commonly heard than that of Edison. For practically half a century Dr. Tesla has occupied himself with the roots and essences of his chosen subject. How essentially necessary to modern industry, offices, and homes is alternating current! For most industrial requirements, direct current is not suited at all. Long-distance transmission of such a current is wasteful and impracticable, as no simple, efficient machinery is available for generating and transforming it at high voltages. Alternating current, on the contrary, lends itself admirably to high voltage generation and to transformation into current of any strength or volume as well as into direct current, at the point of use. . . . Without alternating current, in short, we could not proceed with modern life. Yet more than forty years ago Dr. Tesla discovered the principle of this form of electricity, invented machinery for generating and transforming it, and introduced it to a world which until then had been limping along with direct current as best it could.



One of Dr. Tesla's striking experiments. A blare of light produced in a filamentless bulb by wireless power transmitted from a loop carrying terrific currents oscillating eighty million times per second.

Dr. Tesla's service in this immense field opened up by him is summed up strikingly by Dr. A. B. Behrend, in his book on the alternating-current induction motor:—"Were we to eliminate from our industrial world the results of Mr. Tesla's work, the wheels of industry would cease to turn, our electric trains and cars would stop, our towns would be dark, our mills dead and idle. So far-reaching is this work that it has become the warp and woof of industry."

Because Dr. Tesla knows the principles of electricity and has checked his knowledge in practice, he is able to speak with certainty about electricity not only of today but also of tomorrow. . . . His forecast of the electrical future is not that of an imaginative "philosopher," but of an experimenter and calculator. He is sure of what can be done, because he knows what has been done—by himself. Some results of some of his conclusions he imparted to me in a recent interview.

"Neon lamps are in the public favor and are being used for store windows and in signs (*Continued on page* 1124)

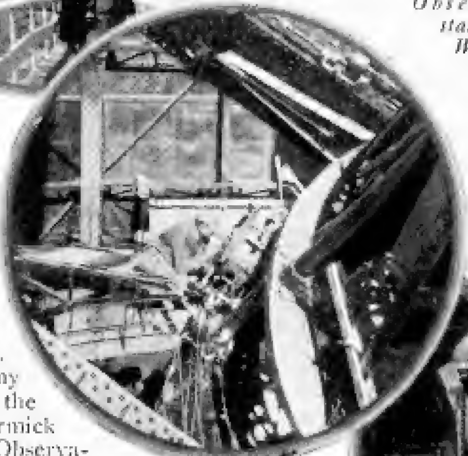
The Marvelous

Telescopes Enable Astronomers to

By Joseph

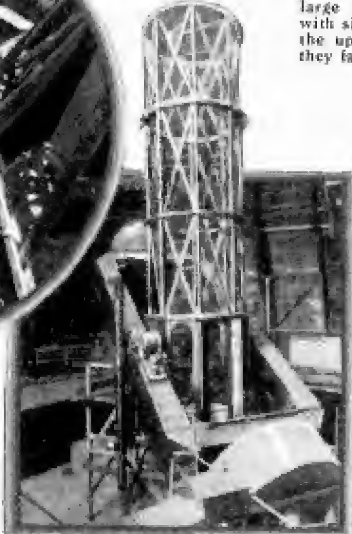
Ewing Galloway

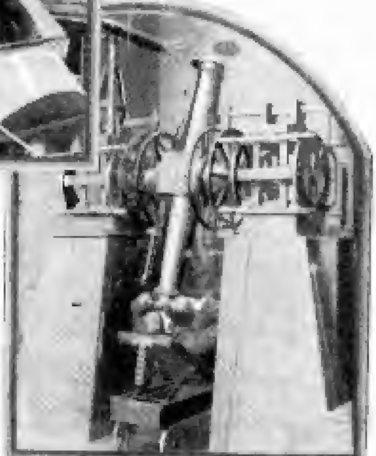
Exterior view of the Mt. Wilson Observatory, which contains a 100-inch reflector.



Observing the stars in the Mt. Wilson Observatory.

Did you know that there are two kinds of telescopes—refracting and reflecting? In the first, light passes through a lens which converges the rays to a focus where the image is magnified by a second lens or group of lenses called the eye-piece. In the second, a large concave mirror of glass coated with silver throws the rays back toward the upper end of the telescope, where they fall on the eye-piece.



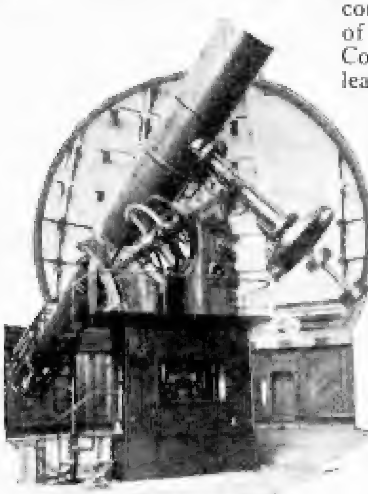


The present world's largest telescope, a 100-inch reflector at Carnegie Institution, Mt. Wilson, California. Below: The most accurate time-piece in the world, where observations are made through a 6-inch transit circle—Naval Observatory, Washington.

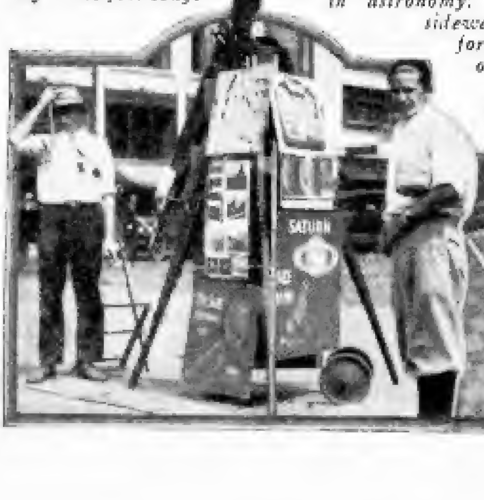
DR. SAMUEL ALFRED MITCHELL was recently honored for his announcement that he had completed measuring the distance to 1000 stars. Dr. Mitchell is Professor of Astronomy at the University of Virginia and the director of the Leander McCormick Observatory. The McCormick Observatory is on top of Mt. Jefferson and this announcement, coming from the famous astronomer, is a great contribution to the science of astronomy. The McCormick Observatory thus leads the world in measuring distances to the stars by the parallax method and is 100 ahead of its nearest competitor, the University of Pittsburgh.

In measuring the distances to stars, there is only one direct way of performing the work. This is known as the trigonometric method and consists in taking photographs of the same star from opposite ends of the orbit of the earth as it moves around the sun. This gives the astronomer a known base line from which he can compute the stellar distances. It takes about half an hour to expose the photographic plate. After this has been done with about 20 plates for the same star, the parallax is measured.

By calculation the astronomers are then able to get the distance to the stars they are measuring, not in feet or miles, but in light years. Light travels at the rate of 186,000 miles a second.

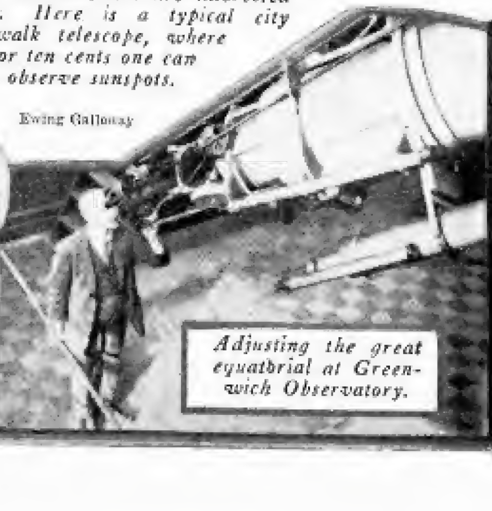


The tube of the 40-inch refractor at the University of Chicago is 63 feet long.



Even the boys on the street are interested in astronomy. Here is a typical city sidewalk telescope, where for ten cents one can observe sunspots.

Ewing Galloway



Adjusting the great equatorial at Greenwich Observatory.

Widow of the great astronomer Flammarion.

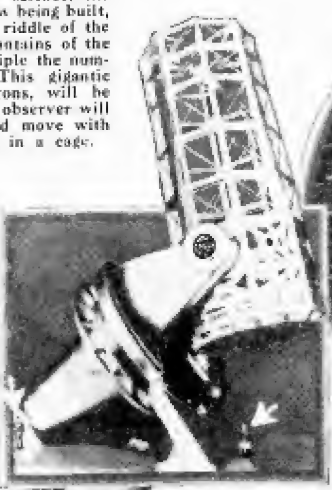
Eyes of Science

Measure Distance to 1,000 Stars

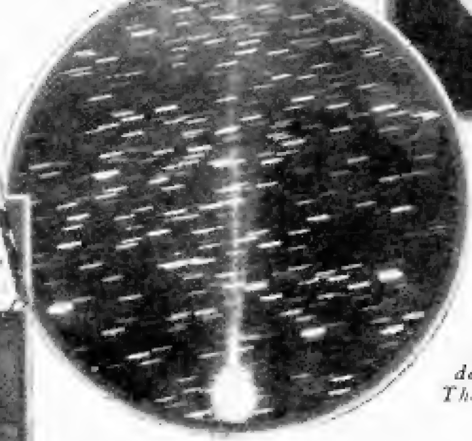
H. Kraus

With the newest "eye" of science, the world's greatest telescope now being built, we may expect to solve the riddle of the canals on Mars and the mountains of the moon, and will be able to triple the number of observable stars. This gigantic telescope, weighing 1,600 tons, will be balanced like a watch. The observer will sit inside the structure, and move with the instrument, like a bird in a cage.

An interesting photograph of the moon. The new telescope will enable us to see moon areas as small as a city block.



The huge newworld's telescope now under construction. Arrows point to men shown for comparison. Below, a board fastened to the end of the telescope to record spots of the sun. This is how Father Ricard, of Santa Clara, California, called the "Padre of the Rains," gets his information.

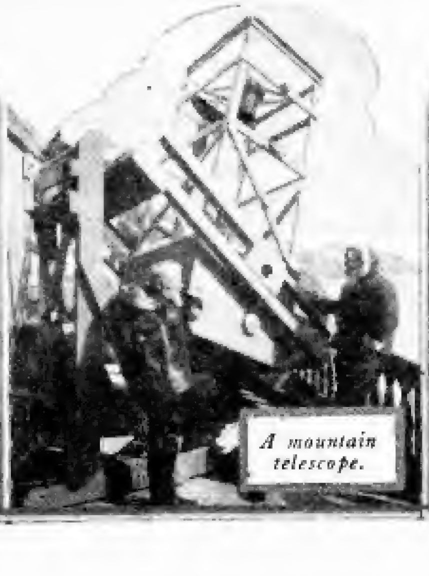


A wanderer of the skies, the comet Wilk. The central beam of this comet is at least a million miles long. The white dashes across the picture are stars. The photograph was taken at the Yerkes Observatory.

Near Boston stands this historic landmark. It was used for testing lenses by one Alvan Clark, famed for his work in the 70's.

IF the reader will look at the illustrations on this page, he will note that all of the telescopes are mounted at a peculiar angle. This angle is called the equatorial, and is predetermined for the position where the telescope is to be mounted. The angle is exactly equal to the latitude of the observer's location. This causes the telescope to be mounted exactly parallel to the earth's axis and enables the observer to follow the path of any heavenly body with remarkable precision, and without the necessity of manipulating too many controls. In the new gigantic telescope, with a mass of 1,600 tons, the astronomer located in the instrument itself, moves with the telescope. He need merely press a button to swing the entire structure noiselessly back and forth. The cost of the new telescope at Mt. Wilson is estimated at $12,000,000.

The Perkins telescope.



A mountain telescope.

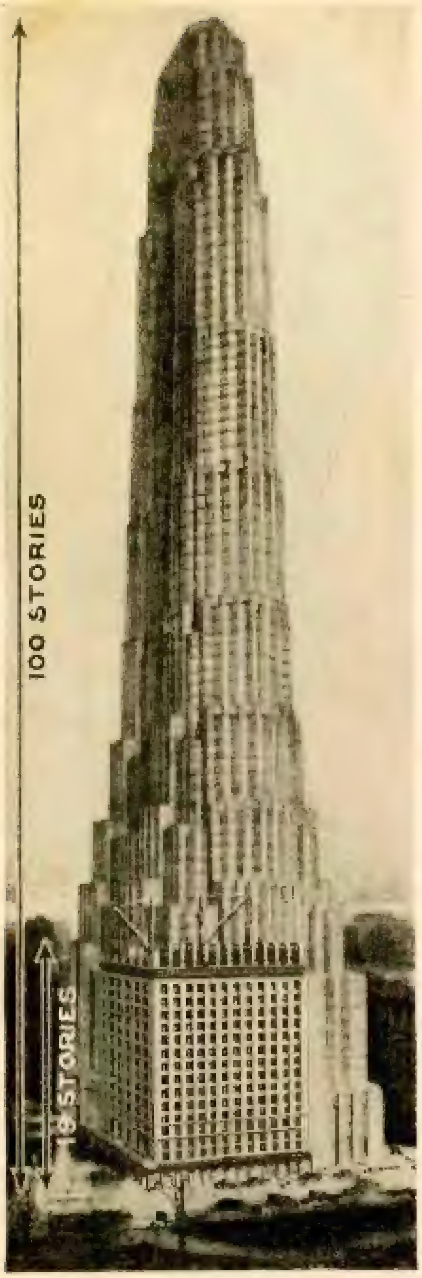
Scene in Lick Observatory.


Science and Invention
JULY
25 CENTS
Towers that Pierce the Clouds
See page 216
The Story of Tornadoes
Building a Short-Wave Receiver
Make Your Own Fireworks
How to Make an
Outboard Aquaplane

Towers Pierce *the* Clouds

Building 100 Stories High, with Population of 30,000, in Prospect

By Marguerite Kujawska



Left — Prospective Metropolitan Life Building, compared with structure it replaces at Fourth Avenue and 25th Street, New York.

MANY a misty Manhattan day has seen the Woolworth Tower's top hidden in rolling clouds, invisible to all but airmen flying above the city. . . . Now, after years of supremacy, the famous tower has been surpassed in height by the midtown Chrysler Building, which reaches into the clouds a total of 808 feet to the Woolworth's 792.

But structures of greater height are in prospect, and one of them is certain to reach completion in the comparatively near future. This is the Empire State Building, which when completed will have a total of 87 stories to the Chrysler's 67, and will rise, without its proposed mooring mast, to a height of approximately 1062 feet.

It is when we come to the second of the prospective structures, however, that the office building of the future presents itself in its most astounding development.

In the picture at the left the 808-foot Chrysler Building has been advanced to its 67th floor. The Chanin Tower appears at the left of the structure. Above is shown the "cupola" with its mighty spire of stainless steel—highest point on Manhattan—looking toward the East River and Long Island.

In ascending order, four successive stages in the construction of the 67-story Chrysler Building are shown here. Note in the picture above how the work of bricklayers has been put on a systematic basis of mass production

The proposed building of the Metropolitan Life Insurance Company, at Fourth Avenue and 25th Street, is designed as a structure which ultimately may be built up to 100 stories; and though the immediate plan calls for the erection of but 32 stories, the foundations to be laid are definitely calculated to support the 100-story structure.

The Metropolitan's home office force comprises more than 12,000 employes, but the rate of expansion points to a future payroll of 30,000 employes as a practical possibility, and it is this the company has borne in mind.

Truly modern in conception is the company's proposed structure. To the first setback the materials used would include a considerable proportion of masonry. But above that point the building would be carried out entirely in metal and glass. No extraneous ornament would be applied. The vertical accent of the immense building would be emphasized by the corrugated form of the structure.

Science and Invention

AUGUST
25 CENTS

What to Do
When Your Outboard Balks
By J. Phillips Dykes
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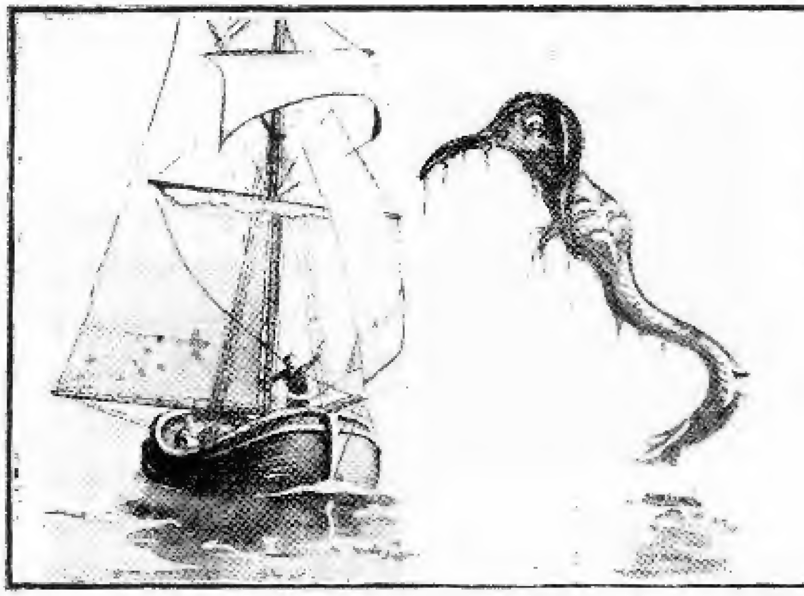
The Truth About Sea Serpents

Make a Collapsible Boat from Old Inner Tubes

The SCOUT Secondary Glider
By Lieut. H. A. Reynolds and Martin H. Schempp

Ideas for the Home Machinist



Sea Serpents, Thinks a Famous Deep Sea Expert, Are Not Delusions, But Illusions . . . Presented by Giant Squids—Fearful and Dangerous Relatives of the Great Octopus

The Truth *about* Sea Serpents

By Alma Chesnut

WHEN globe-trotting friends, returning from Europe with the end of summer, seek to regale you with reports of sea serpents on the way over, do not be too caustic in your comments about wet ocean liners. The ocean enfolds many fabulous creatures, says Dr. Paul Bartsch, deep sea expert of the National Museum, in Washington, and who can deny with finality that such a monster exists?

Science has no authentic record of a sea serpent: that is, none has been captured, measured and preserved in a museum, but scarcely a summer goes by when one is not reported from some vessel or seaside resort. Masquerading under many names—kraken, kraxen, krabben, korven, ankertrold, soe-horven, soe ormen, horven aale-tust—it has been celebrated in literature and folk lore from immemorial times.

"Sea serpents," says Dr. Bartsch, "have undoubtedly decreased in size and number since the Prohibition Amendment and Volstead Act went into effect, but I would not care to assert definitely that there is no such creature.

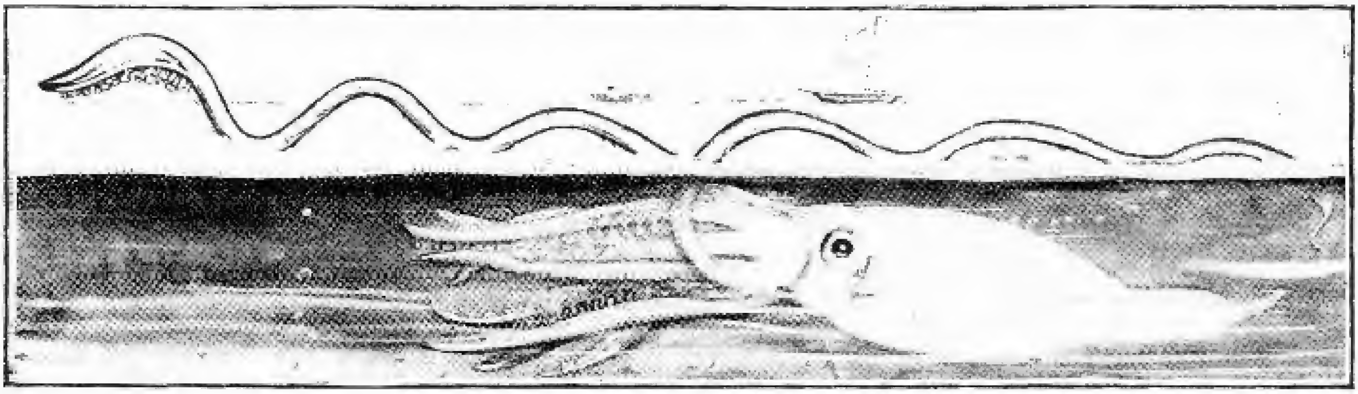
"The ocean is virtually unexplored territory, but we know that it supports many forms of life that are almost unbelievably fantastic. I have seen many strange sights during my voyages

The giant squid has been known to attack fishing boats.

of exploration, which have taken me to Europe, Asia, the Tortugas, the Philippines, the Bahamas, Curaçao, and many other ports. Few would believe that a jelly fish could kill a man, yet in the Philippine Islands a boy dived into a gigantic specimen and was dragged out of the water dead. This is only one instance.

"There are several plausible explanations of these perennial sea serpent yarns. I myself once thought I saw a kraken. It was in 1909 and I was cruising in a little vessel at the southern tip of the Philippines, just off the coast of Borneo. We had come to a place where coral reefs had formed a quiet harbor and the sea was deadly calm. My companion, the Commissioner of Fisheries for the islands, was looking out across the water when suddenly his face went white with excitement. I followed his gaze and, I suppose, turned pale myself at what I saw.

"A series of shining loops, that reflected the bright tropical sun, appeared undulating over the surface of the water like a great snake. We quickly maneuvered the vessel toward this awesome spectacle, but when we examined it with glasses at closer range we found that the effect had been created by a school of porpoises, leaping along, one after the other as if playing follow-the-leader. An unscientific person might not have (Continued on page 360)



Manipulating its arms, the squid may present the appearance of a sea serpent above the surface.

Science and Invention

SEPTEMBER

25 CENTS

Traveling — Straight Down

See Page 408

Uncle Sam's Mechanical Live-Stock Show

How to Match the Hull, Motor, and Propeller of Your Outboard

By J. Phillips Dykes, A.O.A.

How to Make: A Rock Garden — Furniture in the Mode Moderne — A Telephone Table — A Jeweled Lamp

Irving Air Chute Co., Inc.

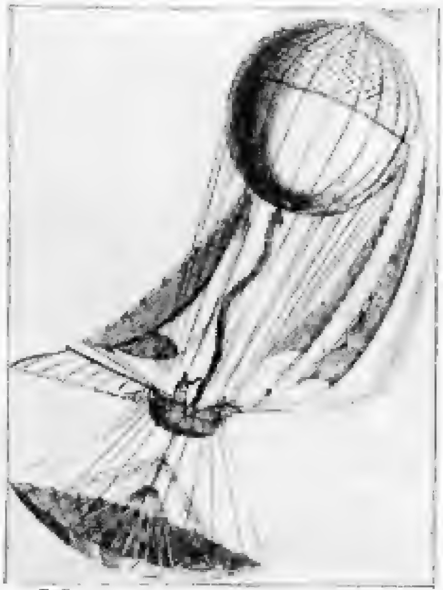
A veteran air force sergeant of the old school offers a final admonition to three students about to make their first jump with Irvin chutes.

Traveling—Straight Down!

THE art of parachuting has never qualified as a method of soothing weak nerves, no matter how purposefully it has been practiced. But it is a fairly safe bet that no member of the well-famed Caterpillar Club ever registered a more thumping thrill than did the unknown who involuntarily treated the world to its first parachute jump, in a 'chute created impromptu by chance and the workings of nature.

Folks talk of lucky breaks. Here was a break that makes most lucky breaks seem the fruit of arduous planning on the part of painstaking beneficiaries.

It took place near Paris something more than 150 years ago. A French gentleman whose name has been lost to history was performing what was then a rare and reputedly foolhardy feat—an ascent in a hot-air balloon. Filled to the limit of its capacity, the inflated globe carried him skyward at projectile speed. Then, suddenly, the watching crowd saw a burst of smoke



G. P. Putnam's Sons

Beneath his Russell lobe, this jumper lowers himself gently to the bosom of Mother Earth.

G. P. Putnam's Sons

In the old days, aeronauts went aloft in ships with lots of trimmings. Note the sails, the sweeps, and the complexly braced 'chute hanging beneath the basket. Like the girls, modern parachutists avoid stays, which present much resistance but don't add to safety. . . . At the left is shown an immense "valve" 'chute developed by Jimmy Russell for the Air Service. It is intended to lower a plane bodily to earth.

where the bag had been, and the aeronaut in his basket began a spectacular descent to earth. The lessening pressure of the atmosphere had permitted the balloon to explode.

Faster and faster the basket and the terror-stricken balloonist sped earthward. But at some distance above the ground the fabric of the bag, blown by the upwash against the corded canopy, formed an inverted cup and began to check the progress of the supposedly doomed craft. In the end the skipper in his basket was lowered to earth so gently that he was not hurt in the least.

Whether the chief actor in this hair-raising performance bowed graciously and let on that it was all included in his act—that is a matter for conjecture. But it is known that he built his next balloon with a relief valve and repeated by plan the parachute drop which he had learned by accident. He repeated it many times, in fact, and never missed out on his turn. He died finally of the smallpox, in bed.

In 1797 another Frenchman, Andre Jacques Garnerin, operated successfully a parachute constructed as a separate unit and attached to a balloon. Five years later he made a descent in this 'chute from (*Continued from page 464*)

SCIENCE *and* INVENTION

Volume XVIII. Number 5

SEPTEMBER 1930

Wings Around the World!

By Augustus Post

Aviation Editor

The Rôle of Prophet Is No New One for Augustus Post. In 1927 Glenn Frank Pointed Out That He Had Pre-Sketched the Lindbergh Flight in 1914. . . . The Present Article Surveys the Prospects for World Air Service in the Near Future

THE twentieth anniversary of the historic Curtiss flight from Albany to New York for the $10,000 prize put up by the New York *World* was celebrated by Mr. Curtiss' flying a Curtiss "Condor" twenty-passenger plane, one of the largest in regular service on any transport line in the world, over the same course which he flew on May 29, 1910. This year's flight gave a unique opportunity to compare the early machine with machines of the present day, and the first cross-country flight with the air routes of the world.

Mr. Elmer E. Robinson, chief mechanic for Glenn Curtiss, describes the plane which Mr. Curtiss flew:

"The plane was built under my supervision in a small shop in Hammondsport, N. Y., by eight employees. It was a pusher biplane with horizontal stabilizer and rudder in the rear and a biplane elevator in the front. The ailerons were placed between the wings and hinged on the outer rear wing strut and were controlled by a shoulder yoke worn by the pilot. The rudder was controlled by a cable passing through the lower rear bamboo poles. The motor was fifty horsepower, constructed in the Curtiss Motorcycle shop, and the airplane was covered on top of the ribs by rubberized silk.

"You can readily imagine the nervous tension when after weeks, and even months, of laborious preparations, Mr. Curtiss took his seat and I grabbed hold of the propeller to crank it. After warming the motor up he made a graceful take-off and started on what, at that time, seemed a tremendously long journey. We watched the take-off breathlessly and saw the plane disappear in the distance. This gave us all a peculiar feeling because all previous flights had been around the landing field with the plane always in sight and this was the first time we had seen an airplane fly away until it disappeared.

"The New York *Times* chartered a special train on the New York Central and Mrs. Curtiss and Augustus Post of the Aero Club of America, who with Alan R. Hawley held the balloon record of America, followed the plane down the River."

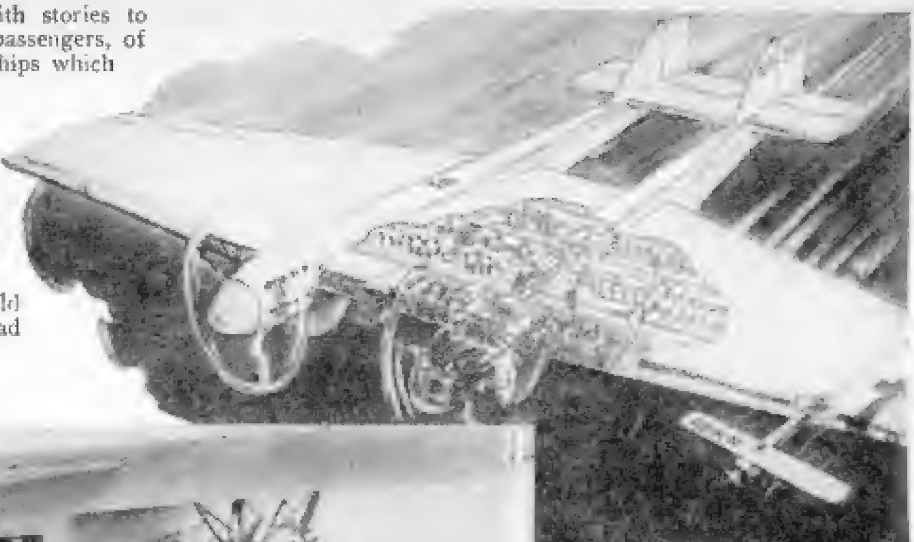
Mr. Post was one of the chosen who saw the Curtiss June Bug evolve, and one of the first to learn to fly the Curtiss pusher biplane. Here he appears with Glenn Curtiss, whelmed 'round by the bamboo and wires of a ship like that in which Mr. Curtiss flew from Albany to New York in 1910. In the pilot's seat, Mr. Curtiss; left foreground, Mr. Post.

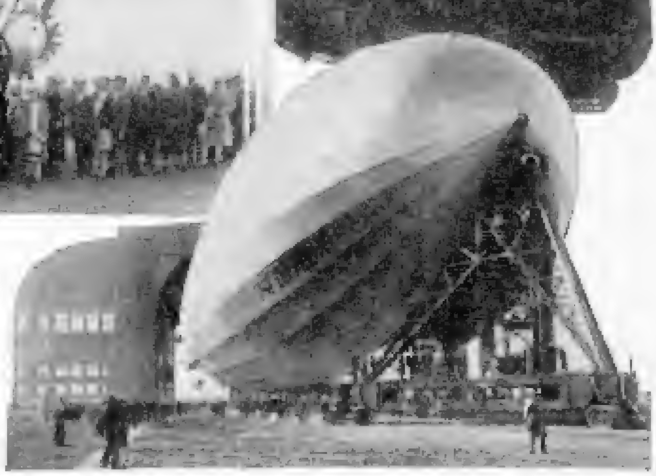
I was pleased to receive an invitation from Mr. Curtiss to accompany him upon the twentieth-anniversary flight. I went out to the Curtiss flying field at Valley Stream with Mr. Alan R. Hawley, with whom I had done a great deal of ballooning in the old days, and we entered one of the "Condor" twenty-passenger transport planes. We flew direct to the Hudson River and followed the shoreline practically the entire way to Albany. At times our pilot allowed the plane to fly itself while he took motion pictures of the accompanying ships. The trip to Albany was accomplished in an hour and fifty minutes with the greatest of comfort and with stories to while away the time, related by the passengers, of the early days of flying and the hardships which seemed to make the present journey far more comfortable than the wildest dreams of the early enthusiasts

After lunch, Mr. Curtiss took off in the "Condor" in which we had flown from New York City. When we reached an altitude of 3,000 feet passing over the city of Albany, Captain Courtney turned over the controls to Mr. Curtiss so that he could follow the exact course which he had flown twenty years before.

"The controls," declared Mr. Curtiss, "seemed even more sensitive than those of the small light machine in which I made the original flight. We found it difficult to pass the New York Central train on the first flight, which was made at the speed of 52 miles an hour, a few hundred feet above the surface of the water; and motion pictures were made from the door of the baggage car. The "Condor" today easily left the trains behind, cruising along at double their speed at an altitude of from 3,000 to 4,000 feet, and the motion pictures this time were taken from the side door of another plane. And we took almost all those who rode on the train which followed us down the river, on board the airplane today."

Four years ago only one airline in the United States, the Western Air Express, was carrying passengers on a daily schedule. Last year the Aeronautical Chamber of Commerce stated that 3,160,793 passengers were carried; 97,995 miles are flown daily over 46,360 miles of airlines, and a grand total of 197,546,590 (*Continued on page* 452)



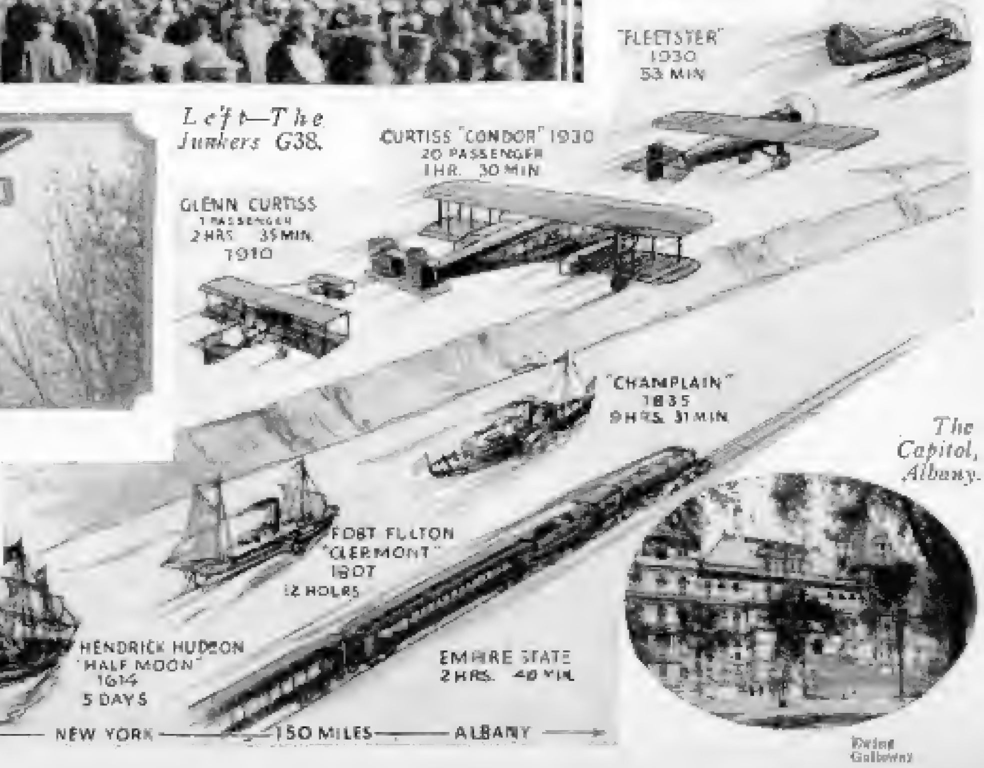


Top right — A 206-passenger Christmas cantilever mon plane, compared with the Spirit of St. Louis. Above—A tandem-engined 32-passenger Fokker.

Above—The Graf Zeppelin being maneuvered into its hangar at Lakehurst by the new tractor stub mast.

Left—Passengers debarking from the Graf.

Left—The Junkers G38.



Manhattan's skyline.

Ewing Galloway

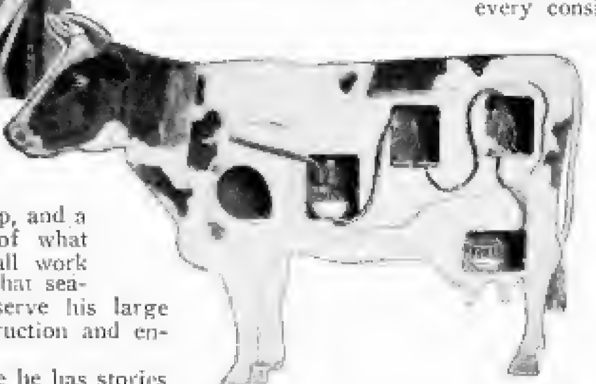
The Capitol, Albany.

Ewing Galloway

Uncle

Cows Demonstrate and Pigs Preach to the Fair Crowds When the Wily Old Showman Pushes the Button on the Ingenious and Instructive Exhibits His Smart Nephews Contrive

Left—The stage manager who engineers the operation of the bossy at the top of the page. Below—another version of the demonstrating cow, who shows the multitude how she manufactures milk.



SCIENCE, art, craftsmanship, and a grand old Yankee sense of what constitutes a good show all work strong for Uncle Sam, when that seasoned promoter sets out to serve his large conglomerate family with instruction and entertainment.

He does it, primarily, because he has stories to tell that the family ought to know about. Stories about dairying and stock-raising, poultry farming and forest conservation—improvements he has developed, economies he has discovered, new ways and right ways of doing things. And because his demonstrations are the product no less of showmanship and a sense of the spectacular than of practical science, the family stops and looks and listens to the tune of 6,000,000 to 10,000,000 a year.

He plays the fairs, mostly—not overlooking a chance to get his stories across, of course, at special expositions where big crowds of folks collect. And wherever people are once acquainted with his stuff he is sure to be invited to participate—abroad as well as on his own shores. One big reason is that each time he comes he rolls from his box a brand-new, extremely original and ingenious mechanical trick.

Down in the latitude of the placid Potomac Uncle Samuel has his incubator of sensational scientific exhibits going full tilt the year 'round. There the busy brains of some of his smartest nephews—engineers, sculptors, photographers, painters, exhibit experts, inventors, and craftsmen in wood and metal—operate ceaselessly to contrive new means and methods of arresting and holding the attention of his farflung family, in competition with the thousand other engines of entertainment met with at every considerable exposition or fair.

So successfully does his incubator compete that advertising enterprises all over the world watch Uncle Samuel's shows like so many hawks. His sparkling new ideas, you see, are not patented or copyrighted. He uses them once and then discards them, whereupon they pass as free booty to the advertising profession.

Did you ever think of making swine and cattle of thin rubber, so that they might be inflated gradually from concealed sources to simulate the process of growing and fattening on various feeds?

That's one of the ideas sprouted in your Uncle's show hatchery for the season of 1930. And ten to one his smart nephews will make it work. It happens to be no easy feat, by the way, to put this one across.

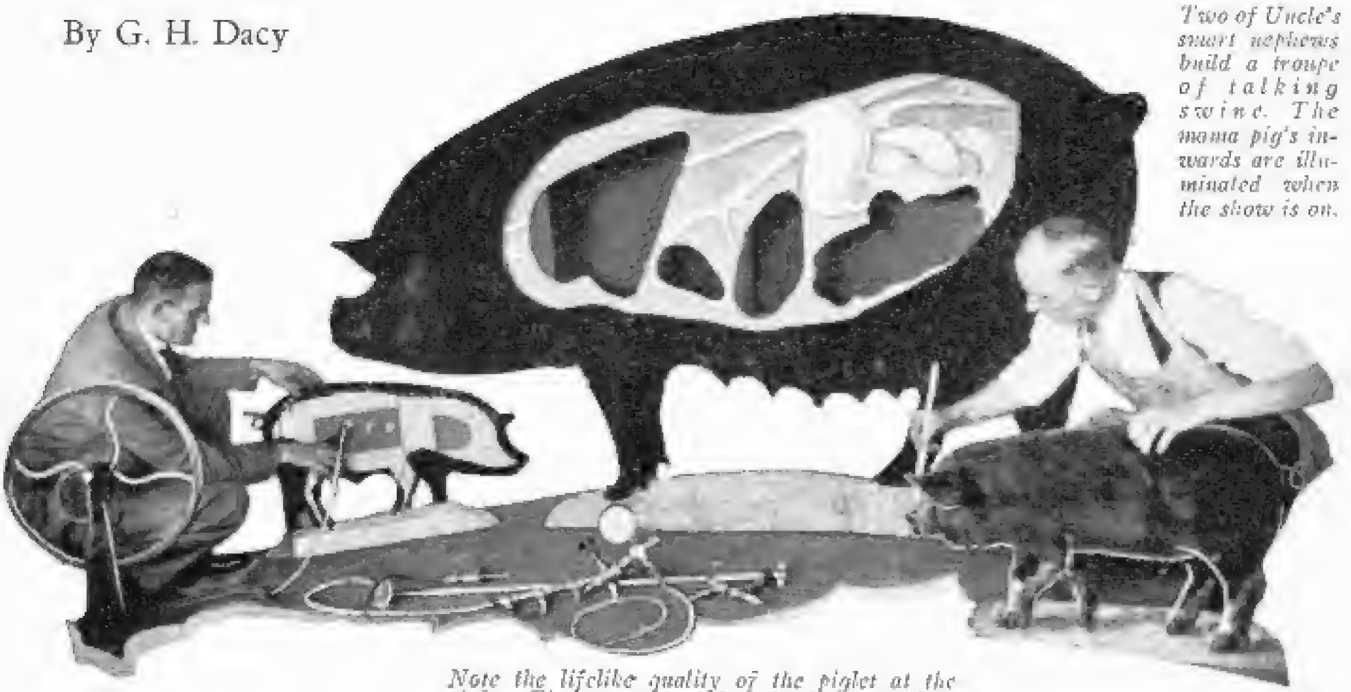
First off, the model pigs in this show were made of dental rubber, and compressed air under special valve control made them grow. But dental rubber isn't rugged enough to stand the strain of trouping, and furthermore it lacks the rigidity necessary to the most stunningly natural effect. So, having proved the idea feasible, the show hatchery boys began to cast about for a better skin.

Rubber salvaged from heavy-duty inner tubes was found satisfactory for the pneumatic piglets, but then came the problem of vulcanizing a rubber form of this size. No vulcanizers of the large capacity demanded were available in Washington, and tire manufacturers pronounced the job out of their line. However, the show incubator has never

Sam's Mechanical Live Stock

By G. H. Dacy

Two of Uncle's smart nephews build a troupe of talking swine. The mama pig's inwards are illuminated when the show is on.



Note the lifelike quality of the piglet at the right. The one at the left is having his valves tested with air.

yet fallen down on realizing an idea. When apparently up against it, the organization has always done better than its best. So it would be no surprise to us to learn that by now the problem has been solved, and that the vulcanized swine act was ready to delight eager spectators at the big fairs.

Among other current productions at the national play factory is a sheep family whose vocabulary has been increased from a mere sarcastic "Baaa" to a dialogue that would astonish its flesh-and-blood relatives. Each sheep is a three-dimensional form, wearing an honest-to-goodness natural (*Continued on page* 459)

Left—Here's the talking pig show set up for action. As a grand finale the piglets explode and fall flat.

One marvelous piece of ingenuity is a mechanical man milking a mechanical cow. Here the performers are in process of construction.

Artists and mechanics work ceaselessly to build lifelike actors for Uncle Sam.

Science and Invention

NOVEMBER
25
CENTS

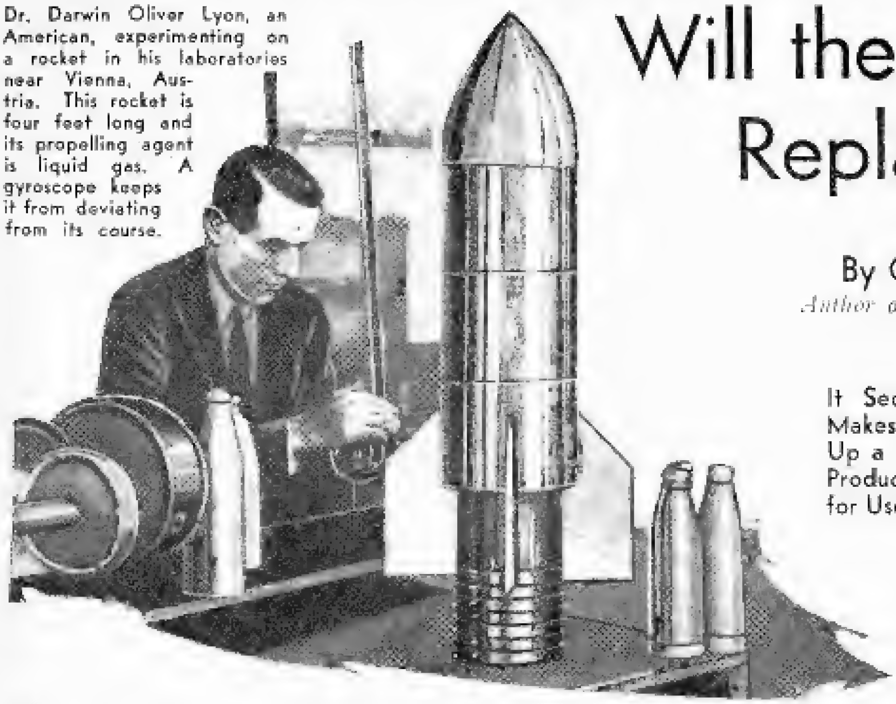
Will the Rocket Replace Artillery?
See Page 600

A Billion Dollar Junk Business!

Sky Jobs and Ground Jobs

How to Make: Modernistic Bookshelves — a Sunlamp — Your Own Castings

Win a Share of $3,250.00 in Fine Tools and Equipment



Dr. Darwin Oliver Lyon, an American, experimenting on a rocket in his laboratories near Vienna, Austria. This rocket is four feet long and its propelling agent is liquid gas. A gyroscope keeps it from deviating from its course.

Will the Rocket Replace Artillery?

By Gawain Edwards

Author of "The Earth Tube," etc.

It Seems Inevitable That Whenever Science Makes Some New Advance, Somebody Thinks Up a Way of Utilizing the Latest Discovery to Produce Still Another Engine of Frightfulness for Use in Time of War. Much Has Been Heard Recently of the Adaptation of the Rocket to the Peaceful Arts. Here We Have the Other Side of the Picture—the Potential Horrors of the Rocket as an Alternative to Artillery

SO many forecasts of the horrors of future war have been made in recent years that military engineers will probably require a long time to work out all the devices that have been suggested to them by imaginative writers and speakers. But recently an authentic touch of frightfulness was added to these forecasts when it became known that the war departments of several European countries, notably Germany, France and Italy were making special and secret studies of rockets to supplement or replace cannon in bombardment and barrage.

What this may mean in terms of military and civilian slaughter in time of war can hardly be imagined. The big gun has grown from the old-fashioned iron cannon to the Big Bertha that bombarded Paris, but this is about the ultimate range of such weapons. As long as no other type of projectile throwing arm is used there is little danger that New York, for instance, can be blown to pieces by batteries placed at Paris or Berlin. The mechanical difficulties preclude forever the throwing of explosives such distances by cannon.

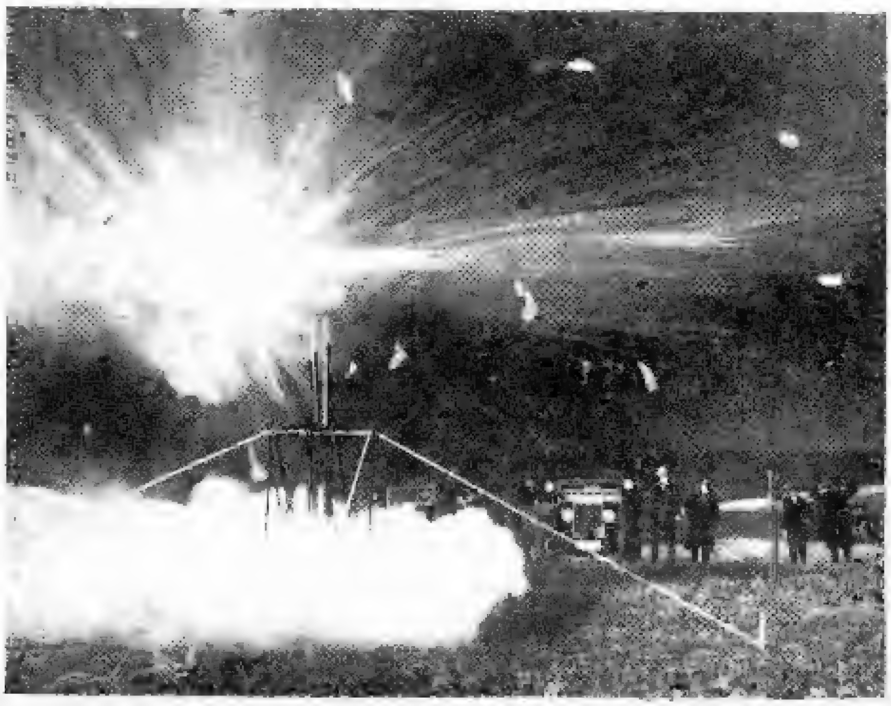
But in modern rockets we have a new and almost untried weapon that may revolutionize warfare, make possible the accurate bombardment of cities half way around the earth, turn every infantryman into a traveling artilleryman, and carry the battle beyond the front-line trenches into the very homes of non-combatants and civilians in the capitals of the world.

Renewal of experiments to adapt rockets to the uses of war, recalls the fact that these devices have already had an important place in military history. Before 1805 Sir William Congreve, an unusual and versatile British inventor, suggested that rockets might be used to good effect in attacking cities, fortifications, or fleets of ships, and to him we owe much of our modern conception of the uses to which rockets may be put. Previously the rocket had been only a pretty product of the pyrotechnist's art, suitable for displays at celebrations. He perceived in the recoil principle that drove these fiery toys, a force that could be turned to the uses of mankind, and since England was at that time embroiled in wars across the channel, his mind naturally linked rockets with military operations.

Carrying on earlier experiments made by General Desaguliers at the Woolwich Laboratory, Congreve mastered the rudiments of rocket-craft, as it was understood in his day, and set himself to the task of making a rocket capable of carrying an explosive or incendiary charge and having a range of two miles or more. At length, he obtained permission for the construction of several rockets after his design in the Royal Laboratory. Military authorities were impressed and preparations were made to try out Congreve's scheme in actual battle.

When Sir Sidney Smith's expedition went against Boulogne in 1805 it included a number of boats equipped with rockets and apparatus for firing them. Congreve himself went along and participated in the subsequent attack against the French flotilla, but rough weather prevented the use of rockets in the battle. The following year however, they were used in another attack against Boulogne and were credited with doing considerable

(Continued on page 652)



This photo shows a slight mishap which occurred when one of Ludvik Ocenasek's rockets exploded at the starting point at Prague, Czechoslovakia.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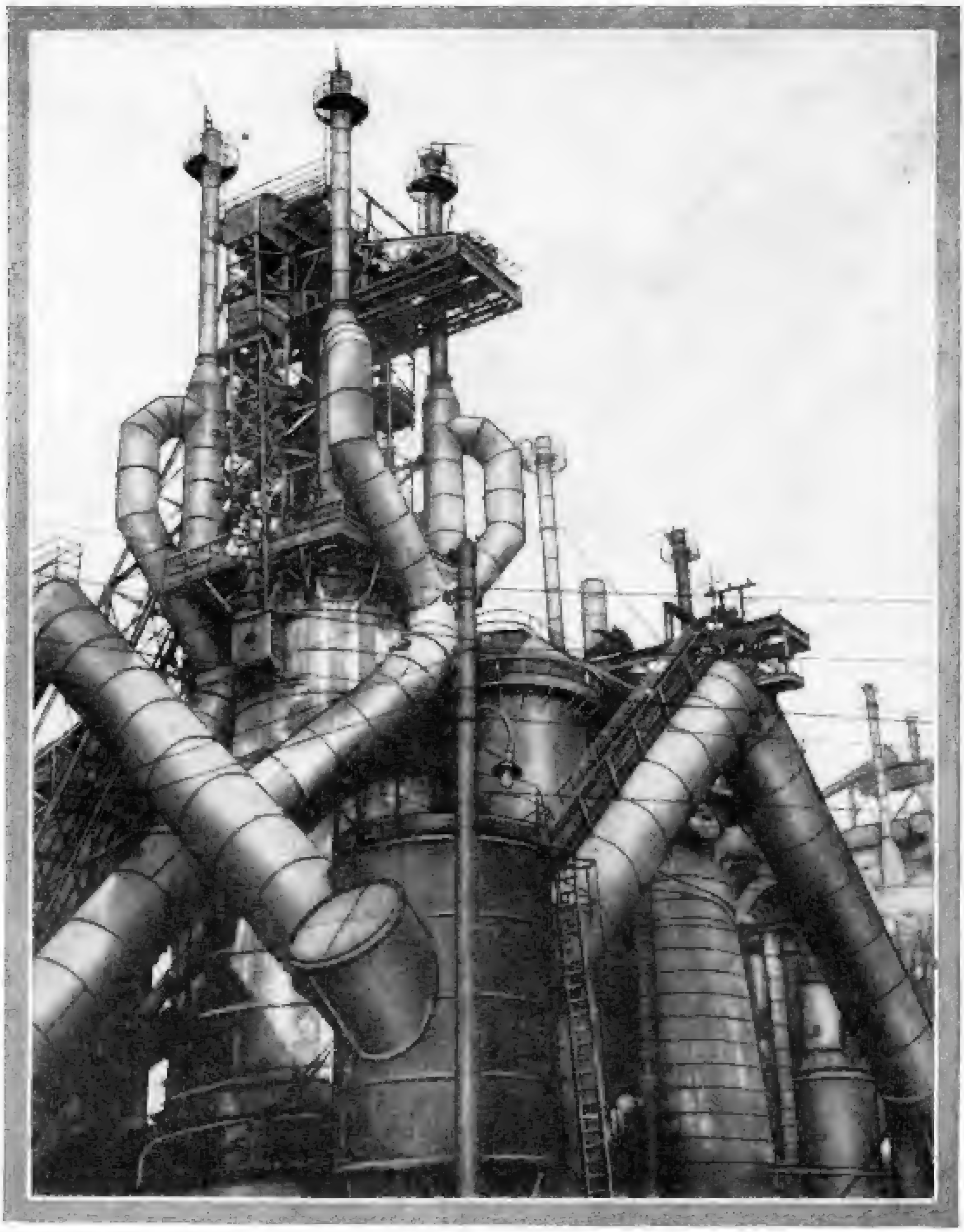


This Fantastic-Looking Picture Is a View of the Blast Furnaces of the Stalin Metal Factory in the Donetz Basin, Where 13,000 Men and Women Are Employed

A close-up of the warrior ant, enlarged. He moves with great rapidity and it is necessary to hurry to keep out of his way when he is on the war path.

Ants Fight

By Don Charles

THE ant nations of the world have no peace treaties, no league, no disarmament conferences. They are followers of Mars, the great red god of war.

Ant wars have been in progress in the Zoological Gardens of the nations —in England, in New York, in Washington and elsewhere. Ant wars are raging in Africa, in South America, in fact wherever rival ant nations or tribes meet war is declared and then it is a battle to the finish, with no quarter asked or given.

H. G. Wells has foreshadowed a sinister possibility — the evolution of the warrior ant to tiger-size. Imagine, if possible, the havoc of great armies of such giant creatures, marching a million strong, to battle for the supremacy. Fighting would be so fierce that rather than release a domestic creature such as a horse or a cow upon whom they chanced, they would allow their heads to be cut off!

The tiny ant is most like the human in living conditions. Ants have their cities, their various social orders, their rulers. For this reason the ant's habits have engaged the attention of scientists who are studying them.

Sometime ago the officials of the London Zoo staged an ant battle in their study of ant behavior. The keepers

The warrior ant is perfectly capable of winning any combat with a bee or a hornet. Here is one carrying such a prize back to augment the tribe's food supplies.

turned a thousand or more loose, permitted them to attack one another, and before the melee was over several hundred had been killed and large numbers badly wounded. Excited spectators viewed the fight.

The most remarkable thing about the whole battle was the way the opposing armies planned their campaigns and conducted their attacks. It was a demonstration that the ant can use his brains in the heat of battle, as well as in the calmer days of peace. It all started on a bright Monday morning, when one of the keepers of the zoo placed a little wooden chip over the moat that separated two ant nations—an old one that had been there for three years, and a new one just arrived. The chip served as a bridge, and for the first time made possible communication between the two colonies.

A member of the old colony became curious. He sneaked across the bridge and penetrated into the new nest. He never came back.

A police ant arresting an unruly member of the tribe.

At left is a cross-section of an ant hill showing how the paths or streets run together, and the care taken of the eggs. Ants are constantly on guard at the openings. In this picture, the ants are shown pouring out to the attack, marching in regular formation like a human army.

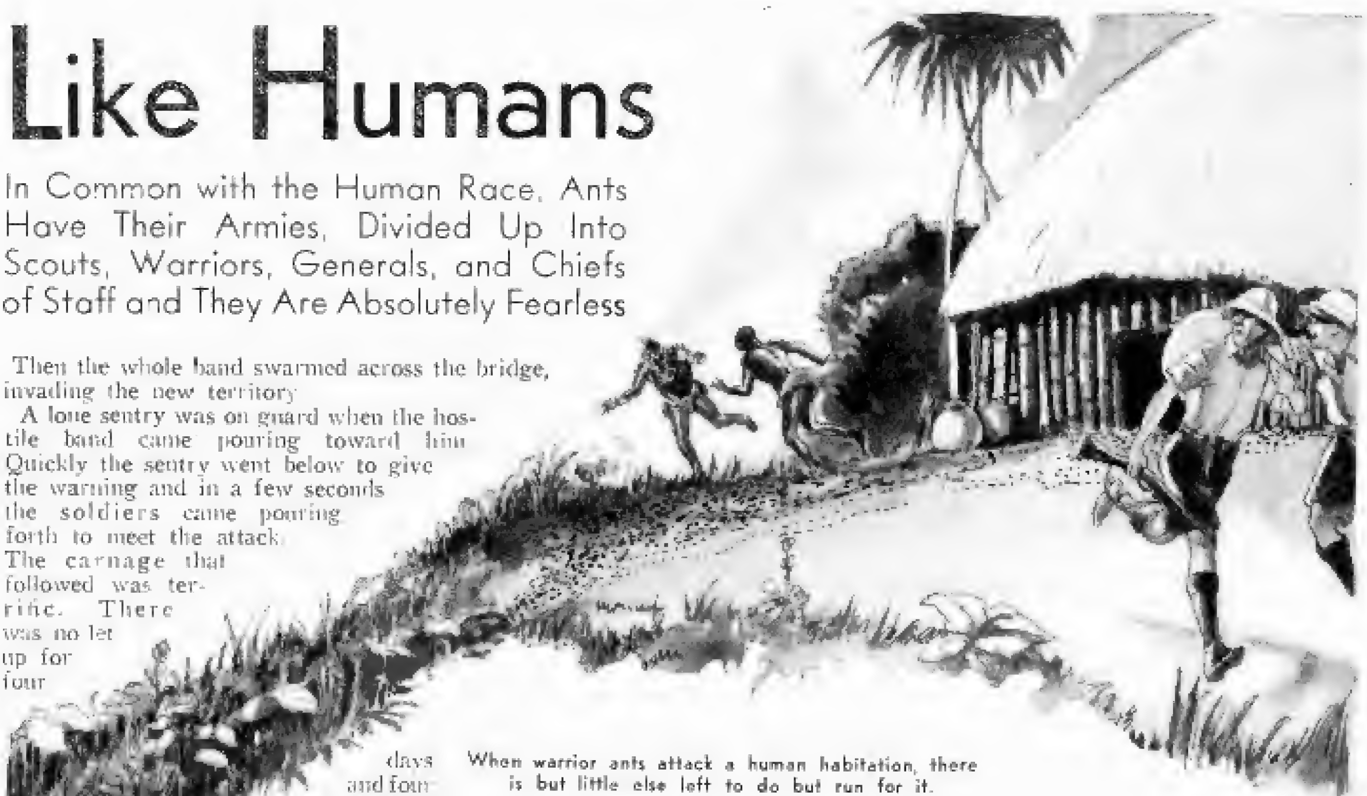
That meant war, the old ants decided. They probably believed that they should protect their nationals. But they did not lose their heads and dash pell-mell across the bridge, only to be swallowed up by a possible ambush. Instead, they chose their best scouts and sent them out to reconnoiter. These daring ants crawled across the bridge and into the enemy's territory.

They found nothing. All the new ants were hidden away, awaiting the advance of the enemy. The scouts went back to the generals and reported.

The zoo keepers and scientists watched closely every move. They noted that a council of war followed the report. In a few minutes there issued from the old nest an imposing array of warriors, marching in ranks as orderly as any crack regiment of infantry. Along beside the column went other ants which threw up earthworks in case attacks might come from such quarters.

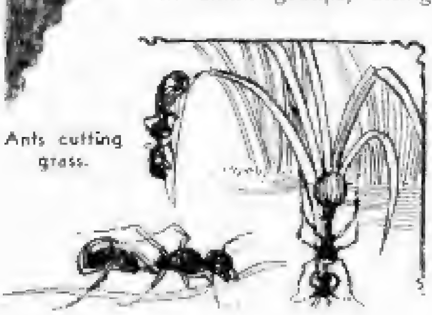
Like Humans

In Common with the Human Race, Ants Have Their Armies, Divided Up Into Scouts, Warriors, Generals, and Chiefs of Staff and They Are Absolutely Fearless


When warrior ants attack a human habitation, there is but little else left to do but run for it.

Then the whole band swarmed across the bridge, invading the new territory.

A lone sentry was on guard when the hostile band came pouring toward him. Quickly the sentry went below to give the warning and in a few seconds the soldiers came pouring forth to meet the attack. The carnage that followed was terrific. There was no let up for four days and four nights. No quarter was asked and none given. They fought in small groups, biting


Ants cutting grass.

and tearing. Warriors were dismembered. Quivering bodies lay legless and headless. So hot waged the battle that only a few of the wounded were dragged aside into temporary safety.

Then an armistice must have been arranged, but it lasted only a few hours. Evidently the terms were broken for the battle was resumed, and more wounded lay quivering or floating helplessly in the water beneath the bridge. With their big mandibles the warriors slashed at one another. They tossed the weaker ones into the moat; or failing this, cut off their opponents' limbs and left them helpless.

By Thursday afternoon the invaders from the old colony had been driven back across the bridge with great losses; in fact they had been practically annihilated. Their rout was complete. The victors took some for slaves, after killing all that they desired. The worker ants were called out and cleared the dead from the field, and peace reigned.

Scientists say that mankind will one day have to contest the rulership of the world with insects and among all the insects the ants have shown the highest capacity for leadership and the greatest intelligence. If, as H. G. Wells has predicted, ants grow to enormous size, becoming as large as tigers or even as cats and dogs, man would find it difficult to live upon the earth.

In Africa where the ant is very much at home, ants create the greatest havoc among humans because of their fighting instincts and their tenacity of purpose.

Dr. Hans Coudenhove, a scientist of note who has studied the warrior ants in Africa, says that all native life flees before the approach of these ant armies. He tells of sitting in front of his tent


If the battle is not too fierce, warrior ants carry their wounded comrades off the field.

or on the porch of his house on an afternoon and noticing that suddenly the harmless brown ants were fleeing in disorderly manner, clutching their pupae or babies, just as peasant women have fled upon the approach of foreign armies in European wars.

This might mean nothing to a newcomer but to the experienced African it means trouble. "He will rise, in haste, call his servants, and say to them:

" 'Siafu are approaching; look about everywhere and stop them if you can!' "

Dr. Coudenhove says that the servants need not be told twice. "They start running, and search the surroundings of the tent or house in extending circles, until one of them will sing out:

" 'There they are!' "

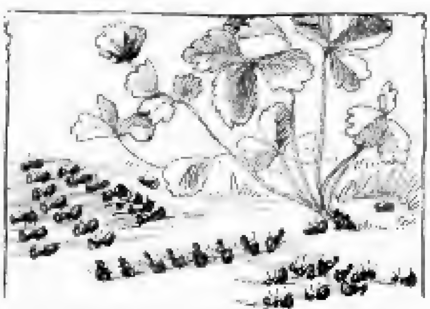
Then there will be jumps, kicks, and clappings of the palms of the hands on the feet, legs and calves. This is because they have suddenly come in contact with the advance guard of the enemy's column.

"Siafu" is the name that the Swahili tribe have given to the warrior ants, the type of ants that are ready to fight at any time the world over, whether in the zoos of London, New York, Washington, or the plains of Africa.

These warrior ants will attack anything alive that they may meet in the course of their advance. They have disproportionately large heads and mandibles, they are bloodthirsty, and while the wound is not poisonous it is none the less dangerous.

"Caged birds and animals have been killed," Dr. Coudenhove says, "if not rescued in time.

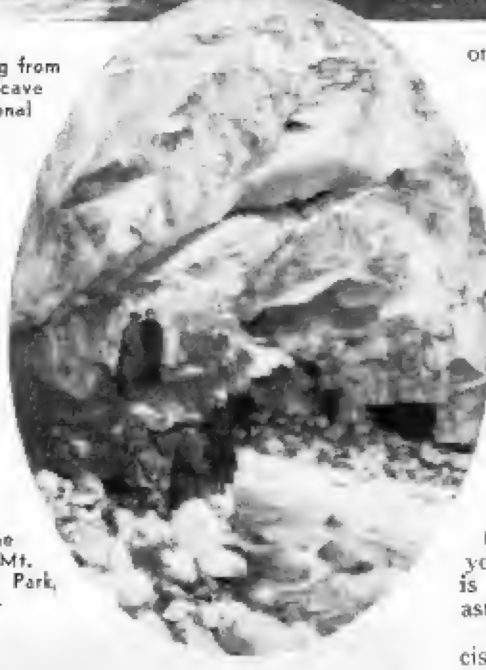
"I remember a case in which they killed during (*Continued on page* 1031)


The warrior ants have been known to bury their dead, laying them out in neat, orderly rows.

Is the

By Orville H. Kneen

Luncheon in Nature's refrigerator. Looking from the interior of the blue-domed, crystal cave under Paradise Glacier, Mt. Rainier National Park, at Washington.



At the foot of the Nisqually Glacier, Mt. Rainier National Park, Washington.

"FOR the year 2931—warmer and drier." This, in effect, is the prediction of our longest-range forecasters of the weather. To these glaciologists, students of the only accurate barometers of world climate, a thousand years is but a moment of geological time.

But as they measure hundreds of glaciers, and find them steadily retreating all over the world, the experts begin to agree on one important point—that we are now emerging from the ice age of some 12,000 years ago; and, barring accidents, for several thousand years our weather should grow warmer.

"There is good reason to believe," says Professor A. P. Coleman, of the University of Toronto, "that our present epoch is not really normal, but decidedly colder than usual, though much milder than in past ice ages. The paroxysms of cold must be looked upon as merely interludes between long periods of warmth."

View from tongue of Freshfield Glacier, Canadian Rockies. The boulder, H, in contact with the ice in 1722, is now 338 feet distant. This explains the origin of isolated boulders which are found in various parts of the country. Note the distant wooded "dam" of old moraine across the valley.

At one time the earth's climate was so genial that even the Poles were free from ice. Temperate-climate vegetation once grew luxuriously even in northern Canada and Antarctica. The presence of coal and fossils in these places, and the absence of glacial action in large areas such as South America, prove that the entire earth was once free of ice. The snow that fell in winter melted each summer.

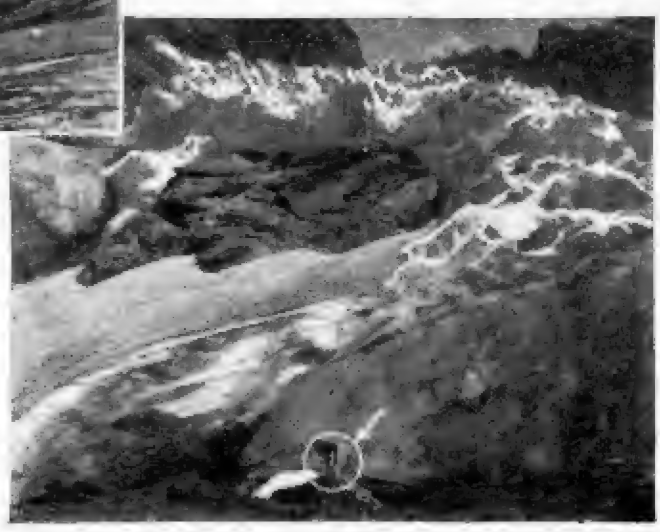
But at other periods much of Europe, as far south as London and Berlin, and most of North America, lay under solid ice. One Canadian sheet extended as far south as Burnett's Mound, in Kansas, where it left piles of gravel and huge polished quartzite boulders—native only to Canada and northern Minnesota.

"These terrible catastrophes which half depopulated the globe," cannot occur for thousands of years to come, scientists believe. They are caused by rare combinations of atmospheric and geologic conditions, perhaps astronomic as well. A lowering of average temperatures of only 25 to 50 degrees would bring on an ice age. Volcanic dust, shifting of the poles, and other disturbances affecting our heat supply, affect our climate at times.

Professor P. L. Mercanton, noted glaciologist of the University of Lausanne, recently reported the continual retreat of Alpine glaciers. These have been accurately measured for fifty years. Four out of five are retreating, some are stationary, none are advancing to any extent. Snows for the past two years have been much lighter. Perhaps there is some connection between this and our disastrous droughts, floods and hot weather.

How do glaciologists measure with precision the complicated movements of glaciers? First their structure must be known. Glaciers of today, even those ten to sixteen miles long, as in Switzerland, are mere remnants of bygone ice sheets. They are formed when moisture-laden winds strike cold mountains,

Oberer Glacier, Grindelwald, Switzerland. The human being standing within the white circle by the hewn-out cave indicates height of the glacier's foot. Note how exposed rocks have been rounded off.



Earth Getting Warmer?

Twelve Thousand Years Ago Much of Europe and Most of North America Was Covered with Ice. This Ice Cap Has Gradually Receded Until Only the Polar Ice Caps and Glaciers Remain. Even These Glaciers Are Slowly Receding and Glaciologists Predict a Warmer Climate All Over the World

Tschierva Glacier, Swiss Alps. This picture shows how deep snow around mountain peaks slides downwards in a confused, tumbled mass, then congeals into solid ice which flows on down the valley like a frozen river. Note the banks of moraine which the glacier has built up for itself at its edges.

are forced up to high altitudes, and there release snow. This piles up, often to a depth of twenty and even fifty feet in a single winter.

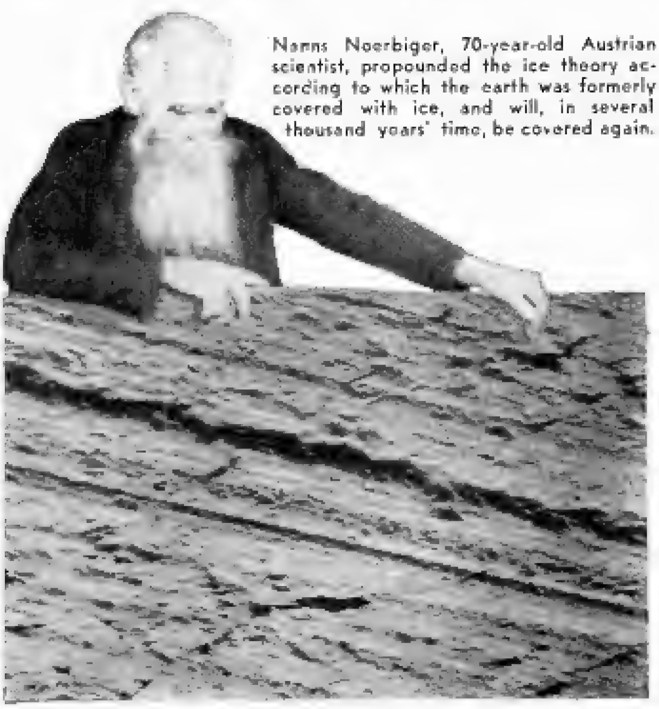
The great pressure, and only partial melting each summer, results in a layer of pure ice. Succeeding layers, piling up in valleys and gulleys, high in the mountains, compress lower layers into "granular" ice globules the size of hazel nuts up to 1 and 2 inches in diameter.

Such globules, all perfectly interlocked, occur in no other form of congealed water. The enormous weight of fifty, a hundred or several hundred feet of ice produces at intervals a temporary melting at slippage layers between globules, and the water so formed runs to points of less pressure. The effect of such slippages is that the whole weight moves forward and downward, due to the inexorable pull of gravity, and the glacier slowly crawls down its rocky bed, with groans and crackings and grindings, as quarried boulders are forced against solid rock. The ice next to the bed and sides moves slowest, because of friction.

Glaciologists often must climb for hours or days, packing their own provisions, perhaps braving storms and intense cold, to reach their open-air "laboratory." They measure general movement by various means. Two permanent points may be selected, on either side of a glacier, and a transit line run across the ice. Successive readings show clearly that the middle moves most rapidly. Early scientists had to work fast in drilling deep holes, to keep their tools from wedging in the hole. Today a hole 300 feet deep is drilled in a day. Echo sounding, in which the echo from an explosion is timed, measures depths accurately.

Special devices register on moving charts, something like seismographs, every time a granular slippage occurs. In 1922 J. Monroe Thorington, M.D., of the Smithsonian Institution, set a reference line (*Continued on page* 1042)

Above—Where icebergs launch themselves into the sea in Magdalene Bay. The foot of the glacier, forced far out into the sea, breaks off under the influence of wind and tide to form giant icebergs. Left—Glacier markings on rock along Lincoln Pass, Montana. These markings can be seen in Central Park, New York, and in very many other parts of the country.



Nanns Noerbiger, 70-year-old Austrian scientist, propounded the ice theory according to which the earth was formerly covered with ice, and will, in several thousand years' time, be covered again.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When a Comet
Strikes the Earth
By Dr. H. H. Sheldon
Hunting with African Giants and Pygmies — By Paul L. Hoefler

MAY, 1931
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Science and Invention

VOLUME XIX
NUMBER 1

When a Comet Strikes the Earth

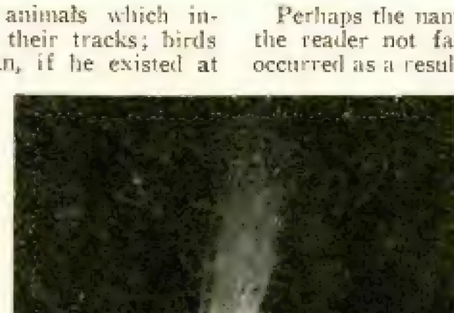
By Dr. H. H. Sheldon

Professor Sheldon Is Chairman of the Physics Department at New York University; Fellow of the American Association for the Advancement of Science; the Acoustical Society of America; the American Geographical Society; and a Member of the American Physical Society. He Is Also President of the New York Electrical Society

THOUSANDS of years ago the animals which inhabited the earth were stopped in their tracks; birds went flying crazily to shelter; man, if he existed at that time, fell to his knees and prayed to whatever gods were then popular. The earth shook and swayed beneath their feet. For days they did not dare to venture forth from their shelter. And then, only because the need for food made it imperative. The earth had received the worst wallop it has had since its formation. A direct hit had been scored upon it from interstellar space.

Many thousands of years later civilized man, man as we know him today, stumbled upon the peculiar scar that was left on the earth by the tremendous impact of this gigantic projectile and wondered at its peculiar shape. Here, in Arizona, was a giant crater, 4,000 feet in diameter, surrounded by a ragged land formation, resembling a wall, about 120 feet high. It looked a good deal like one of the huge craters so evident on the surface of the moon, when viewed through a telescope.

During recent years this crater has been the subject of much investigation. It has been variously known as Coon Butte, Meteor Butte, The Meteor Crater, and, more recently, the Barringer Crater. The last name has been given it as a mark of respect to the Barringers, father and son, who carried on such prolonged research in its connection. How did the crater get there?



Ewing Galloway

This white-hot ball, with its equally blazing tail, reappears about every 76 years, passing sufficiently near the earth's orbit to hurl down meteoric showers. It is called Halley's Comet; the above photograph was taken at Santiago, Chile on May 7, 1910, when it last appeared.

Perhaps the name, meteor crater, is such as to suggest to the reader not familiar with the crater that it may have occurred as a result of a collision of the earth with a meteor. This is generally considered as one possibility; but it is not the only one. At first sight the crater has the appearance of a rim of an old volcano, gradually sunk into the earth, until only its edge remains above the surface. Until considerable research had been done to prove otherwise, this theory was somewhat generally held. It has been completely disproven, however, by extensive borings which show that the floor underneath is continuous with the surrounding rock strata. Large numbers of borings have been made in all parts of the crater to depths of nearly fifteen hundred feet. Further, there are no materials found in the neighborhood that are suggestive of volcanic origin.

A second theory, likewise now generally discarded, is that the crater was formed by erosion. True, the walls of the floor of the crater itself all bear deep scars of erosion. This is not to be wondered at, in view of the fact that it has withstood the torrential downpours of the desert for centuries. But were it due to erosion, and merely a sinkhole, it would be difficult to account for the surrounding walls. It has been said that the particular kind of rock which lies beneath it, Kaibeb limestone, is quite sponge-like in character. In other places where this rock occurs, small sinkholes have been found. If this theory were correct, it is strange that no craters to compare in size with the Barringer Crater appear elsewhere.

It must be admitted, then, that the most likely thing that could have produced this peculiar crater was a direct hit by a very large meteor arriving on the earth with terrific velocity, or possibly by a collision with a comet. Whatever it was, the earth must have been shaken like a ship is shaken when it strikes a rock. It must have been the most awe-inspiring sight that living eyes have ever had the opportunity of witnessing.

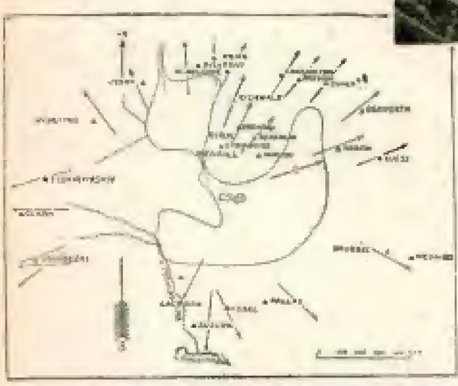
Imagine, streaking out of the sky, a huge mass of material, perhaps four hundred feet in diameter, and trailing behind it a long tail of white hot matter, burned by the heat of friction with the air! Picture this huge white-hot ball striking the earth with a thunderous impact that nearly shatters the ear drum. Dust from powdered rocks fills the atmosphere, while the earth fairly stops in its tracks, and shivers! Then follow unimaginable explosions, like cracks of thunder piled one on the other. Water, in the saturated rocks, has been turned to steam by the tremendous heat caused by the impact from this giant missile. Dust cloud follows dust cloud, until it seems that the very earth is being rended apart, for miles.

Hours after, when winds have cleared the atmosphere, there is a new row of hills visible at a distance. On going close they are found to have been formed by the dust which has heaped up around the center of disturbance. They form a closed circle, and the whole resembles a huge arena formed to stage the world's most spectacular drama. Nodules of iron, perhaps still hot, are found for miles around. It is these, which, centuries later, form the major clue to what took place at this point of the earth's surface.

With this picture in mind let us examine the ground in more detail. What became of the comet has always puzzled geologists. Here is the crater—where is the missile that made it? For a long time it was thought to be buried deep beneath the floor of the crater. But the same borings which show that it cannot be a volcano show also that

Dr. O. C. Farrington measuring the largest meteoric stone that was ever seen to fall. Its weight is 820 pounds.

A devastated forest, photographed by Professor L. A. Kulik of the Siberian Meteor Expedition. Trees were thrown down by the terrific wind created at the time of the meteor fall, which occurred on a plateau in Siberia, between the rivers Kimtchu and Huchmo.



Map of the affected region, also provided by Professor Kulik. Arrows indicate the direction in which the trees fell, away from the center of the disturbance.

The famous Meteor Crater, or Barringer Crater, near Winslow, Arizona. The meteor has entirely disappeared.

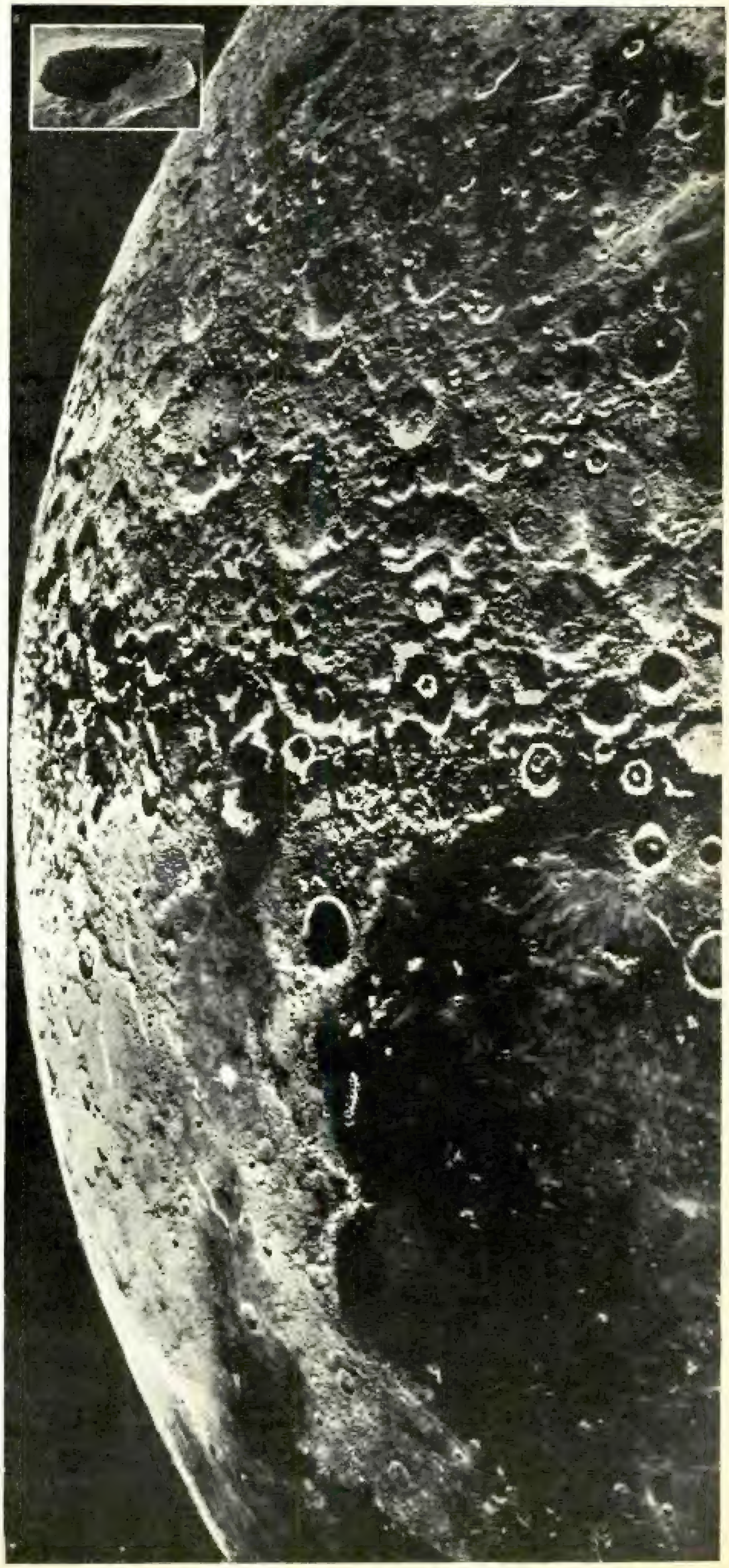
there is no buried meteor. Drillings have been made at suspected spots around the edge, on the theory that it may have struck the earth at an angle and so have been stopped, not underneath the crater, but off to one side. While meteoric material has been brought up from depths as great as 1,376 feet, there has been no evidence of the presence of the meteor itself. The result is that we are driven to the conclusion that the meteor was completely destroyed by the impact.

Naturally our curiosity as to what the meteor was like, in the first place, leads us on. How big was this meteor, how fast was it going when it hit the earth, and of what was it composed? On the assumption that the meteor was composed wholly of nickeliferous iron, calculations indicate that it may have been about 4,000 feet in diameter and weighed some ten million tons. Only a few tons of iron are now left. But this is not at all surprising, for iron quickly oxidizes when exposed to the air. That is why so few meteors are found after they have been seen to fall. The iron nodules, of which several tons have been discovered around Meteor Crater, are those which were of a resistant nature.

But whether or not the meteor was wholly of iron is open to question. The Barringer theory is to the effect that the meteor was composed of many fragments of iron not bound together. These formed the immense cluster which made up the meteor. If any stone had been present in the cluster it would have been ground to powder, as if in a ball-mill, and would have been separated from the comet, or meteor, by pressure of the sun's light. There is to be found no stone near the crater that is foreign to the region.

On the other hand, Professor Herman L. Fairchild, noted geological authority of the University of Rochester, believes that the iron nodules must have been bound together by rock. If this were not so, he feels that the desert would have been pitted by smaller craters produced by pieces of the meteor separated from the main body by the friction with the earth's atmosphere. He believes that the pieces of iron found in the region should show evidence of friction with the air through which they must have passed with terrific velocity. They do not. He therefore thinks that they arrived protected by a rock coating. This rock coating might have been powdered so fine as to have completely disappeared from the region. Individual sand grains were shattered so fine, possibly by supersonic vibrations, that they produced dust of angular crystalline quartz of microscopic fineness. Fifty-five per cent of these dust particles will pass through a 200-mesh sieve.

It has been objected that if the iron particles were (*Continued on page* 85)



When the moon was hot enough to be plastic, it must have received many comet bombardments. Some of the craters on its surface are 500 miles across and ten miles deep. They resemble the Meteor Crater, cut in on the top of the photograph.

Science and Invention

James

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Art

Aerial Bombs Will Decide the Next War

Harnessing the Tides — Forests of Stone

An airview of the airport at Fairfax, Neb., taken from 1500 feet, showing extensive landscape designing around the administration building.

Airscapes—The Latest in Architecture

By James R. Lowell

MOTION picture directors, authors of scientific fiction and cartoonists are drawing upon their imaginations for predictions as to what the world may expect a few decades hence in the appearance of our cities and towns as influenced by aviation. Visions are painted of a landing field on every roof, and cities erected around central airports. Just how far-fetched such developments may be no one can say, but it is a fact that in Lincoln, Nebraska, a step of considerable importance and of an entirely practical nature has been made in that direction.

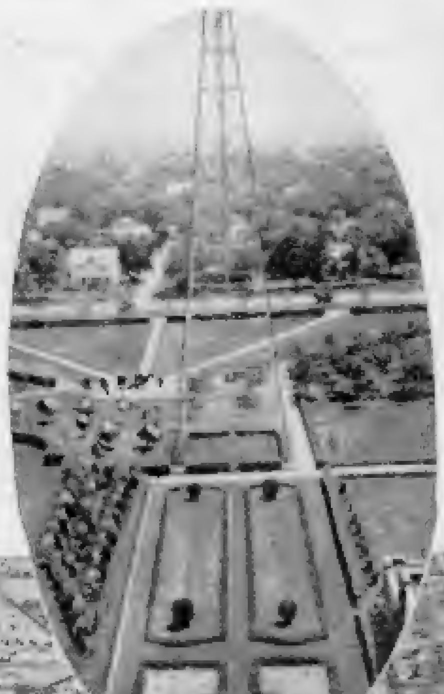
A new residential district has been laid out in Lincoln, designed, for the first time on record, with an eye to its appearance from the air. A formal type of landscape architecture was used, and the effect may be judged from the photograph accompanying this article.

Ernst Herminghaus, Lincoln landscape architect, designed this new residential district, which, incidentally, occupies a part of the same field at which Colonel Lindbergh learned to fly. Mr. Herminghaus may be classed as America's pioneer air-minded landscape architect. He has studied aviation as a factor in landscape architecture and gardening, park design and city planning for a number of years, and besides the new sub-division in Lincoln he has designed several other projects with an eye to their appearance to the air traveler. These include parks at Clay Center and Madison, Neb., and Fairfax airport at Kansas City.

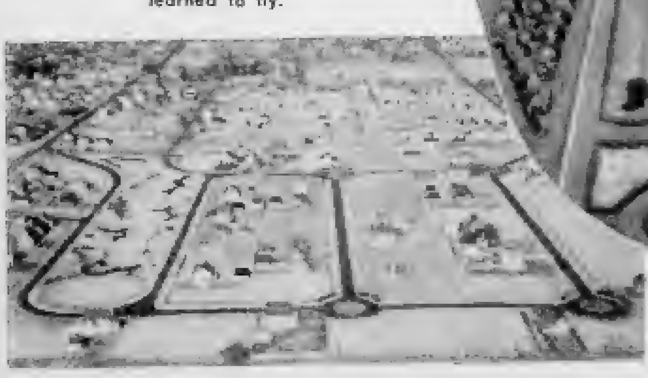
Most cities look much alike to the air traveler, and aside from rivers and lakes the only thing that strongly attracts the eye from above is a formal design of landscape architecture. This engages the attention immediately and gives the same sort of pleasure that one derives from a perfect geometric figure amidst random lines.

"From the air one looks down upon the earth as if it were a great map," says Mr. Herminghaus. "Consequently, landscape designs will be viewed as one sees a plan of them on paper, and they are necessarily just as attractive from the air as they are on the plan. The viewpoint is somewhat different; from above, there are essentially only two di-

(*Continued on page* 163)



Left—Airview of city park at Clay Center, Neb., showing formal landscape design laid out so as to be attractive looking when viewed from the air. Below—Airview of a typical residential district in an American city, not laid out so as to be pleasing when seen from the air.



Below — Woodsshire residential district of Lincoln, Neb., as seen from a height of 2000 feet. This is believed to be the only residential district in the world designed with an eye to its appearance from the air. Its site occupies part of the field at which Lindbergh learned to fly.

Aerial Bullets Will Decide

The U.S. Air Corps Is the Only Air Corps in the World Which Now Has Available Powerful Attack Planes Mounting Six Browning Machine Guns Per Plane

This aerial gun, a marvel of ballistical science, can pour forth 1200 bullets per minute at the maximum rate of fire.

SAMLAND'S modern aerial gunners talk defiance to foes with showers of bullets from skyway machine guns that belch leaden missiles like raindrops fall in a thunder storm.

Frequently you have heard libel against the American Air Corps broadcast by the gossips and amateur critics. They charge our Federal system of air defense and attack as being rather antediluvian. Like most idle talk these rumors are spun from pure fiction.

Jot this down on your diary of new facts and underscore it so you will not forget its importance. The U. S. Air Corps leads the flying world in the development of attack planes. It is the only air corps extant which now has available powerful attack planes in which six Browning machine guns are mounted per plane. The pilot and two gunners per plane operate this group of rapid-fire aerial guns which can vomit a maximum of 6,000 bullets per minute on enemy ground forces.

Never in the history of warfare has a more stealthy and annihilative system of attack been devised. A squadron of 28 of these planes, which have peak cruising speeds of 150 miles per hour when flying from 150 to 200 feet above the ground, can utilize woodlands, hills and mountains as screens to conceal its approach from large units of ground foes. It is true that the enemy will hear the drones and echoes of the approaching planes, but unless they are reinforced with aeronautical scouts they will be unable to determine definitely from what direction the aircraft are approaching and whether they are friends or enemies.

Aerial gunnery practice with a towed target used to simulate an enemy plane.

Suddenly the planes in formidable battle formation sweep into view over the protecting woods or hills, spitting a rainfall of lead as their introduction. Stupendous casualties result where enemy infantry, artillery or cavalry are entrapped on the ground subject to such air attacks. The attacking air force also suffers large losses in such daring sorties, but the punishment which it peddles is much greater than which it receives. According to the revised doctrines of modern warfare, such air losses are justified if they sow correspondingly greater destruction than they reap.

Installing a modern machine gun in the cockpit of an army pursuit plane. Inset—the gun in position.

A 30-calibre Browning machine-gun mounted on the wing of a U.S. Army airplane.

The Lewis machine gun, historic in the development of Uncle Sam's attacks and defenses by air, has been replaced as standard equipment on fighting planes by the more efficient Browning gun. The Lewis gun is simple in operation, is easy to adjust and repair in the air, but it has always been handicapped by the fact that it could never be synchronized "to shoot through the propeller," as the popular expression goes.

The Browning gun, so the story goes, possesses all the advantageous features of the Lewis gun, and in addition is synchronized to shoot through the propeller. Research experimenters met with considerable difficulty in the development of a streamlined magazine for this gun but even that riddle was solved eventually. The guns in the war planes operating at high speeds are exposed to terrific wind blasts; hence the need for the streamlined design of magazines.

What has been said previously is true with one exception —that no machine gun whatsoever is actually synchronized to shoot through the aircraft propeller. The real fact of the matter is that the machine gun is synchronized so that it will not vomit forth its rain of lead when one of the blades of the propeller is in the line of fire. This refusal of the gun to "sing its song" under such conditions is governed automatically. The pilot can press the trigger of the gun which is mounted on his flight control stick, but the gun will not fire until the propeller blade moves enough to facilitate an unobstructed line of fire.

and Bombs the Next War

By Gene Day

The new Browning machine gun is a marvel of ballistical science. It is an aircooled weapon, being skeletonized with the bolt machined out. Under ordinary firing conditions, it spits bullets at the rate of 850 to 900 a minute, while it can be stepped up to shoot 1,200 leaden charges a minute, with a fast firing rate of 1,000 shots being rather traditional for this weapon.

In the small single seat pursuit planes the pilot operates two machine guns which are mounted in front of him underneath the cowling in the forward part of the cockpit. Usually one of these guns is a .30 calibre weapon while the other is a .50 calibre affair. Although a .30 calibre bullet is usually adequate to disable the enemy plane, a .50 calibre gun is also desirable for emergency use because of its greater range. The maximum effective range of the latter gun is about 2,500 feet, while that of the former is approximately 1,400 feet under aerial warfare conditions.

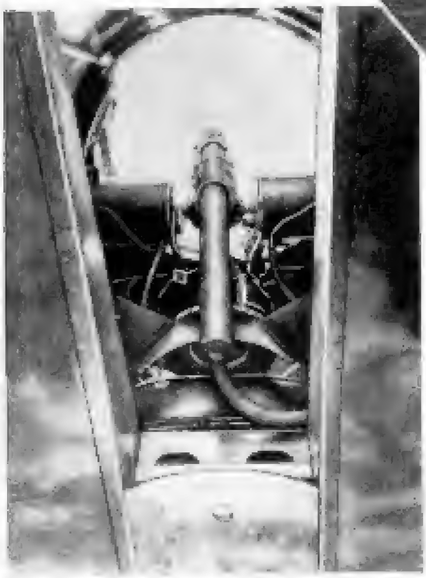
Both the observation and attack planes have twin machine guns on flexible mounts in the rear cockpit which are operated by skilled aerial gunners. New types of mounts are being devised and tested by the Government research engineers, as the flexible ones now in use are not entirely satisfactory because they were originated primarily for effective use at speeds of from 80 to 90 miles an hour. Logically, they are not in tune with the plane speeds of 150 miles an hour, which are now becoming proverbial among the best of the new war planes.

The target practice of Uncle Sam's military birdmen is as accurate a simulation as may be of the bombing and gunnery tactics of actual conflict along the skyways. It consists of diving and shooting at targets on the ground and fabric sleeves towed behind other planes as well as low and high altitude bombing.

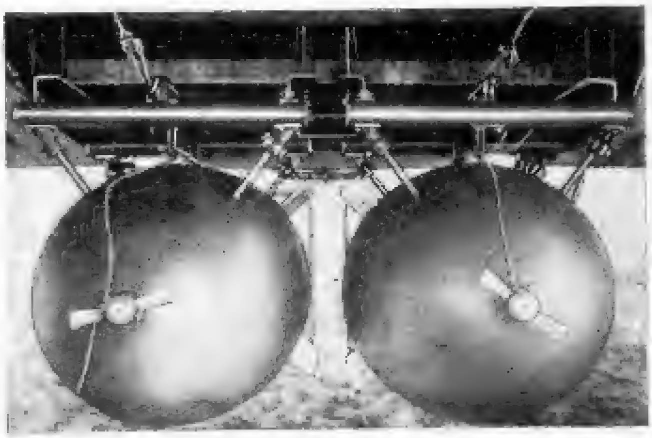
Although the machine guns mounted in attack planes are infallible harbingers of large enemy losses, the major weapons of these "warships of the upper air" are the light 25-pound fragmentation bombs. Ten of these destroyers are carried as death-dealing equipment in each of the attack planes. You can gain some idea of the destructiveness of one of these bombs by the fact that it contains among other explosives four pounds of T N T. The machine guns, in the parlance of the army fliers, are used for "mopping up," supplementary to the bomb-dropping activities. (*Continued on page* 175)

Bombing practice, using the ice in a river as a target. Two bombs are shown just after they have left the plane.

Bombing U.S.S. Alabama. A 100-pound phosphorus bomb has just exploded over the masthead of the target ship. Phosphorus bombs are used to produce a smoke screen, and not to do damage. Such bombs do not explode on contact; they are set off by a time fuse set according to the height of the plane, so that the missile will explode just over the target.



Above—Bottom view of a bombing sight, as installed in the nose of a Martin Type C-2 bomber.



Right—Two 1100-pound demolition bombs loaded on the undercarriage of a Martin bomber, ready to take to the air. The little propellers on the noses of the bombs, by turning as the bomb falls through the air, release the firing pins so that the bombs explode on contact.

Shouting It from the Housetops

Throwing Its Message from the Roof of a Nearby Skyscraper on to the Expansive Side of That King of Skyscrapers, the Empire State Building in New York, a Modern Projecting Device Provides This Striking Tribute to the United States Army

Science and Invention

AUGUST
25 Cents

New Sun Motors

Changing JOBS to Keep HEALTHY

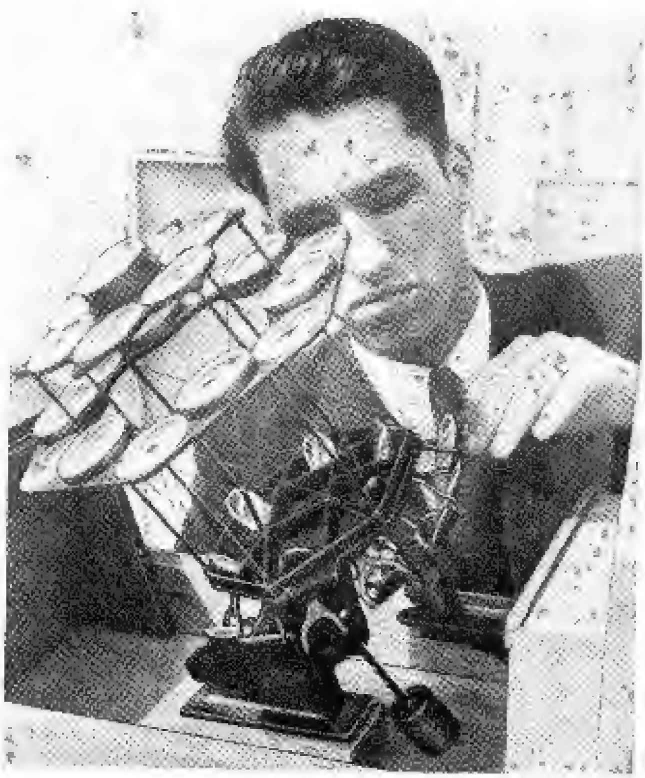
New Sun Motors to Produce Terrific Temperatures

The Sun Pours Forth Millions of Horsepower Every Minute of the Day. So Far, We Have Made Only Indirect Use of This Enormous Energy, in the Form of Coal, Oil and Water Power. Scientists Have for Long Been Making Attempts to Harness the Sun's Power Direct, But So Far Without Commercial Success. Some Suggested Methods for Utilizing the Sun's Heat Are Made Here

By Thomas Elway

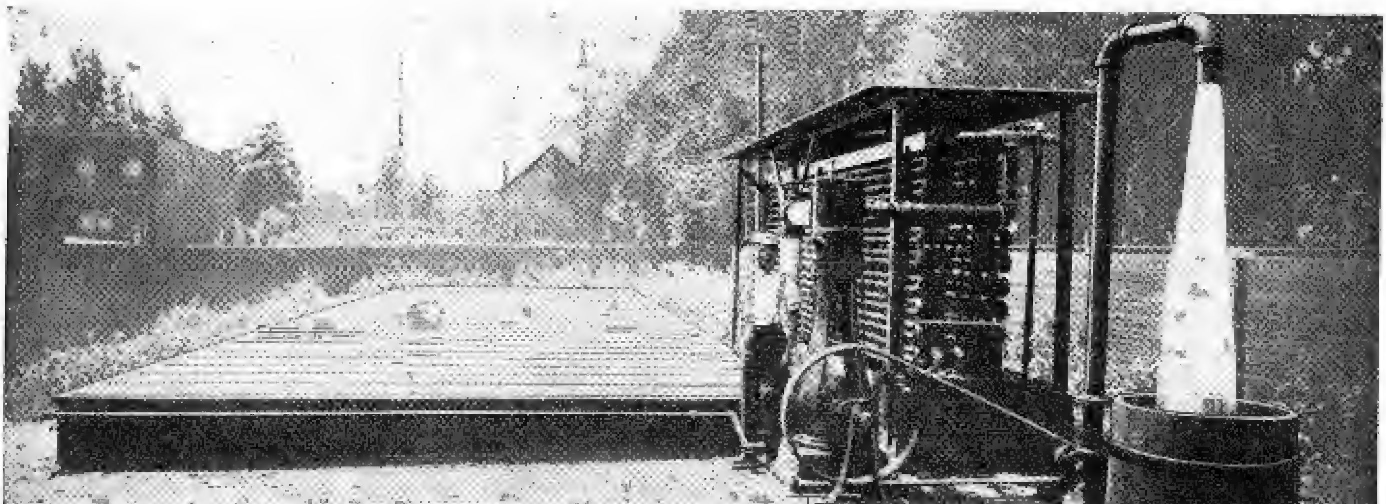
BRINGING the sun to Pasadena to make liquid diamonds, or to strip atoms of their coats of electrons so that scientists can learn more about the structure of matter, is the latest enterprise of scientists at the California Institute of Technology. Nor do the possibilities of this enterprise stop with the fusion of elements or the disruption of atoms made possible by the concentrated solar heat, for the devices to be used may give new life to the age-old problem of obtaining free power from sunlight.

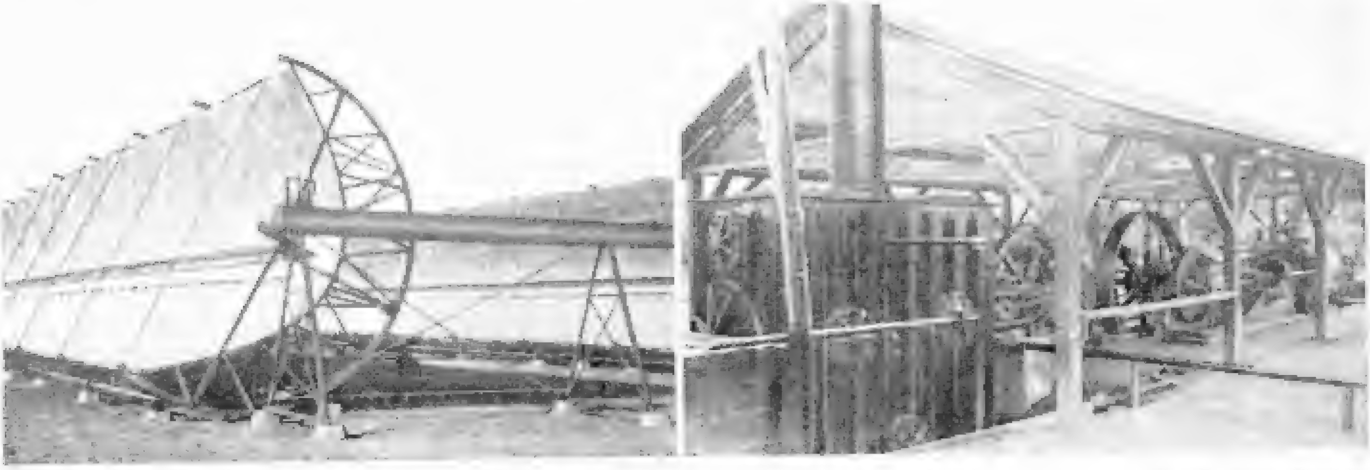
The apparatus which the California physicists are now constructing is designed primarily to produce solar heat, rather than solar power. In many ways it is solar heat with which physicists are most concerned, for ample sources of power are available anyway in such forms as water power, coal or oil. Earthly laboratories are entirely lacking, on the other hand, in means for producing continuous degrees of heat even approximately as great as the heat of the sun's surface, or as great as the new apparatus for controlling solar rays may possibly provide.



A model of a solar furnace which may melt diamonds, built by scientists of the California Institute of Technology, Pasadena. Each of the 19 lenses sends its ray to a common focal point at the base of the instrument. Below—An experimental sun engine using sulphuric ether as the working fluid.

The hottest furnaces ordinarily used on earth run only to some 2000 or 3000 degrees, Fahrenheit. Temperatures about twice as great as this can be obtained, under favorable circumstances, in the centers of electric arcs. Many years ago Benjamin Franklin devised another method of obtaining very high temperatures, by passing large quantities of electricity suddenly through thin metallic wires or strips of metal foil. When this happens the wire or foil explodes violently, producing for a tiny fraction of a second temperatures recently computed by Dr. J. A. Anderson of Mount Wilson Observatory, to reach perhaps 30,000 or 40,000 degrees. It is by means of this method that Dr. Anderson and his colleagues have obtained much of the present-day information about the structure of atoms, but unfortunately these electric temperatures last for only a thousandth of a second or less, so that substances cannot be exposed to them for any length of time.





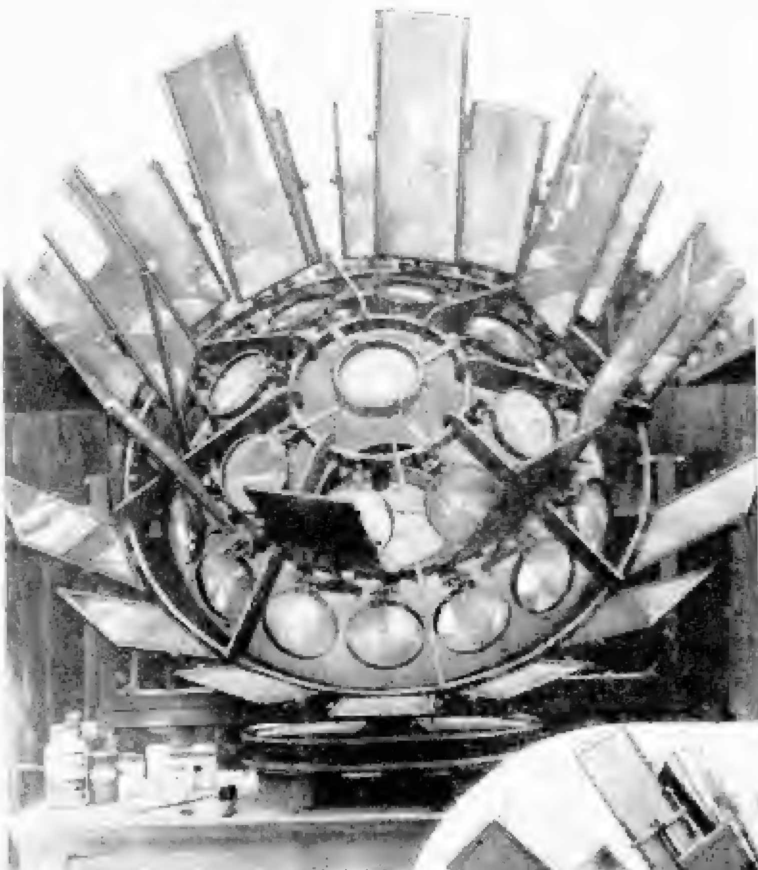
Left—Side view of one of the sun-power boilers, heated by sun's rays reflected by the parabolic mirrors, which is used to generate power for irrigation pumps in Egypt. The inclination of the mirrors is slowly altered through gearing so that at all times of the day they face the sun. Right—View of the engine shed, from the irrigation pump end.

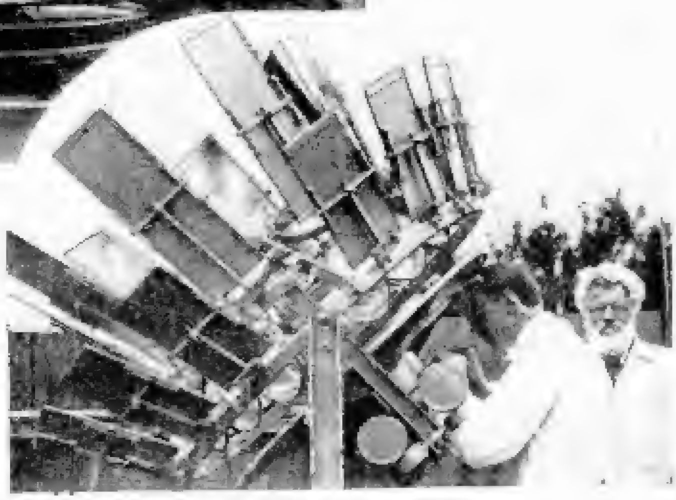
The surface of the sun, on the other hand, has an enormously greater temperature and maintains that temperature continually, thanks to vast amounts of radiant energy generated inside the sun which flow outward continually through its mass. The most recent measurement of the temperature of the sun's surface, communicated last winter to the American Astronomical Society by Miss Charlotte E. Moore, also of Mount Wilson Observatory, places this temperature at 9,869 degrees Centigrade, equivalent to nearly 18,000 degrees Fahrenheit. This is somewhat greater than the usual estimates, but is probably correct. In any event, the surface of the sun unquestionably is far hotter than anything which scientists can duplicate on earth. Things happen to atoms of matter in the sun which do not happen on earth. That is why physicists would like so much to get earthly furnaces approaching the same temperature.

One of the commonest elements, carbon, has never been fused in terrestrial laboratories. A little carbon is vaporized in electric arcs, but droplets of liquid carbon have never been examined because they cannot be produced. No one knows what they would resemble. Perhaps the liquid would be dull and black like solid carbon, or like the graphite of lead pencils. Perhaps, on the other hand, it would be as brilliant and scintillant as a diamond. It is not impossible that *liquid* carbon, could it be produced, might cool into actual diamonds instead of into black carbon grains.

No scientist is much interested in making artificial diamonds to be worn as jewelry, but that is by no means the most important use for these gems. Diamond is the hardest substance known. It has remarkable mechanical, optical and atomic properties. Were it possible to cast fused diamond in laboratories into shapes of scientific or practical utility, enormous advances might be possible in the study of crystals, the handling of the harder metals, and in many other directions. Probably the making of fused carbon, whether or not this becomes fused diamond, will require great pressures as well as great heat. Present resources of earthly laboratories can provide the pressures, but they cannot provide the heat.

One difficulty which prevents the attainment of very great temperatures in ordinary furnaces is that the heat usually is supplied from the outside of the pot or crucible containing the substance that one wants to melt. No known material that might be used for crucibles could resist the enormous heat necessary to fuse carbon. The crucible would melt before the carbon did. A part of this difficulty can be avoided by using the (*Continued on page* 335)





The above machine, invented by Marcel Moreau, Jr., of San Francisco, catches the rays of the sun, deflects them to a focus by lenses, and creates a heat at that point sufficient to melt refractory substances. Right—The inventor and his father.

VOL. I, No 2

BROADCAST WRNY STATION

25 CENTS

TELEVISION

EX... ENTER PUBLIS... NG COMPANY, ...

Sanabria-Hayes Televisor

THIS LATEST TELEVISION TRANSMITTER AND RECEIVER WAS RECENTLY DEMONSTRATED AT THE SECOND ANNUAL RADIO TRADE SHOW IN CHICAGO

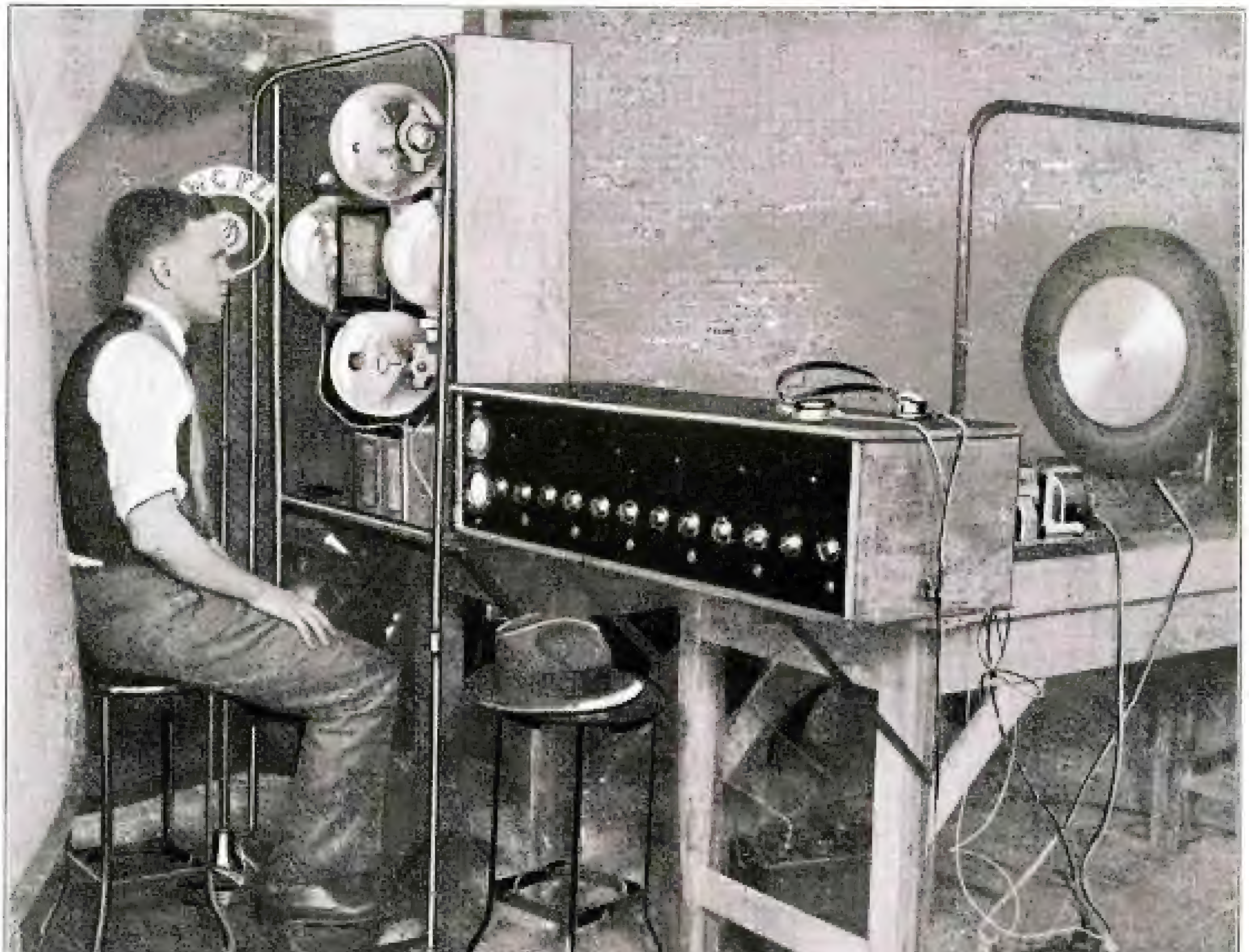
THE photograph herewith shows one of the newest television transmitters and receivers which was successfully demonstrated at the recent Radio Trade Show in Chicago. The managing editor of *Radio News Magazine* saw the apparatus in operation and stated that the reproduced image was very clear and brilliant. In general, this newest television system designed and built by two Chicago engineers, Mr. M. L. Hayes and U. A. Sanabria, is based on the Ives system demonstrated about a year ago by the Bell Telephone Laboratories in New York City. Those interested in the details of this television system will do well to read the description of the Bell Telephone Laboratory televisor described in Vol. I, No. 1, of *Television*.

Looking at the photograph we see that an intense beam of light from an arc or incandescent lamp passes from right to left, through a whirling perforated disc, the successive beams of light falling on the subject's face. As the reflected light beams fall on one of the four huge photoelectric cells, observed in the cabinet directly in front of the subject, minute photoelectric currents are produced by the cell or cells affected by the reflected light beam at any particular instant. These weak currents from the photoelectric cells are then highly amplified by the vacuum tube amplifier shown in the center of the picture. Eight stages of resistance coupled (thoroughly shielded) amplification are available in the amplifier, and jacks are provided so that any number of stages may be used as occasion requires.

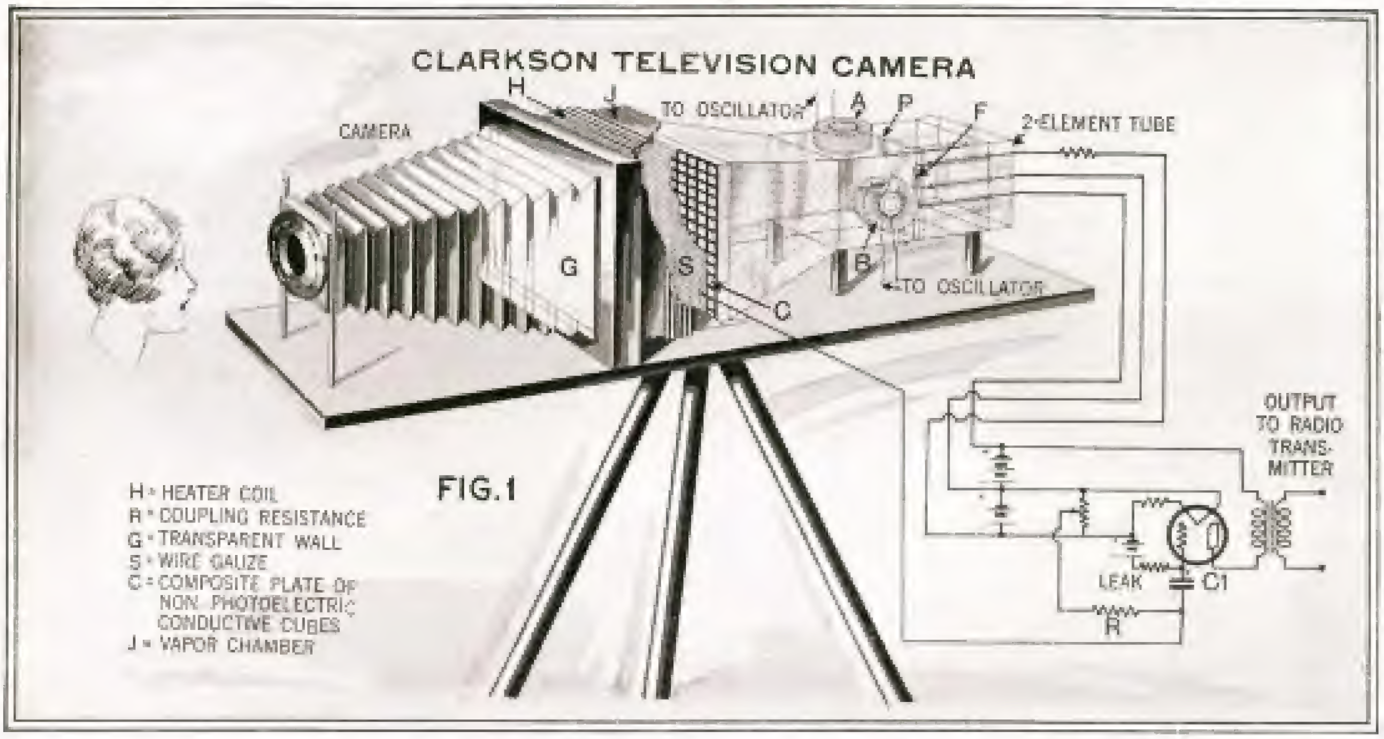
When the amplified photoelectric cell currents emerge from the last stage of the amplifier, which should preferably be a power stage, this current is connected to a neon tube, which is placed behind a second revolving perforated disc. This receiving disc is rotated at exactly the same speed as the transmitting disc by a synchronous motor. The reproduced image is observed by looking through a diaphragm in front of the whirling perforated disc at the spot where the neon tube light is situated. As the constantly changing picture image currents arrive at the neon tube, the latter instantly regulates the amount of light given off in simultaneous fashion. The transmitting and receiving disc each have a similar spiral of holes on them so that when a disc makes one revolution, the spiral of perforations has succeeded in completely scanning the image to be transmitted.

One of the newer developments of these enterprising inventors takes the form of specially perforated discs, each disc containing three spirals of holes. In this fashion each disc scans the picture three times in one revolution and the scanning is not in the usual sequence one, two, three, four, etc., but one, four, seven—for example. The second spiral of holes scans paths two, five, eight, etc., the third spiral three, six, nine, etc. It is claimed that much better definition and detail are obtained in this way.

The large photoelectric cells here shown were constructed at the University of Illinois by a research scientist and their performance is similar to that of the large Ives cells used in the Bell Telephone Laboratory demonstrations last summer. Television amplifiers require the use of resistance coupling to avoid distortion and the cutting off of certain frequencies, which would happen if ordinary transformer coupled amplifiers were used.



The photograph above shows the newest television transmitter recently demonstrated from broadcast station WCFL Chicago. The apparatus was designed and constructed by two Chicago engineers, M. L. Hayes and U. A. Sanabria. The system is similar to the Bell Telephone Laboratory arrangement and large photoelectric cells are used. These cells will be observed in the cabinet directly in front of the subject who is here shown being televised. The amplifier cabinet is shown in the foreground on the table, together with a power amplifier just behind it. The amplifier is shielded electrically and mechanically.



What the television "camera" of the future may look like. P and F are plate and filament, respectively, of the electron-projecting tube. A and B are the coils whose magnetic fields influence the electrons which stream through the opening in P.

electrons shoots from the cathode to the plate a stream of them passes at high speed through the tubular opening, creating a narrow beam which impinges on the back of the composite plate C. This beam is really a flexible, weightless conductor, *an electric current without a wire*. It has around it a magnetic field, like any other conductor, and any magnetic field of the coil A will attract or repel the field of the electron beam, thus moving the beam itself.

The Pencil of Electrons

If we put an alternating current in coil A the weightless beam will move back and forth vertically in unison with the coil frequency, as it has no inertia. This coil frequency is, say, only 5 cycles per second. Then the beam will go back and forth across plate C five times a second or, in other words, will cross plate C ten times per second.

In the same way, and at the same time, coil B is moving the beam horizontally, say, 1,000 times a second, or across the plate C up and down 2,000 times in each second.

The distance moved horizontally or vertically depends only on the *strength* of the coil field, which may be changed by moving the coils towards or away from the tube, or by changing the current in the coils.

Now, with arrangements of the frequency stated, the beam will go up 100 times and down 100 times for each trip across plate C. If the distance across the plate is 8 inches, the beam will, in effect, draw 25 vertical lines on plate C for each inch of width. If the conductive portions are properly divided and positioned, the beam will hit each one of them once in this journey across the plate.

The Circuit

Suppose the beam strikes a conductive portion of the plate C which happens to be strongly illuminated by the rays of light falling through the screen S upon the other side of C. Then some of the electrons will travel along the ionized path of the light ray in the vapor, from that conductive section of C to the screen S; and a current will flow around through the resistor R and back to the cathode F along the filament wires, the beam itself and the conductive path in the plate completing the circuit. The screen S may have a positive potential bias to aid this action.

The current which flows around this path is determined by the conductivity of the vapor path along the light ray between plate C and screen S at each conductive point. This, in turn, will depend on the intensity of the light ray at that point. Thus, as the electron beam sweeps over or "scans" plate C, there is created a varying current through resistor R depending on the intensity of the image at different points. This variation in current will cause a varying potential across resistance R and this is the potential applied to grid and filament of the amplifying tube. The condenser C1 permits the grid circuit of the tube to be adjusted to its best operating point. The output of the tube may be amplified and used to modulate a carrier wave. (See Fig. 1a for details of the circuit.)

The Projector

Then, at the receiver, the amplifier output goes into the projector tube (See Fig. 2) which operates like any radio vacuum tube. The grid G is heavily biased negatively. Thus no electrons escape through the tubular opening in the plate P. When the varying signal impulses come through, however, this bias is counteracted and through the tubular opening passes an electron beam varying in intensity with the received signal.

Here again we have two coils at right angles, having the same frequencies as the coils of the camera tube and in phase with those frequencies. When the camera beam is at the top, the electron beam of the projector is at the top. When one is at the left, the other is at the left also. The relative position of the end of the projecting beam on the phosphorescent viewing screen of the projector is the same as that of the camera beam on the plate C in Fig. 1.

This viewing screen is phosphorescent and is swept or "scanned," just as plate C is scanned. When the electron beam strikes this phosphorescent screen, it "luminesces" or lights up at that point and the path of the beam on the screen becomes visible; the light and shade from instant to instant depending on the intensity of the beam. This instantaneous intensity is proportional to the received signal and, therefore, proportional to the intensity of the light and shade of the image points on plate C of the camera. Thus an image is projected, point by point and line by line, on the phosphorescent screen in the projector.

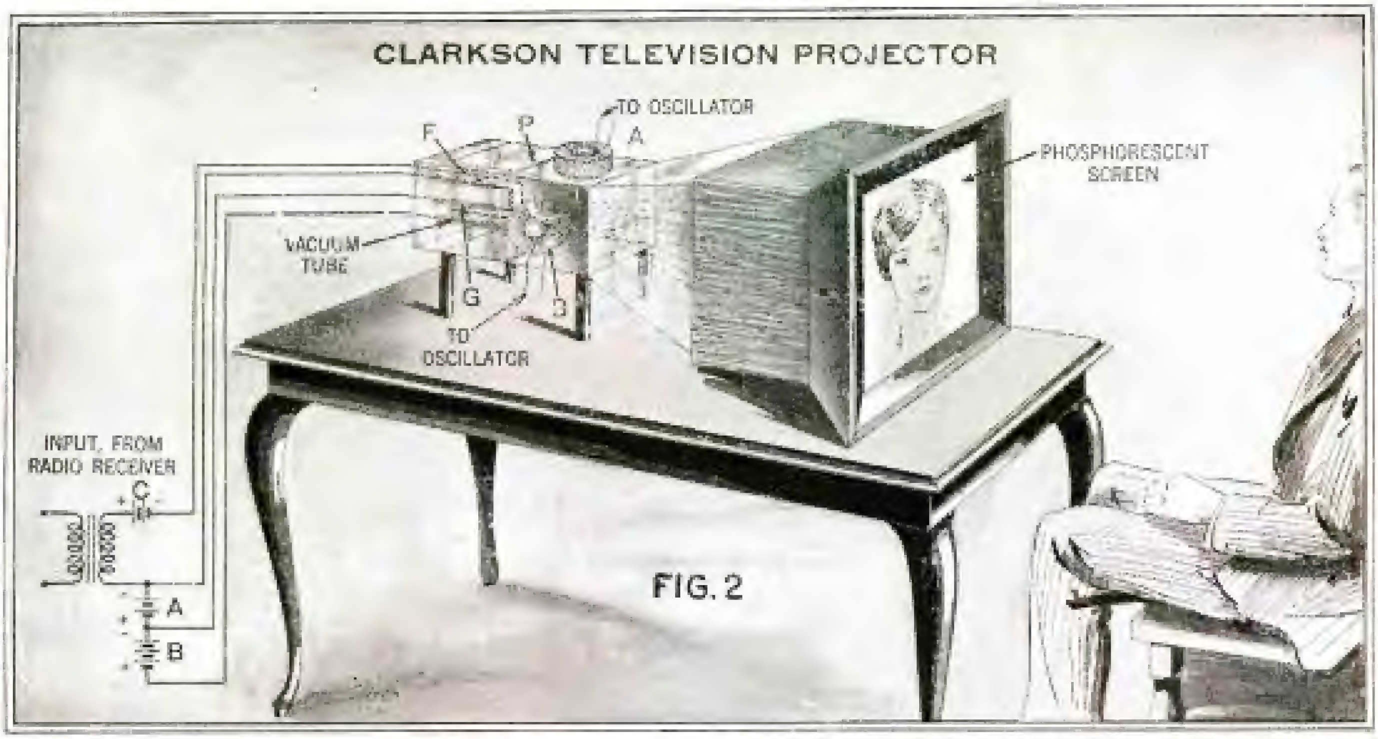
This image is readily visible in the partial darkness caused by the hood over the screen and may be larger or smaller than the original image; one way of changing the size being to move the phosphorescent screen in or out. The image may be applied to a film running through the vacuum tube by means well known in the oscillographic art; or it may be projected by prisms from the luminescent screen upon the wall of the room.

Speed of the Electrons

The electron beams may be moved at any speed and have been known to record a frequency as high as 220,000,000 cycles per second. Thus any speed of transmission is possible. Any sluggishness in the passage of the current through the vapor will have no effect on the image; as it will be uniform sluggishness all over the plate C. In fact, selenium may be used for the conductive portions of plate C (though not when potassium vapor is used) and thus an added variation in the current impulses produced by the effect of light and shade on plate C, will be obtained.

There are many incidental advantages in the apparatus which has been described but, in one particular, it gives rise to hopes that have never been dreamed of before; and that is, of a reproduction comparable to a "half-tone." In no other method is this even conceivable; for the reason that, while graduations of light and shade may be obtained, all of the dots reproduced are of the same size and shape. With the projector shown in this article, the reproducing beam varies in intensity, in number of electrons, *and thus in size*, under proper conditions. Intense beams will cause large dots and less intense beams small dots, and thus a graduation of the pictures may be expected.

It is the feeling of the editors that this idea of using a stream of electrons will one day be perfected by some genius. It is not the most perfect nor the most desirable method which involves the use of motors and revolving perforated discs. In the first place the picture is not perfect and the apparatus is limited to the transmission and reception of small images.



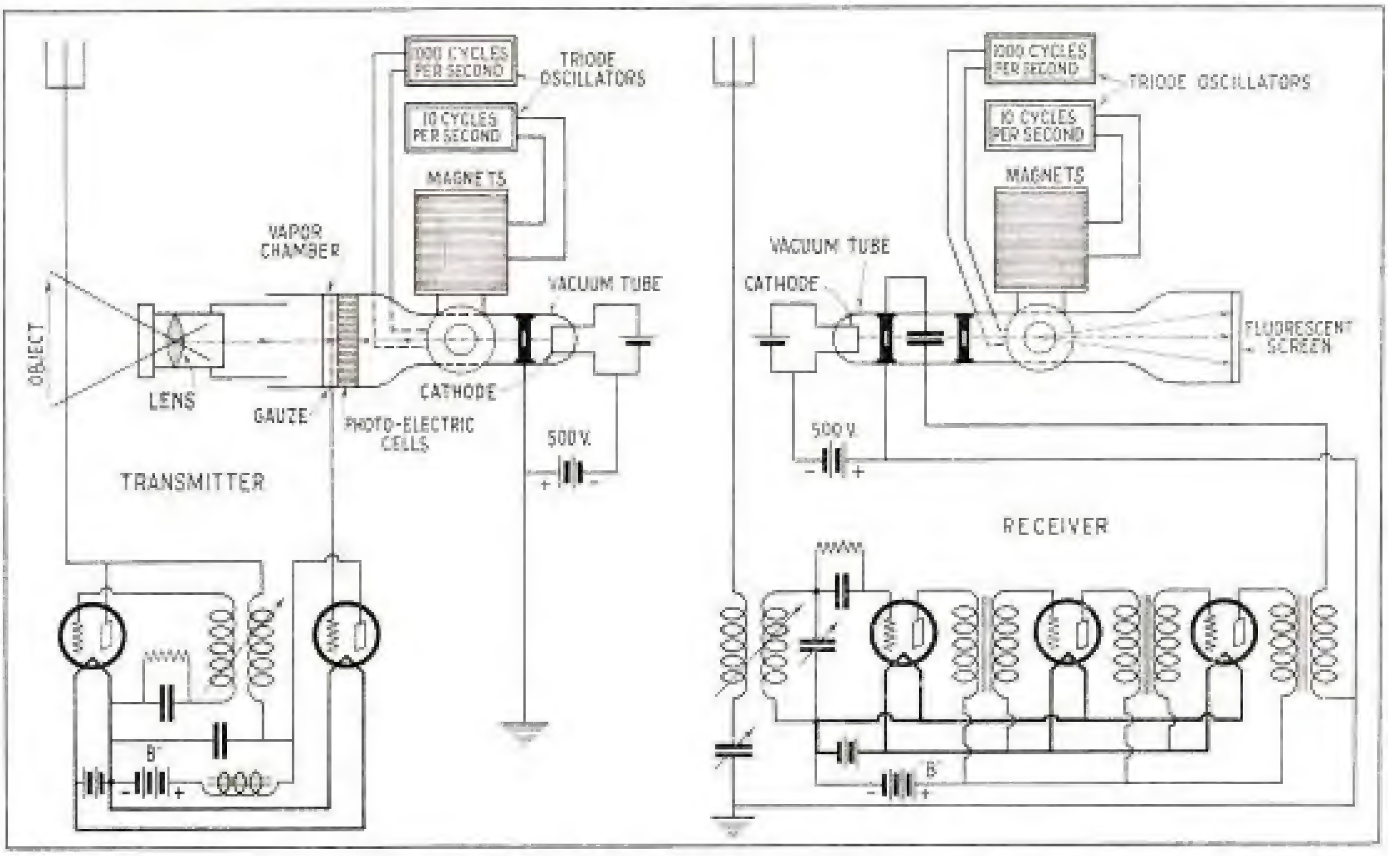
The receiving televisor, similar in construction to the transmitter, makes use of an identical two-element electron-projecting tube. The image will appear on a phosphorescent screen. There are no moving parts at either end, except the electrons. The idea seems very promising indeed.

Campbell Swinton Television System

THE diagram shows my apparatus, both for transmitting and for receiving, as figured in my paper of 1924, but modified as employing triode thermionic oscillators instead of rotating dynamo machines.

At both ends the two cathode-ray beams impinge on screens, which they are caused by the deflecting systems to sweep over rhythmically and in complete synchronization in parallel lines backwards and forwards from end to end.

The Photo-electric Screen. In the transmitter the screen is composed of a very large number of minute photo-electric cells which are each activated, more or less, by the amount of illumination each receives from the image thrown upon the whole screen by the lens. The end of the transmitting cathode beam explores each of these cells in turn, and as to whether it finds it illuminated and thus activated or not, an electric impulse of varying intensity, proportional to the amount of local illumination, is transmitted to the neighboring gauze grid.



Details of Campbell Swinton television scheme using cathode rays to scan image at sender and receiver.

TELEVISION News

HUGO GERNSBACK Editor

FEATURES:

- AN EXPERIMENTAL CATHODE RAY SCANNER
- COLOR TELEVISION
- NEW TYPES OF PHOTO-ELECTRIC CELLS
- HOW TO BUILD A SCANNING UNIT
- MAKING AND TESTING NIPKOW DISCS
- THE NEW JENKINS TELEVISION STATION
- IMPROVED SYNCHRONIZING METHODS

August

50¢

TELEVISION
Here and There

Fannie Hurst Sees Hubby Via Television

Fannie Hurst, well-known and celebrated woman novelist, is seen in the television booth in the A. T. & T. Co. building, New York City, getting what she confessed to be "the greatest thrill of an eventful life." She talked with her husband and saw him laugh, smile, and move his lips, although he was located at the Bell Laboratories, five miles away. Hubby was having the same thrilling experience at his end of the circuit. In each case the party at the receiving end appeared as if they were only nine feet away.

Television Enters the Movies

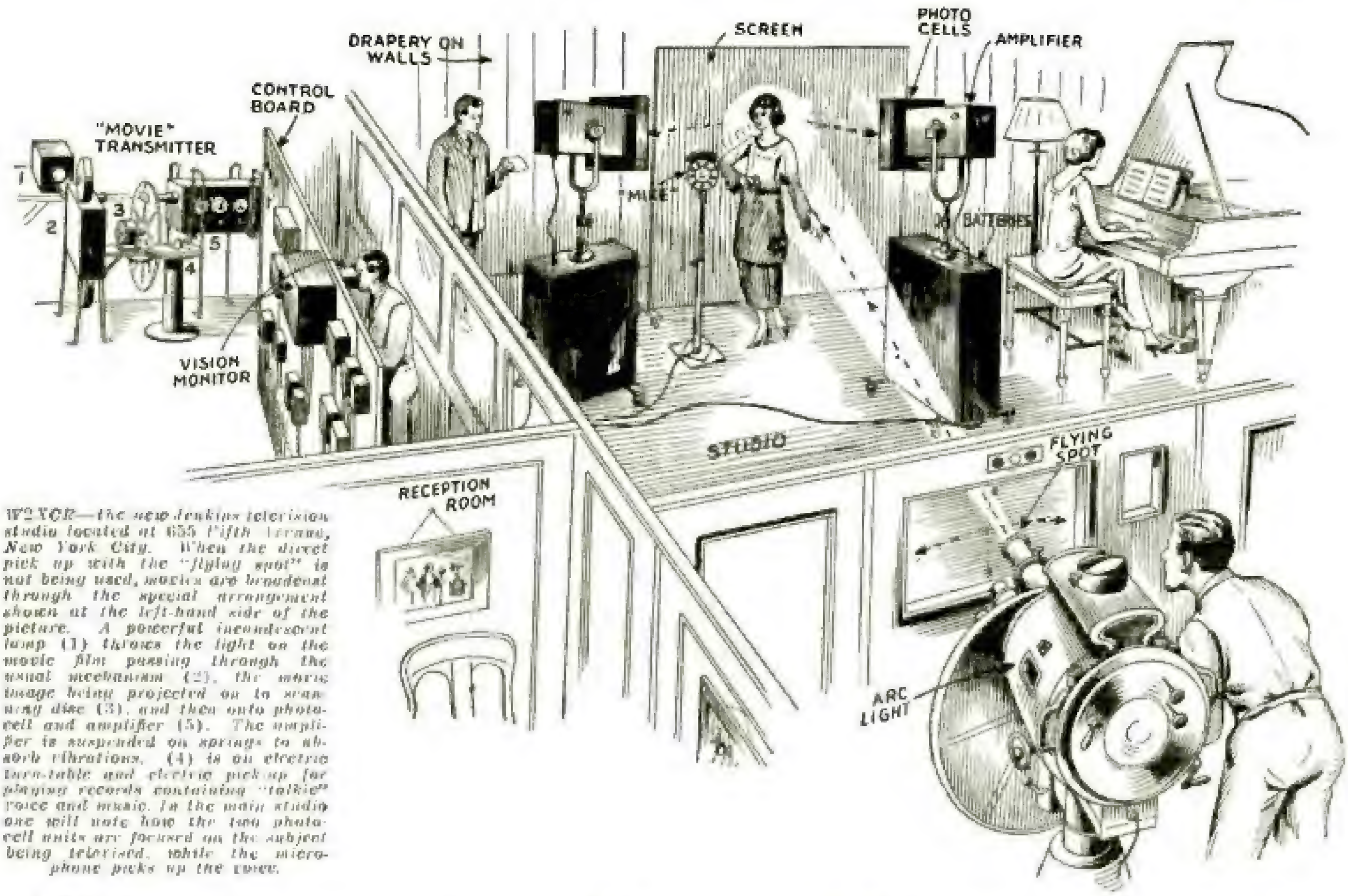
One of the most interesting photoplays of the present season is "Just Imagine", featuring the famous comedian, El Brendel. Television is featured among many other scientific devices in "Just Imagine" and one of the television screens is shown on the wall toward the left of the picture with an image on it. Note the "artificial sunlight" window and the flash of light in front of the actor, which announces that someone is at the door. A fearful and wonderful "rocket plane" is also a feature of the photoplay.

"Electric Eye" Gets Oculist's Test

What is believed to be the first test of the "sight" of an electric eye is being made at the Westinghouse Research Laboratories at East Pittsburgh, Pa. The electric eye—which sees many different objects—is put in a queer reflecting egg-shaped box. A special electric light bulb is placed alongside. As day after day passes, various degrees of "fatigue" are recorded on a chart which resembles somewhat a patient's fever chart at a hospital. By means of this new instrument, invented by C. C. Hein, Jr., of the Westinghouse Laboratories, it is hoped to find out exactly how much more reliable the electric eye is than the human eye.

Look Out Crooks! Televisor 'll Get You!

Some time ago in Chicago, Police Commissioner John A. Alcock, tried out Television, in order to ascertain its merits toward broadening the activities and usefulness of the Police Department. Our grandchildren will probably see the "cop on the corner" observing the face of a wanted criminal as reproduced on the dial of his pocket televisor. With the aid of television, the list of automobile thieves will be greatly reduced.



W2XCR—the new Jenkins television studio located at 655 Fifth Avenue, New York City. When the direct pick up with the "flying spot" is not being used, movies are broadcast through the special arrangement shown at the left-hand side of the picture. A powerful incandescent lamp (1) throws the light on the movie film passing through the usual mechanism (2), the movie image being projected on to scanning disc (3), and then onto photo-cell and amplifier (5). The amplifier is suspended on springs to absorb vibrations. (4) is an electric turn-table and electric pick-up for playing records containing "talkie" voice and music. In the main studio one will note how the two photo-cell units are focused on the subject being televised, while the microphone picks up the voice.

The Jenkins New York Studio

Excellent reception has been reported by hundreds of "lookers-in" from the new Jenkins transmitting station, W2XCR. Accompanying voice and music are simultaneously transmitted over the broadcast station WGBS.

By D. E. REPLOGLE
Vice-President of Jenkins Television Corp.

Specially prepared for TELEVISION NEWS

SHOWMANSHIP — the magic wand that converted the radiotelephone experiment into the mighty broadcasting institution of today—is being applied to the television situation. However, instead of being merely waved, it is actually being prodded into the television art; thereby causing the latter to break into a brisk trot towards the early realization of a real television industry.

The latest, and no doubt the most ambitious, introduction of showmanship into the television situation takes the form of complete sight and sound studios at 655 Fifth Avenue, New York City, with television and sound broadcasters joining hands in providing the necessary outlets. Located in the very heart of a great cultural center, the new television studios are assured of endless talent of all kinds, in addition to the handy film pick-ups that serve to plug the holes in the television program.

Miss Dorothy Altman, pianist and singer, in the Jenkins television studio W2XCR, in New York City.

How the Subject Is Scanned

The new studios of the Jenkins Television Corporation contain complete equipment for sight and sound broadcast pickups. The *direct pick-up* studio has the general atmosphere of the usual sound broadcasting studio, with the noticeable draperies for acoustic treatment, and with the necessary microphones. In addition, however, there is the flying-spot scanning system, comprising the beam projector and the photo-electric cell banks. The former is a powerful arc lamp in a large housing, provided with an enclosed scanning disc and with three lenses of different focal lengths; the assembly being mounted on a swivel pedestal resembling the usual barber's chair base. The operator can readily aim the flying-spot beam at the subject and, by using the proper lens, cover the desired area for a close-up, half length or long shot, without changing the relative positions of either subject or scanner. The scanner operates on the standard system of 60 lines, 20 pictures per second.

Frank Du Vall and Grace Jones being made man and wife by Dr. A. Edwin Keigwin (center), at station W2XCR-WGBS in the first television ceremony. The television "eye" broadcast the sight of the bride and groom while the radio voice channel broadcast the synchronized "I do's" to thousands of visualists who were thrilled by this marvel of modern science.

Photo at left shows Mortimer Stewart, television program director of W2XCR-WGBS and Miss Patricia Bowman, première ballerina of the Roxy ensemble, as she appeared before the "television eye" of station W2XCR.

Light Reflected Onto Photo Cells

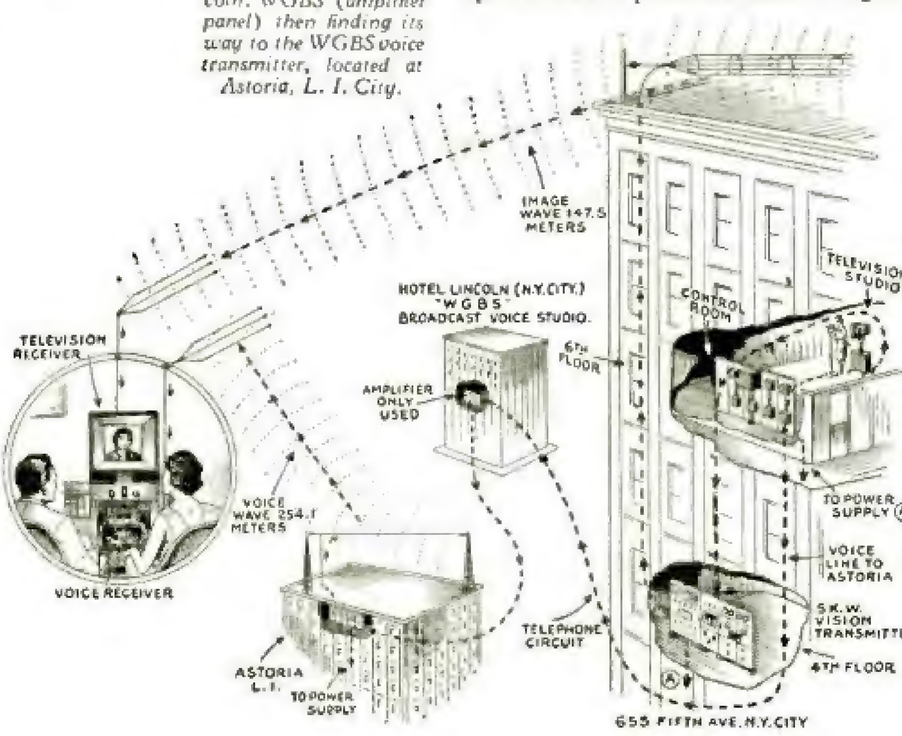
The beam of light that sweeps the subject is reflected in greater or less degree by the subject. The reflected light actuates the banks of photoelectric cells, which translate the varying light values into corresponding electrical terms. Amplified millions of times, these latent pictorial values are sent by wire to the 5,000-watt transmitter, located in the same building, for broadcasting.

Meanwhile, the microphone placed close to the subject serves to pick up the sound accompaniment, which may be voice or music. Properly amplified, the sound accompaniment is sent over a direct wire to the transmitter of Station WGBS at Astoria, Long Island, across the East River.

How Movies Are Televised

The *film pickup* studio contains equipment not unlike the conventional film projector. As a reel of film passes through the machine, it is scanned line by line with a powerful beam of light.

Below we have diagramatic view showing how the image and voice are transmitted from W2XCR, the voice circuit passing through the Hotel Lincoln, WGBS (amplifier panel) then finding its way to the WGBS voice transmitter, located at Astoria, L. I. City.



Mr. Sanabria, the youthful television inventor, is here seen holding the new Taylor neon arc tube.

SANABRIA Produces

By H. WINFIELD SECOR

Giant television image is made possible, thanks to a new neon arc tube perfected by Dr. W. G. Taylor. The neon arc tube excited by a 250 watt amplifier output tube, yielded an image of surprising brilliancy.

THE biggest television pictures ever to be reproduced flashes across a ten-foot screen in the laboratory of Ulysses A. Sanabria, 24-year-old engineer. The radio pictures, beautifully clear, perfectly defined and possessing the illusion of depth, danced across the big screen like super-movies, while young Sanabria described modestly the achievements which have made him one of the world's most important contributors to television.

"I couldn't get a light bright enough," Sanabria said. "And then my friend, W. G. Taylor, invented a revolutionary new lamp, utilizing a neon arc, which makes these brilliant, large-size pictures possible."

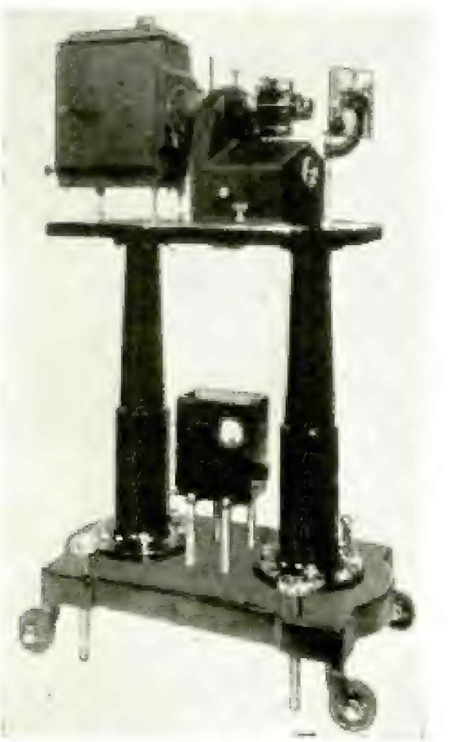
Taylor, himself barely 30, also was present at the demonstration in Sanabria's tool-littered laboratory in an obscure west side Chicago machine shop. "The pictures have a slightly pinkish tinge," he said. "That's the fault of the lamp. I think I can build another which will project pictures of pure black and white."

Largest Lens Disc Ever Built

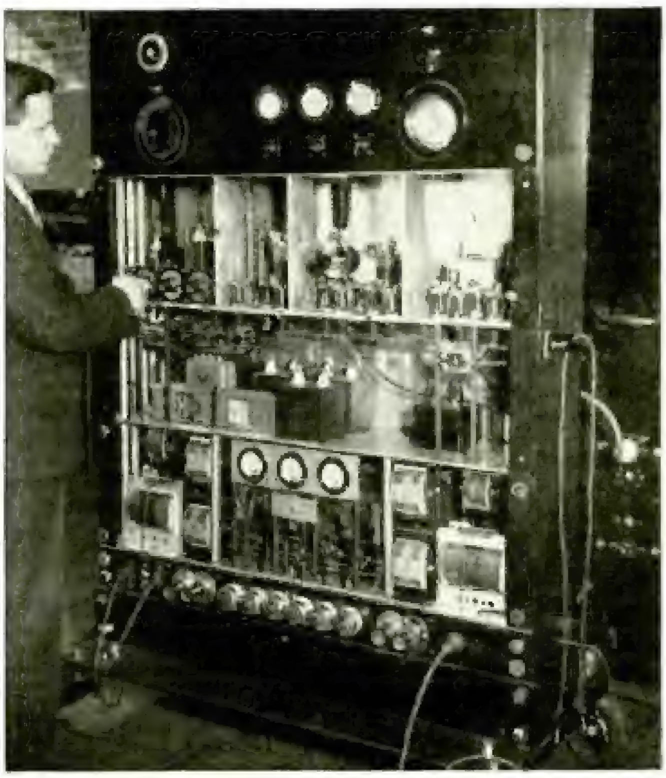
The lamp glows in a brass tube behind the largest *lens disc* in the world, perfected by Sanabria. The disc is a solid aluminum wheel with forty-five lenses sunk in it. An electric motor drives the disc at a speed of 120 miles per hour on its outer edge, so that the whirling lenses distribute the light over the ten-foot square screen in front of the device. The light races so rapidly over the screen and its intensity varies so accurately that the human eye sees actual motion pictures, instead of a zipping daub of light. The apparatus is much too ponderous and expensive for home use, but Mr. Sanabria is now manufacturing similar equipment for an advertising concern which intends to use the giant television pictures to draw crowds to display rooms in most of the big cities.

Neon Arc Similar to Crater Tube

The new neon arc tube used by Mr. Sanabria and which was developed by Dr. W. G. Taylor, is somewhat similar in principle to the neon crater tube, the development of which has been eagerly watched by television fans everywhere, for the very good reason



Left: Sanabria projection lamp and scanner used at transmitter.



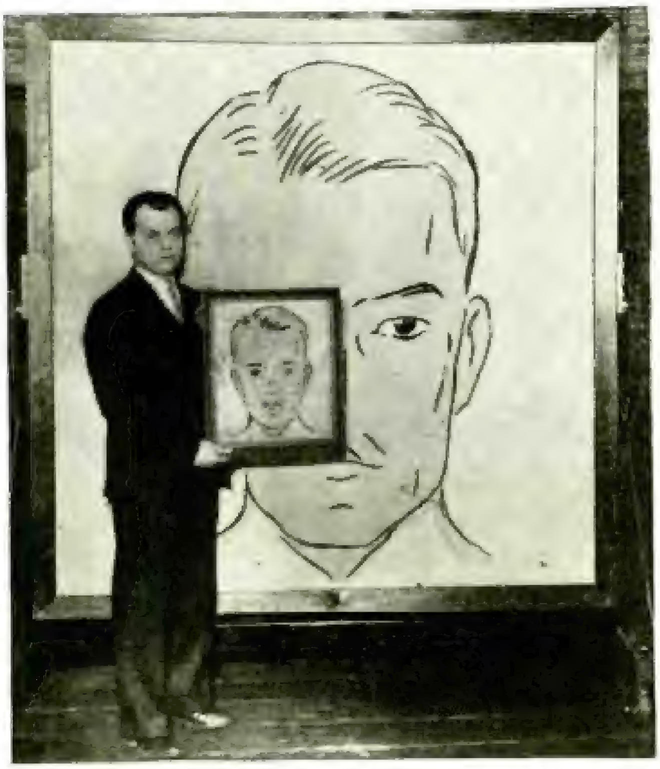
Right: The elaborate television control switchboard used in operating the new Sanabria transmitter. The amplifier stages, amplify the minute photo cell currents over 2,000,000 times.

10 by 10 Ft. Image

that a new and powerful illuminant for lighting the television screen has been sorely needed. The original neon crater tube excited by an amplifier tube no larger than a '50 and possibly having 800 volts on the plate, has produced a brilliant television image about two feet square.

The tremendous difference between this size and one 10 ft. x 10 ft. square is made readily apparent, by a study of one of the accompanying illustrations, which shows Mr. Sanabria holding a screen of the two foot size. The larger screen has twenty-five times the area in square feet, of that exposed to the eye by the smaller screen. Certainly we could not hope to brightly illuminate a screen 10 ft. x 10 ft. with the ordinary television means so far known, except perhaps with a powerful arc lamp and a Kerr cell, such as used by Alexanderson, in his 6 x 8 ft. screen demonstrations in a theatre about a year and a half ago. Therefore it was up to Dr. Taylor and his co-worker, Mr. Sanabria, to devise an efficient and quick-acting or easily modulated source of illumination for the television reproducer; this has been evolved in the form of a neon arc.

Mr. Sanabria is here seen standing in front of his television transmitter — note the bank of photo-electric cells which pick up reflected light rays falling on his face when being scanned.



This picture shows the relative size of the former largest television screen used in connection with a neon glow tube as compared with the latest screen recently illuminated in a demonstration at Chicago by Messrs. Sanabria and Taylor, utilizing Mr. Taylor's neon arc tube.

How Neon Arc Tube Is Used

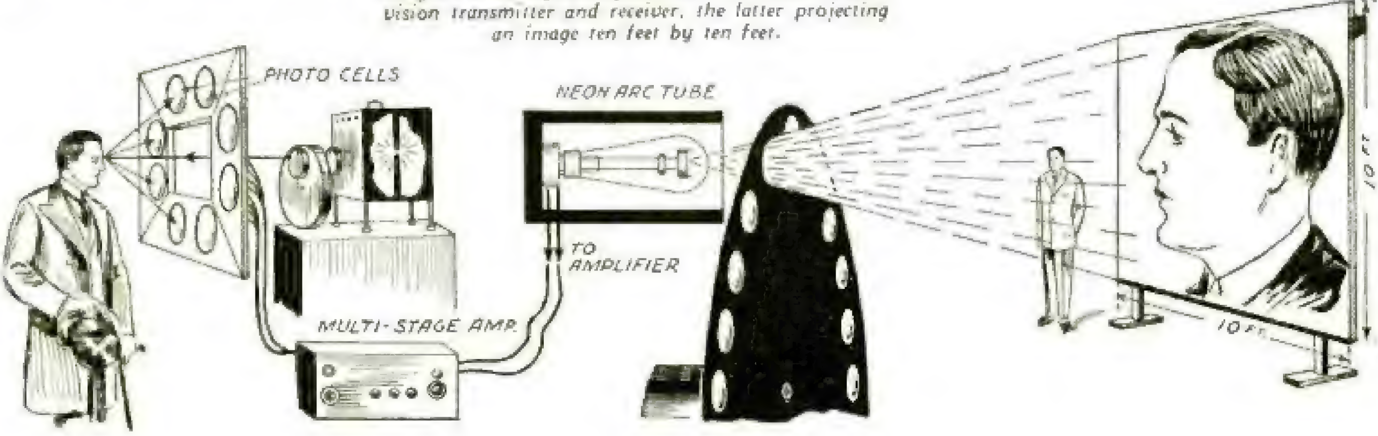
The brilliant and highly concentrated spot of light in the neon arc tube is created partly in virtue of the utilization of a heated cathode, so one report states. The same source of information discloses the fact that a power tube as large as one-quarter kilowatt, was employed to excite the neon arc tube.

The new neon arc tube is placed behind a large scanning disc fitted with a series of lenses arranged in a spiral, in a similar manner to those used in the Jenkins 2 ft. x 2 ft. image projector, which utilizes a neon crater tube. (*This is described elsewhere in this issue and is also shown on the front cover.*)

One of the accompanying photographs shows the elaborate amplifying

(*Continued on page* 231)

Diagram showing arrangement of the Sanabria television transmitter and receiver, the latter projecting an image ten feet by ten feet.



Mar.—Apr.

TELEVISION News

Hugo Gernsback Editor

ARTICLES BY

Dr. E. F. W. Alexanderson

Dr. Herbert E. Ives

Laurence M. Cockaday

C. Francis Jenkins

D. E. Replogle

Philo T. Farnsworth

Dr. Fritz Noack

Clyde Fitch

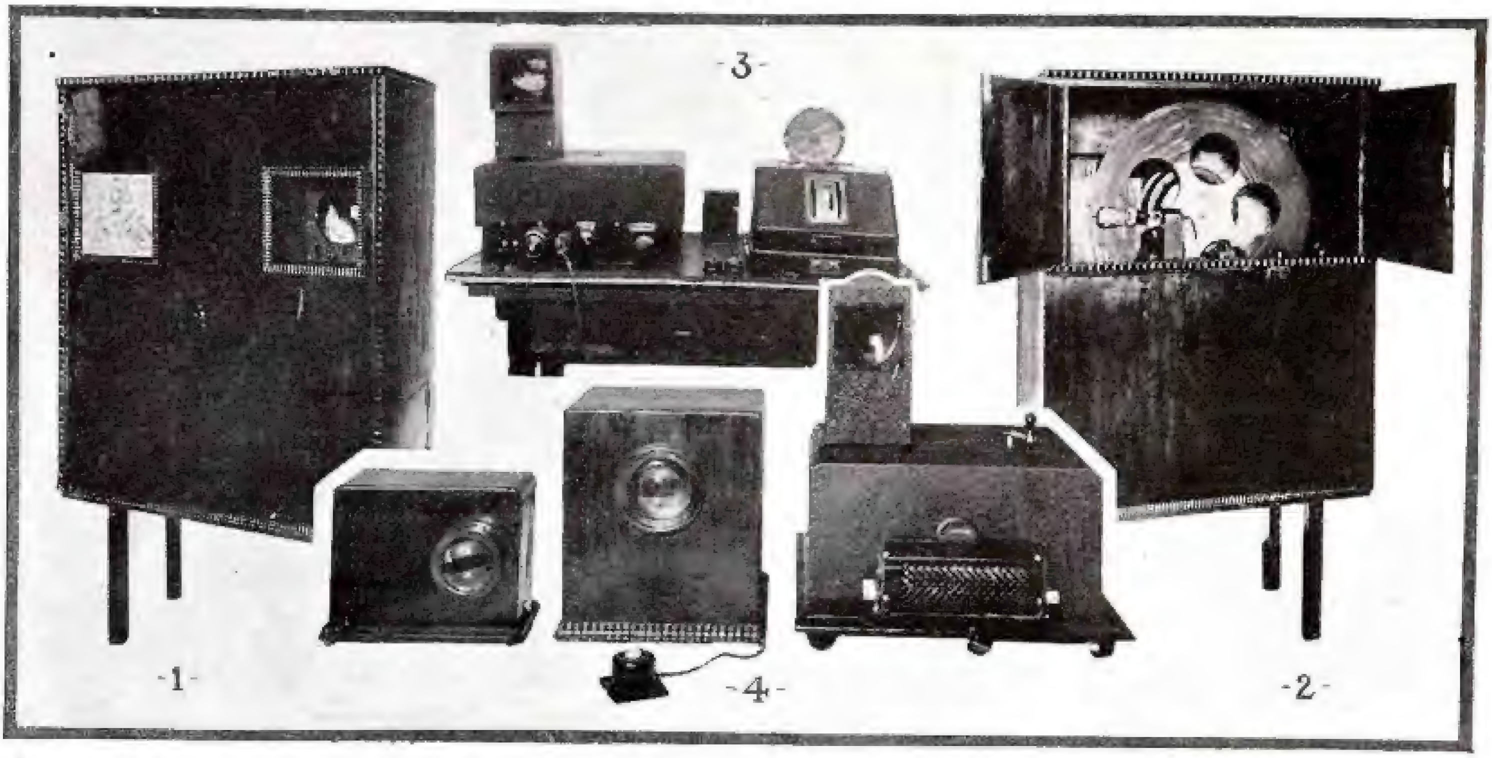
H. W. Secor

50¢

The MIHALY TELEVISION *SYSTEM*

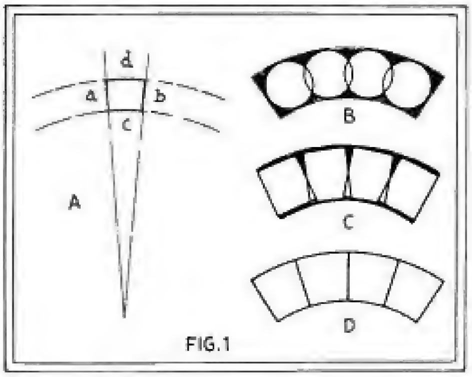
The latest Mihaly television apparatus is claimed to produce exceptionally clear images at the receiver, free from the shifting dark lines caused by scanning disc holes and so characteristic of the usual television image.

By Dr. Albert Neuburger
(Berlin)



A group of televisors produced by the Telehor Company, of Berlin, which is developing the inventions of D. von Mihaly. The large sight-and-sound receiver shown at 1 is viewed from the rear at 2; it has a large disc, reproducing the image at the side in the window. At 3, a layout including a modern German broadcast receiver, with a televisor at its left; here the image is reflected upward into a "window". In the foreground at 4 are small televisors, one in the center with a speed control.

THE difficulty of obtaining freedom from the flickering which is familiar to all who have seen television images, has been completely overcome by D. von Mihaly. In his latest apparatus, the images are perfectly motionless in the "window," and they do not show the customary shifting dark lines, which are due to the holes in the scanning disc. The image is evenly illuminated and clear.

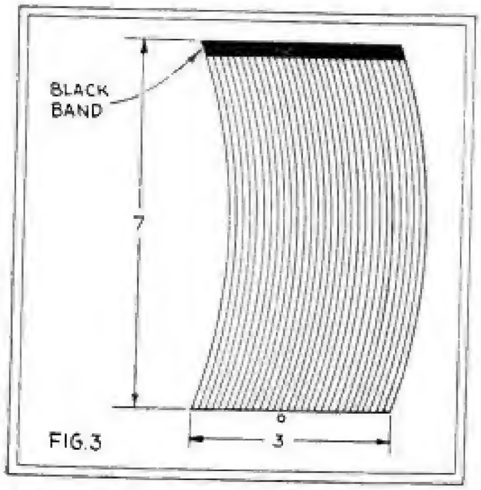


The Mihaly disc has holes (A) bounded by arcs and radii. This overcomes the unevenness of light received through circular (B) or square (C) holes; and gives perfect illumination, as at D.

Part of this is due to the increased speed of the scanning disc. This, which has thirty holes, revolves so fast that an area 12 x 16 inches is covered at the rate of 15,000 scanning points a second; and this figure may be increased to 18,000 points. (*The former corresponds to a speed of 750 revolutions per minute, and the latter to 900, which is standard with American 48-hole scanning. German television, however, is permitted the use of the broadcast band, and this limits the modulating frequency.*)

Furthermore, the holes in the scanning disc have been given the special shape shown in Fig. 1A. The sides of the hole slant toward each other at a very acute angle; while the top and bottom are concentric arcs.

From Fig. 1B, it will be seen that equality of illumination cannot be obtained with circular holes; in 1C, it will be seen that square holes, while an improvement, still cause lines; but the shape of opening just described, with its slanting sides, gives exactly even illumination and freedom from lines, as illustrated at 1D.



In the Baird system, which scans the image vertically, a part of the line is cut off at the upper end; this serves to create a synchronizing signal.

The Radio-Controlled TELEVISION PLANE

Tomorrow we shall find a new order of things if a war should occur. Pilot-less Radio-controlled planes fitted with "Television" eyes will flash back what they see to headquarters.

By HUGO GERNSBACK
Member of American Physical Society

ON a recent trip to Washington the writer visited the laboratories of C. Francis Jenkins, the well-known experimenter of international reputation. It was Mr. Jenkins who perfected the shutter that made our present-day motion pictures possible. He was paid over $1,000,000 for this invention.

Of late he has been experimenting with television and has already obtained astonishing results. At the time of the writer's visit Mr. Jenkins demonstrated his television machine before a number of Government representatives, including the Chief of the Signal Corps. At that time the writer actually saw his own waving hand, projected by radio over a distance of some thirty feet, the shadow of the waving hand being transmitted to a screen at that distance. Every motion made by the writer's hand was faithfully reproduced on the distant screen. Opaque substances, such as a cross, knife, pencil, etc., were also successfully transmitted and projected by the Jenkins Television machine.

It is the writer's opinion that, within two or three years, it will be possible for a man in New York to listen over his radio to a ball game 500 miles away and see the players on a screen before him at the same time. Whether it will be the Jenkins machine or some other machine that will achieve this result is of little consequence. The main thing is that experimenters all over the world are working frantically on television and sooner or later the problem will be solved.

An entirely new age will then be opened up and it is not necessary for the writer to expatiate at length on this phase; as it has been exploited by him in his past writings and by others for some time.

In this article, we shall concern ourselves with the radio-controlled television plane, which will come into being immediately the minute the television problem is put on a practical basis. It should not be construed that the radio television plane is merely a monstrous war machine, but it also has its uses during peace time, as will be explained. At the present time it costs great effort, time and aviators' lives in order to train our perfect flyers.

A radio-controlled airplane has already been demonstrated by the French and American Governments, and it flew for a lengthy period without anyone on board. The entire control was from the ground while the machine was aloft. The plane arose, cut figure eights, volplaned, ascended, descended and went through all the ordinary evolutions; the control being effected entirely and solely by radio. The same kind of a machine is also being experimented with successfully by our own and several other Governments, and it may be said therefore that the radio-controlled airplane has passed the experimental stages and has become practical and feasible for military use.

THE accompanying article appeared in the November, 1924, issue of THE EXPERIMENTER.

While at that time the ideas set forth therein might have appeared more or less fantastic, they are no longer considered so today. As a matter of fact, the radio-controlled airplane is with us today. Several of the leading governments have already in their possession airplanes that can now fly and stay aloft for any length of time, within reason, without a pilot or any human being on board.

The television adjunct will follow as a matter of course.

Most of those who read this article will live to see a television-controlled airplane a reality during the coming years.

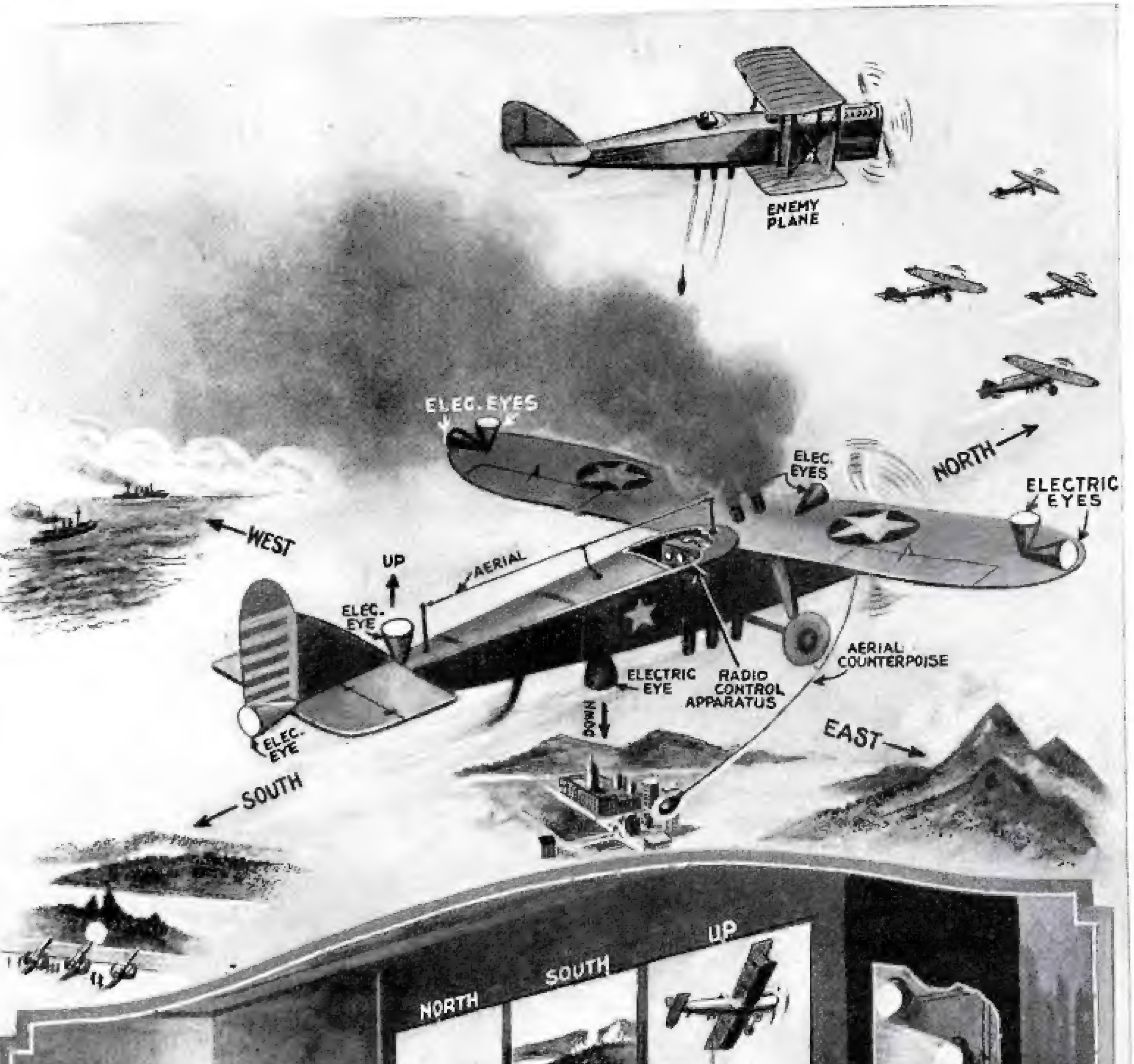
But the great trouble with radio-controlled airplanes is that the operator must see the plane. If his machine were to make a landing at a great distance he might land the airplane on top of a building or in a river, or it might collide with a mountain.

A Pilot-less Plane Which "Sees"

Imagine now a radio-controlled pilot-less airplane which is also equipped with electrical eyes, which eyes transmit the impulses—or rather what these eyes "see," by radio—to the distant-control operator on the ground. Our illustration on the opposite page, which shows a war machine, depicts this phase. Here we have a radio-controlled airplane equipped with a number of lenses which gather in the light from six different directions, namely, north, south, east, west, up and down. The impulses are sent to the operator on the ground, who has in front of him six television screens labeled "North," "South," "East," "West," "Up" and "Down." Each screen corresponds to one of the electric eyes attached firmly to the body of the airplane, as shown in the illustration.

Let us now see what happens. The airplane is started from the ground and is sent over the enemy territory. During every second of its flght the control operator, although 50, 100 or possibly 500 miles away, will see exactly what goes on around the plane, just the same as if he himself were seated in the cockpit; with the further advantage that, sitting before a screen, he can scan six directions all at once, which no human aviator can do. If, for instance, an enemy airplane suddenly comes out of a cloud and starts dropping bombs on our machine below, the control operator sees this enemy machine quicker 500 miles away, than if an aviator sat in the cockpit one-quarter of a mile away from or below the enemy bomber. The control operator will send a radio signal that will immediately discharge a smoke screen from his radio television plane, hiding his craft in smoke. He can also make it turn

(*Continued on page* 75)



The Pilot-less radio television plane, directed by radio; the plane's "eyes" radio back what they see.

TELEVISION News

December

HUGO GERNSBACK Editor

FEATURES:

Baseball Game Successfully Televised

50¢

Our artist's picture reproduced above from a photograph appearing in a Japanese magazine, shows that they are wide-awake indeed on television in Japan, for we have not reached the stage in America where we are televising ball-games, although the technical equipment available here is capable of doing so. We predict that by next summer we shall see ball games televised over more than one television system in this country.

STRIKE ONE! GREETS JAPANESE VISUALISTS

By H. WINFIELD SECOR

JAPAN is wide-awake when it comes to the latest advances in television, as the accompanying picture clearly demonstrates. This illustration was made by our staff artist from a photograph, showing a baseball game being televised in Japan. In the illustration shown on our front cover, the apparatus has been somewhat modernized by placing the televisor on gimbals, so that it can be quickly pointed, in any direction, by the operator. Judging by the original photograph, which appeared in a Japanese magazine, the televisor utilized for picking up the baseball game was a stationary affair, and it evidently was focused across the home plate. In the last issue of TELEVISION NEWS, we showed how the Baird experts, in conjunction with the British Broadcasting Company, recently televised the famous English "Derby", so that the present instance affords another link in the chain of evidence that television is indeed marching forward.

Recently a Japanese magazine contained a photograph showing a baseball game being televised. The recent television broadcast of the English Derby, coupled with the televising of fistic encounters in America, demonstrates that television is steadily marching forward.

Public Anxious to "See" Sporting Events

American *visualists*, by the tens-of-thousands, are waiting for the day when prizefights and other athletic events will come to their homes via the television screen. Probably this coming winter will see the first prizefight shown via television—that is actual prize matches in such large places as Madison Square Garden, New York City. As a matter of actual fact, the Columbia Broadcasting System have shown several "prize ring" scenes over their television station, W2XAB (107 meters) accompanied by voice over W2XE (49 meters). Mr. William Schudt, director of television programs for the Columbia Broadcasting System, and his staff, especially arranged these "studio" boxing scenes between well-known exponents of the fistic art.

About three years ago, the writer saw what was probably the first demonstration, in America, of an "outdoor" pick-up as given by the Bell Telephone Laboratories. At that time a man going through various motions with a tennis racket, was shown on the television screen, which utilized a 60-line scanner. Public demonstrations by the Bell Telephone Laboratories, since then, have been practically all confined to "close-ups" such

(*Continued on page* 392)

TELEVISION News

HUGO GERNSBACK Editor

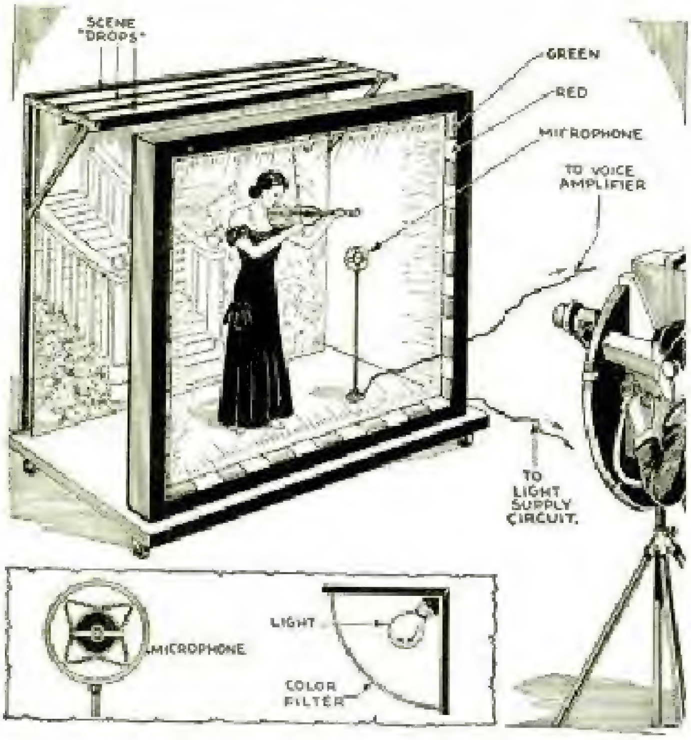
FEATURES

- TELEVISION—TODAY AND TOMORROW BY DAVID SARNOFF
- THE SANABRIA GIANT TELEVISION SCREEN
- SYNCHRONIZING WITH A HOME-MADE MOTOR
- AN EXPERIMENTAL KERR CELL
- BUILDING A SYNCHRONOUS MOTOR
- BAIRD'S NEW TELEVISION RECEIVER

October

50¢

Jenkins Televises With New Lighting System



The newest Jenkins "stage lighting" scheme for use in the television studio, the artists being illuminated by lights placed behind red and green color filters arranged around the frame as shown.

JENKINS

By D. E. REPLOGLE*

Specially Written for TELEVISION NEWS

How best to illuminate the person who stands or sits before the television pickup, has been one of the toughest problems which television engineers had to solve. Mr. Replogle gives us some interesting fresh angles which show how the Jenkins experts have solved the problem, without having to use the old-style highly concentrated banks of lights, which are very annoying to the artist. The value of colored lights is also explained.

THE flying-spot type of pickup, which is used by all present television broadcast stations, has one major disadvantage along with several minor disadvantages. The major one is lack of flexibility, which handicaps the showman in making television presentations, along with the necessity that the studio should be darkened, or at least illuminated with special colored lights.

The studio of the future will undoubtedly present a different picture from the present fixed-apparatus type. In this future studio, one will find several pieces of apparatus which, in appearance and operation, will closely resemble the conventional camera, found in today's motion-picture studios. The scenes to be televised will be staged on special stages or sets, before each of which will be a cameraman with his camera. Off from the studio will be a make-up room, with the make-up attendants, a costumer's room and a property room. Curtains at the rear of the sets will be used for scenery; and back in the control room will be a highly-paid specialist, who will "mix" the scenes coming from the various sets, and put on the air, in proper continuity, the story as the author meant it to be.

All the continuity ideas of the picture will rest on his shoulders. On his skill will depend the sight and the sound emphasis which must be placed on each part of the plot. Here the pictures coming from two or more sets will be "mixed" and sent out to the radio transmitter at the proper time. This specialist will correspond to the present "film editor," who cuts out the unwanted parts of the scenes that have been "shot," and pieces together the completed picture.

When such studios are available, together with proper receiving equipment for the home end (which is well on the road to production), we can truly say, *"Television is here with genuine entertainment value."*

Direct Pickup Camera, the Latest Step Ahead

The most recent step forward towards the aforementioned ideal is in the development of the direct pickup camera, shown in the accompanying illustrations, which is capable of being used outdoors, when mounted on trucks; and used as well in studios and theatres to pick up any scene that can be brilliantly illuminated.

Mr. Replogle, author of the present article, is widely known to the radio and television fraternity. He has just been honored with the title of chief engineer of the De Forest Radio Company.

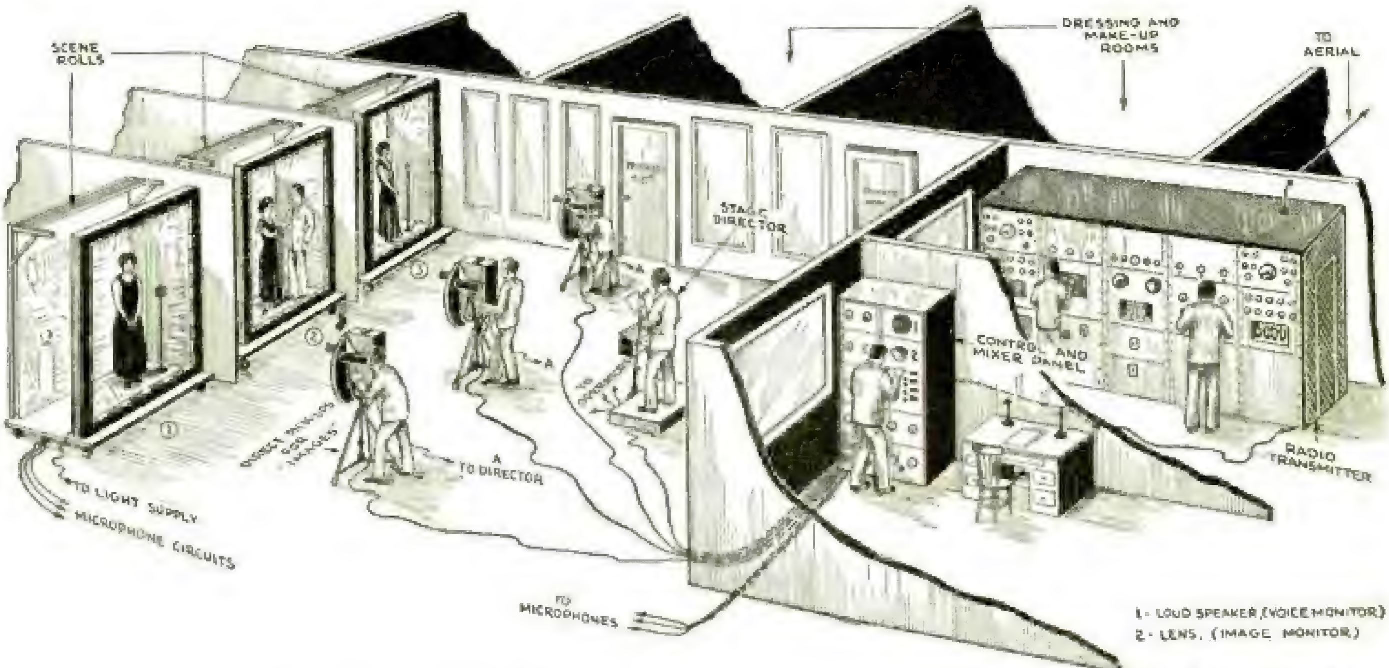
The idea of this camera is not new. However, it has heretofore been considered impractical by television engineers, because of the difficulties attending this method of television pick-up. These difficulties have been mainly in the small amount of light available on the photoelectric cell; necessitating very high amplification, with attendant noises and troubles. Development of the more sensitive caesium photoelectric cell, as well as more intelligent use of the screen-grid high-gain amplifying tubes (which, with better manufacturing, have reduced the microphonic and electronic noises) have enabled the engineers of the Jenkins-DeForest Laboratories to overcome the basic difficulties. They have achieved the undoubted advantage of the direct pick-up camera system in the television studio.

Present Experimental Studio of the Jenkins Laboratories

While in New York, at Station W2XCR, the conventional flying-spot system is still in use, yet in Passaic, in the Jenkins-DeForest Laboratories, a model studio using this direct pick-up camera is in use. A glimpse into this studio shows, at one end, a stage around the outer edge of which are mounted groups of lamps spaced at intervals along top, bottom and both sides. These lamps are of fairly high candle-power, and their purpose is to illuminate with an even amount of light every portion of the stage. On the stage are a piano, music racks and other properties necessary for the immediate scene to be televised. Over alternate lamps are placed special optical filters. The filter on one lamp permits the red and infra-red rays to flood the stage; while the next lamp is filtered so that the blue part of the light floods the stage. The reason

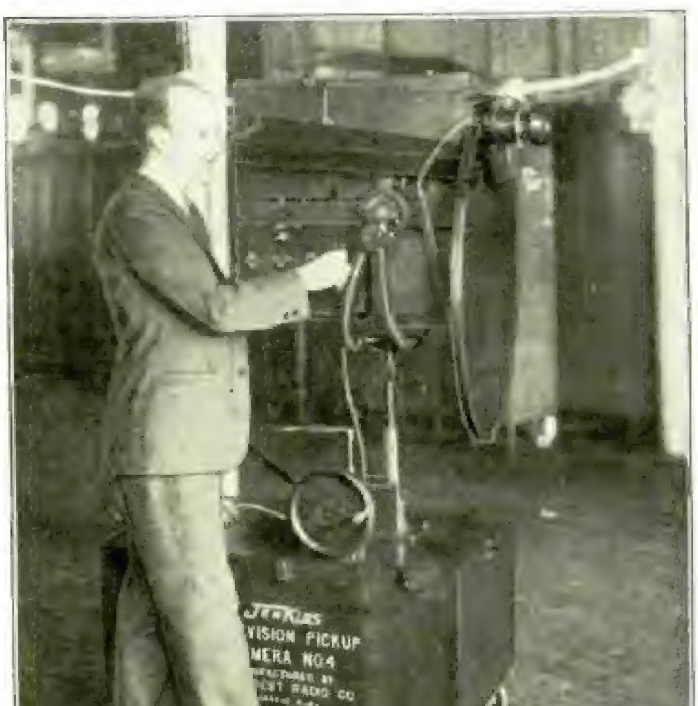
* Vice-President, Jenkins Television Corporation.

TELEVISES *with* New Lighting System



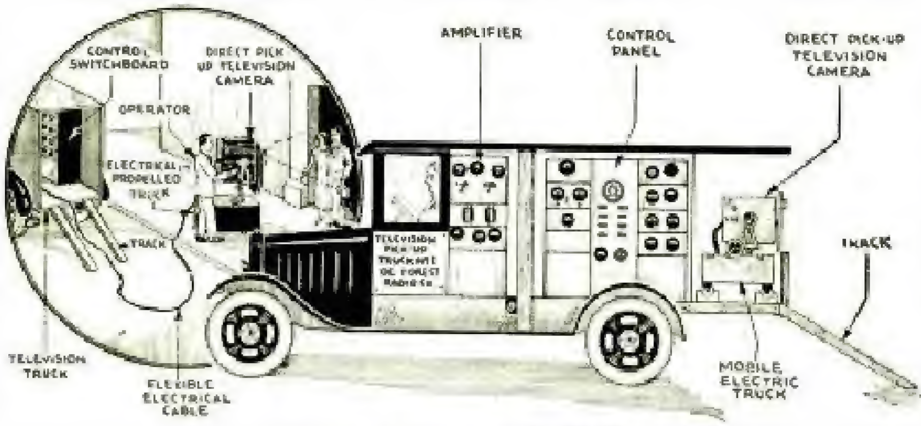
Here we see how television dramas and other entertainments will be staged, with three or more "direct pickup" cameras, this arrangement enabling the supervisor at the mixer panel to fade the images in or out as desired.

for this light-filtration is as follows: If all the lights were permitted to flood the stage with the total candle-power, the brilliance presented to the eyes of the artists would be very annoying to say the least.



Latest model Jenkins "direct pickup" camera with mobile truck. The operator checks the image by looking into the scanner hood shown.

New style mixer and control panels, with image monitor, for television transmitting stations, designed by the Jenkins engineers.



~ CROSS SECTION OF TELEVISION PICK-UP TRUCK ~

Latest portable "television pickup" equipment. The "direct pickup" television camera can be rolled down the tracks and used wherever desired. A front view of the pickup camera is seen at right.

Bothersome Light Filtered Out

The total amount of illumination versus the light spectrum is shown in the accompanying curve. It is noted here that, by far, the greatest brilliancy is in the yellow part of the light spectrum. Fortunately or unfortunately, the latest highly-sensitive type of photoelectric cell made with caesium has a curve as shown; the greatest response of the cell is in the blue and red portions of the spectrum, with very little response in the yellow. It is obvious, then, that all the brilliancy which is so bothersome to the eyes of the artist actually does very little good as far as actuating the photoelectric cell in the camera goes. Hence, it is feasible, with negligible loss of light, to filter out entirely the center portion of the light spectrum emitted by the lights around the edge of the stage. In this way the comfort of the artist is assured, and ample light can be secured to actuate the latest types of television pickup device.

In front of the floodlighted stage is placed a direct pickup camera, an illustration of which is shown on the cover of this magazine. The attending operator is aided by very accessible controls to focus his television camera on any portion of the stage for the desired action.

Scenes Can Be Accurately Focused

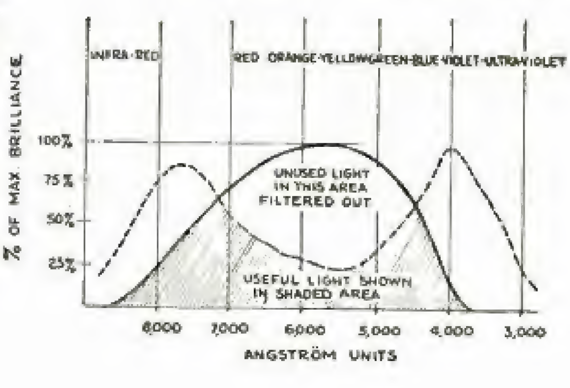
If a close-up is desired, he brings his camera close to the stage, refocuses the image on the photoelectric cell, and keeps the image in the center of the television field. He ascertains the focus and center of his image by means of a *television monitor;* and not by an optical finder — the common practise with movie cameras. In this way, he is absolutely certain just what portion of the scene is put on the air, the proportion the image occupies in the field, and how well it is focused.

Should the scenario call for a full-length stage effect, the cameraman is able, without changes of lenses as is necessary in the flying-spot, to follow the story by moving his camera back, refocusing as he goes; and thereby give the looker-in a wider field than previously. By swinging his camera he is able to focus on any one of several objects on the stage, as they become successively of prime importance in the sequence of the story.

Photo above shows a lighter weight direct pickup for studio use, the photo-cell being placed behind the scanning disc and lens.

●

Chart (right) shows how both ersome light is filtered out in new studio lighting scheme. Full line shows distribution of incandescent flood-light over light spectrum; dotted line shows sensitivity distribution of television camera photo-cells.



Prize Fights, Etc., Have Been Televised!

From the foregoing brief description, the flexibility of this new camera device is obvious. *With it we have been able to televise plays involving a plot of three or more people; we have been able to put on prize fights on a restricted stage, with a fidelity that would enable the looker-in to follow each blow of the contestants; we have been able to televise pianists, showing the technique of the fingers, and, of course, artists singing or speaking, reproducing the facial expressions with recognizable detail. Ballet dancers and clog dancers have been televised with excellent results.* Therefore, it will be noted that, if two or more sets, with a camera before each set, were available, with the proper "mixing" or continuity selection from each of these sets, a satisfactory presentation of even intricate plots would be possible.

In the studio at Passaic, immediately behind the camera, is an open window through which, on sunshiny days, the camera is turned outdoors. Cars on the streets a block away, as well as signs on buildings a block or more away, are readily observed in the camera's monitor. An airplane a half-mile away can be distinguished as it crosses the field of the camera. In fact, the operators of the camera state *that they can pick up better pictures on a sunshiny day out-of-doors, than can be secured on a specially-lighted stage.*

Outdoor Pickups Now Possible

The success in operating this camera outdoors has been such that the Jenkins-DeForest engineers are now developing a truck on which will be placed a camera, with a long flexible cable on a reel; so that the truck may be driven to a baseball game, to the arrival of some notable, or to any other outdoor event to be televised.

TELEVISION News

HUGO GERNSBACK Editor

NOW 25¢

FEATURES

PRACTICAL HINTS ON OPERATING A CATHODE RAY SCANNER
By M. RAPPAPORT, E.E.

"SUBSEA" TELEVISION

A NEW AND POWERFUL SOURCE OF MODULATED LIGHT
By C. H. W. NASON

OPTICAL SYSTEMS FOR CONTROLLING SIZE OF CRATER
By IVAN BLOCH, E.E.

"PRIZE-WINNING" TELEVISION RECEIVER

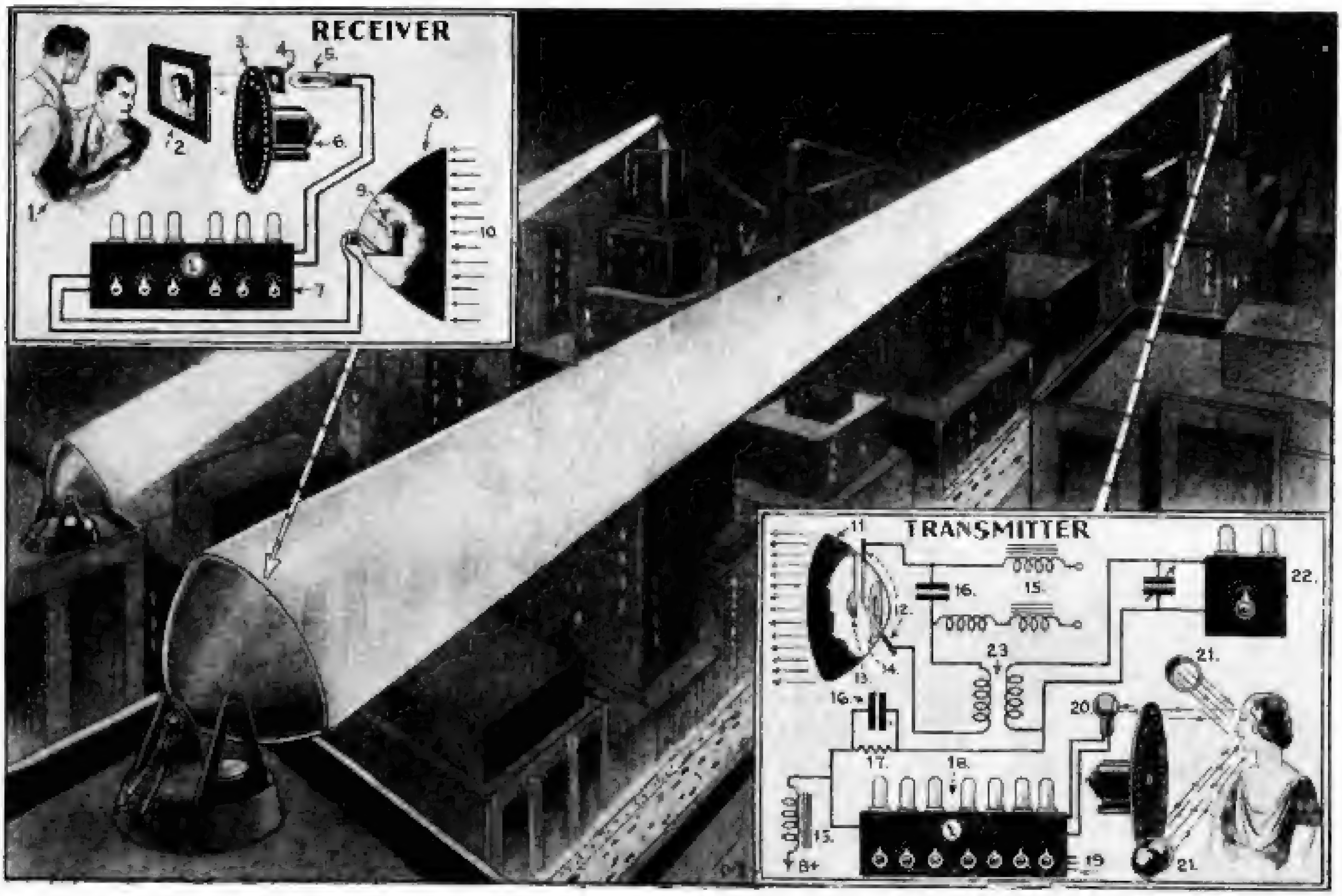
THYRATRON OSCILLATORS FOR CATHODE RAY SCANNERS

TELEVISION PATENTS REVIEW

THE LORA CATHODE RAY TUBE

April

How To Build Your Own Lens Disc Television Receiver



Television over a light beam—Transmitter: Subject scanned by lights 21, disc and photo-cell 20. Photo-cell current, amplified by 7 stage amplifier 18, modulates oscillator 22 (15 choke, 16 a condenser, 17 a resistance): which in turn modulates current to arc between carbons 12. 11 reflector, 13 small spherical reflector, 14 diaphragm, 23 transformer, 16 condenser, 15 iron core chokes. Receiver: 1 observers, 2 image, 3 scanning disc, 4 diaphragm, 5 neon tube, 6 motor, 7 detector and amplifier, 9 photo-cell, 8 reflector, 10 light beam.

LIGHT BEAM TELEVISION

How Dr. E. F. W. Alexanderson of the General Electric Co., successfully transmitted and received television images over a light beam.

ONE can never tell today what is being transmitted over a searchlight beam. Without any translating apparatus such as a television receiver, you would not know that a television image was possibly being transmitted by slight variations in the light. Just recently a very interesting and startling demonstration of television over a beam of light took place in the Radio Research Laboratory of the General Electric Co., at Schenectady, N. Y.

Dr. E. F. W. Alexanderson, well-known television expert and consulting engineer of the General Electric Co., directed the experiments and the accompanying drawing shows the arrangement of the apparatus. Many interesting variations of this latest television scheme may present themselves in the future. For one thing, the light-beam does not have to be radiant or visible, for we may make use of the invisible infra-red or ultra-violet rays. It is believed that this demonstration and the experiments lying behind it may indeed pave the way for a new day in television, and that we may expect as a consequence more distinct and better detailed images. The wave length used in the light beam television demonstration was of the order of a millionth of a meter.

As revealed in the diagram the image of the subject being televised, is picked up by photo-cells and then amplified by a seven-stage amplifier. The television signal is caused to modulate a carrier frequency, which, in turn, modulates the arc light source. The fluctuations in the light beam, even though slight at times, are faithfully picked up and translated into electrical currents by the photo-cell (light-sensitive relay), placed in the focus of the parabolic reflector at the receiving station, located 130 feet from the transmitter in the demonstration.

The minute fluctuating electric current coming from the photo-cell in the receiver reflector, is greatly amplified by a shielded, resistance-coupled amplifier of six to eight stages. The amplified television signal is then past into a neon tube, and by whirling a scanning disc in front of the pulsating neon light, an image of the person or object before the transmitter is reconstructed. A crater or spot source neon tube may be used, together with a lens disc and ground glass or other screen, to provide an enlarged image.

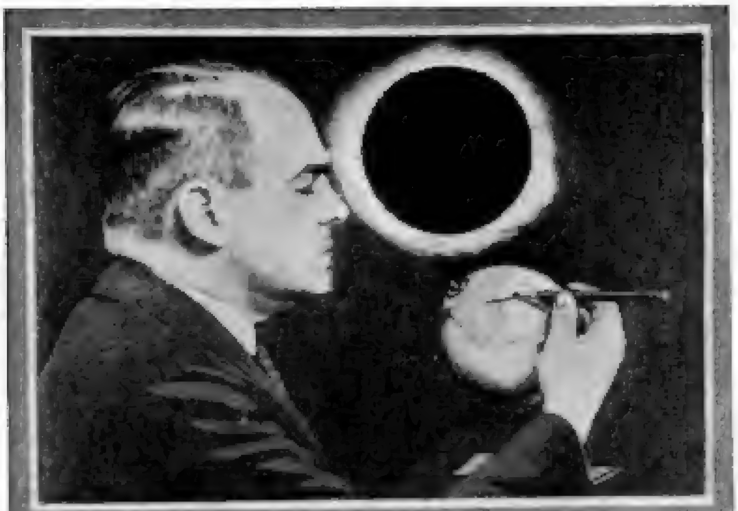
Telecasting With Powerful Light Beams

"The work thus far is highly experimental, yet some day we may see television broadcast from a powerful arc light, mounted atop a tower high above the city," Dr. Alexanderson said. "These modulated light waves will be picked up in the homes by individual photoelectric tubes, or electric eyes, instead of the present-type wire antennae.

"Light-broadcasting may have the same relation to radio broadcasting that the local newspaper has to the national newspapers. These light waves can be received only at relatively short distances, perhaps ten miles. Each community could then have its own light-broadcasting system."

The greatest difficulty in television today, Dr. Alexanderson believes, is in the method of transmission. Radio waves usually follow several paths in travelling from the transmitter to the receiving station. Each ray following a different path produces a different image, so that a composite image is apt to be blurred. For this reason, television has been tending toward shorter and shorter waves.

(Continued on page 57)



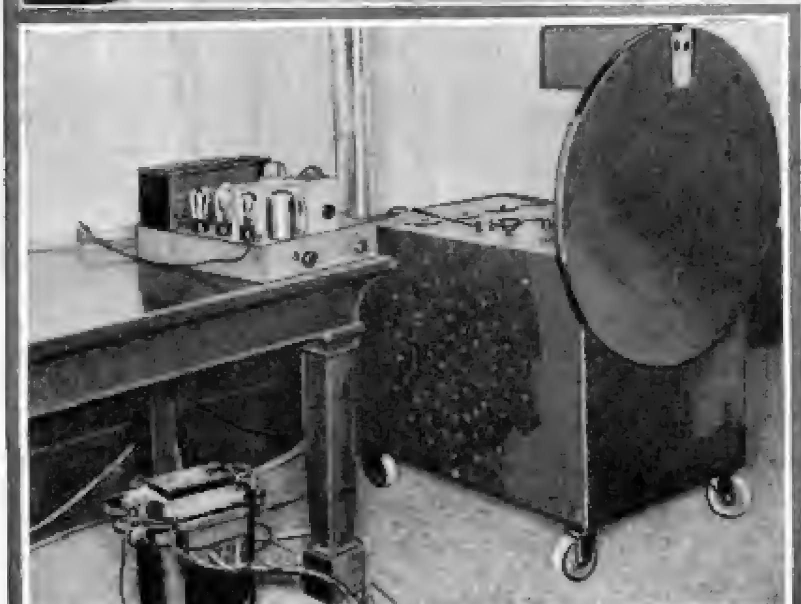
Televising Sun's Eclipse

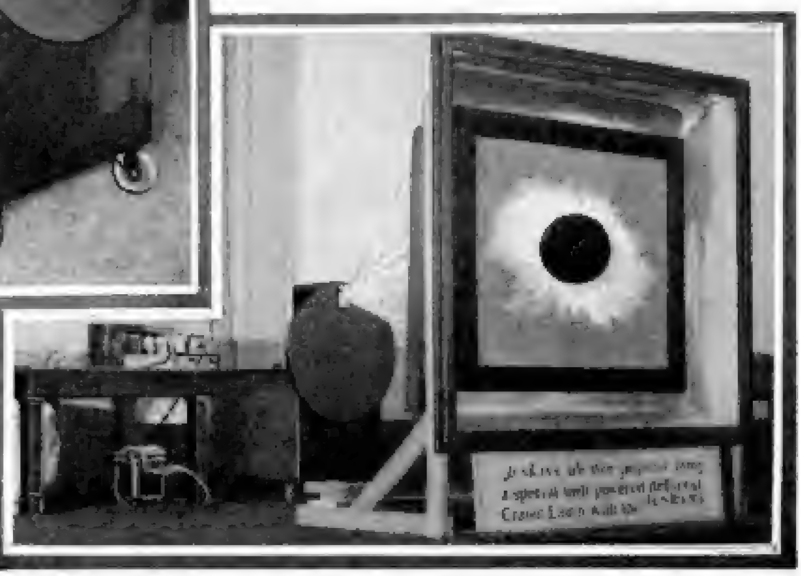
A bold plan to televise the "total eclipse" from an airship and broadcast the image to all "visualists".

By D. E. REPLOGLE*

O. H. Caldwell, tracing the path of total eclipse; he hopes to broadcast image from airship.

The route along which the total eclipse of the sun next August will be visible, is a narrow path extending, in part, across New England. Along this path, about fifty miles in width, it is proposed to send an airship fitted with a television pick-up camera. The image of the "total eclipse" can thus be radiated to a land station and re-broadcast to thousands of "visualists". Below and at left—eclipse demonstration described by Mr. Replogle.



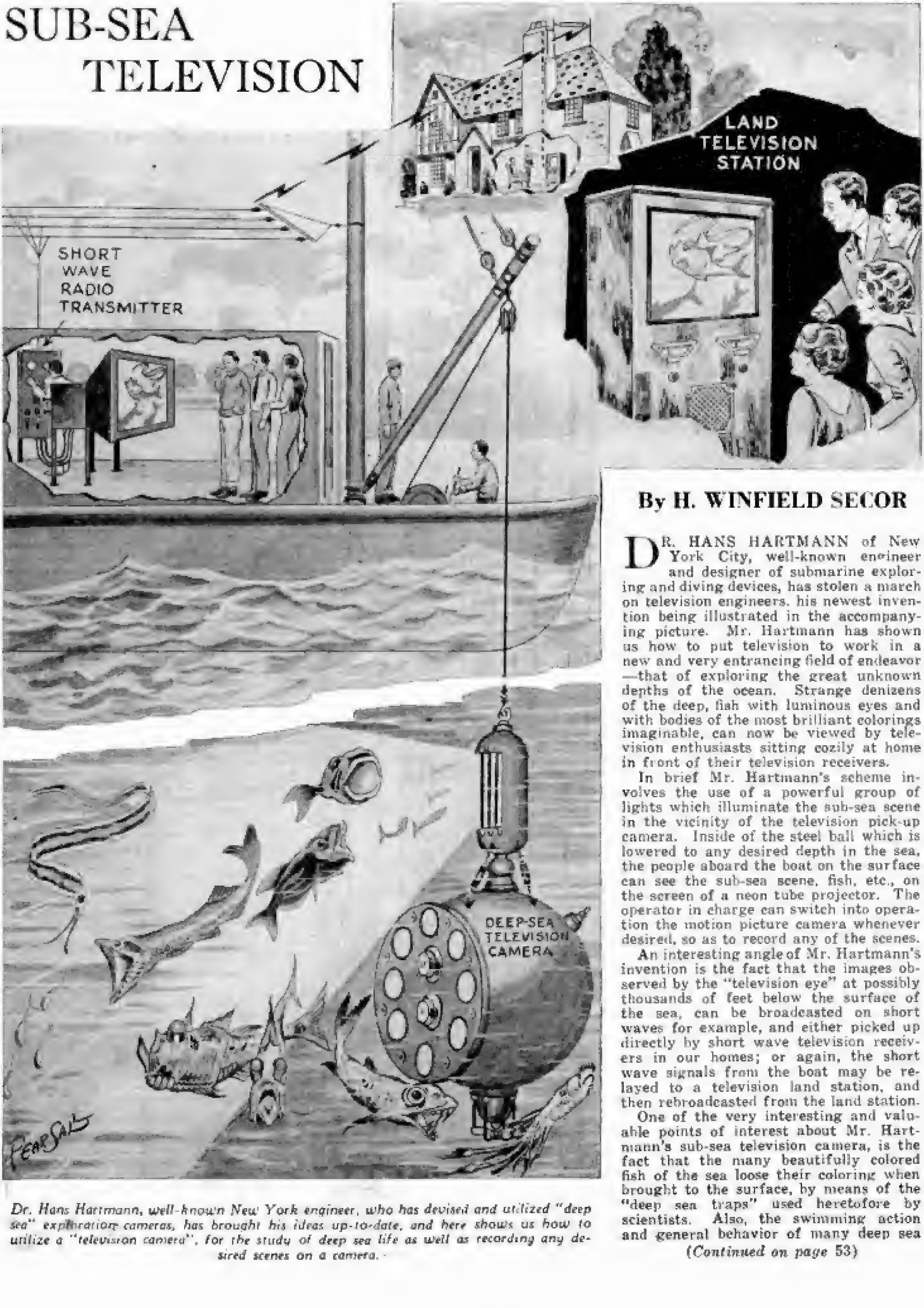


ANTICIPATING a solar eclipse by several months through the instrumentality of *radiovision* presents its whimsical side in conjunction with the importance of showing in advance just what the heavenly constellations will do this coming August. All of which occurred on December 2nd at 9:15 P. M. The scientists and engineers who carefully rehearsed and finally put on this unusual show were O. H. Caldwell, the eminent astronomer, formerly member of the Radio Commission, editor of *Electronics* and other publications; Doctor Fisher, president of the New York Astronomical Society; the author, D. E. Replogle, Chief Engineer and Vice-President of Jenkins Television Corporation and De Forest Radio Company, and two members of his engineering staff, Paul H. Thomsen and Frank B. DuVall.

At the broadcasting studio of the (*Continued on page 62*)

* Vice-President, Jenkins Television Corporation.

SUB-SEA TELEVISION



Dr. Hans Hartmann, well-known New York engineer, who has devised and utilized "deep sea" exploration cameras, has brought his ideas up-to-date, and here shows us how to utilize a "television camera", for the study of deep sea life as well as recording any desired scenes on a camera.

By H. WINFIELD SECOR

DR. HANS HARTMANN of New York City, well-known engineer and designer of submarine exploring and diving devices, has stolen a march on television engineers, his newest invention being illustrated in the accompanying picture. Mr. Hartmann has shown us how to put television to work in a new and very entrancing field of endeavor—that of exploring the great unknown depths of the ocean. Strange denizens of the deep, fish with luminous eyes and with bodies of the most brilliant colorings imaginable, can now be viewed by television enthusiasts sitting cozily at home in front of their television receivers.

In brief Mr. Hartmann's scheme involves the use of a powerful group of lights which illuminate the sub-sea scene in the vicinity of the television pick-up camera. Inside of the steel ball which is lowered to any desired depth in the sea, the people aboard the boat on the surface can see the sub-sea scene, fish, etc., on the screen of a neon tube projector. The operator in charge can switch into operation the motion picture camera whenever desired, so as to record any of the scenes.

An interesting angle of Mr. Hartmann's invention is the fact that the images observed by the "television eye" at possibly thousands of feet below the surface of the sea, can be broadcasted on short waves for example, and either picked up directly by short wave television receivers in our homes; or again, the short wave signals from the boat may be relayed to a television land station, and then rebroadcasted from the land station.

One of the very interesting and valuable points of interest about Mr. Hartmann's sub-sea television camera, is the fact that the many beautifully colored fish of the sea loose their coloring when brought to the surface, by means of the "deep sea traps" used heretofore by scientists. Also, the swimming action and general behavior of many deep sea

(Continued on page 53)

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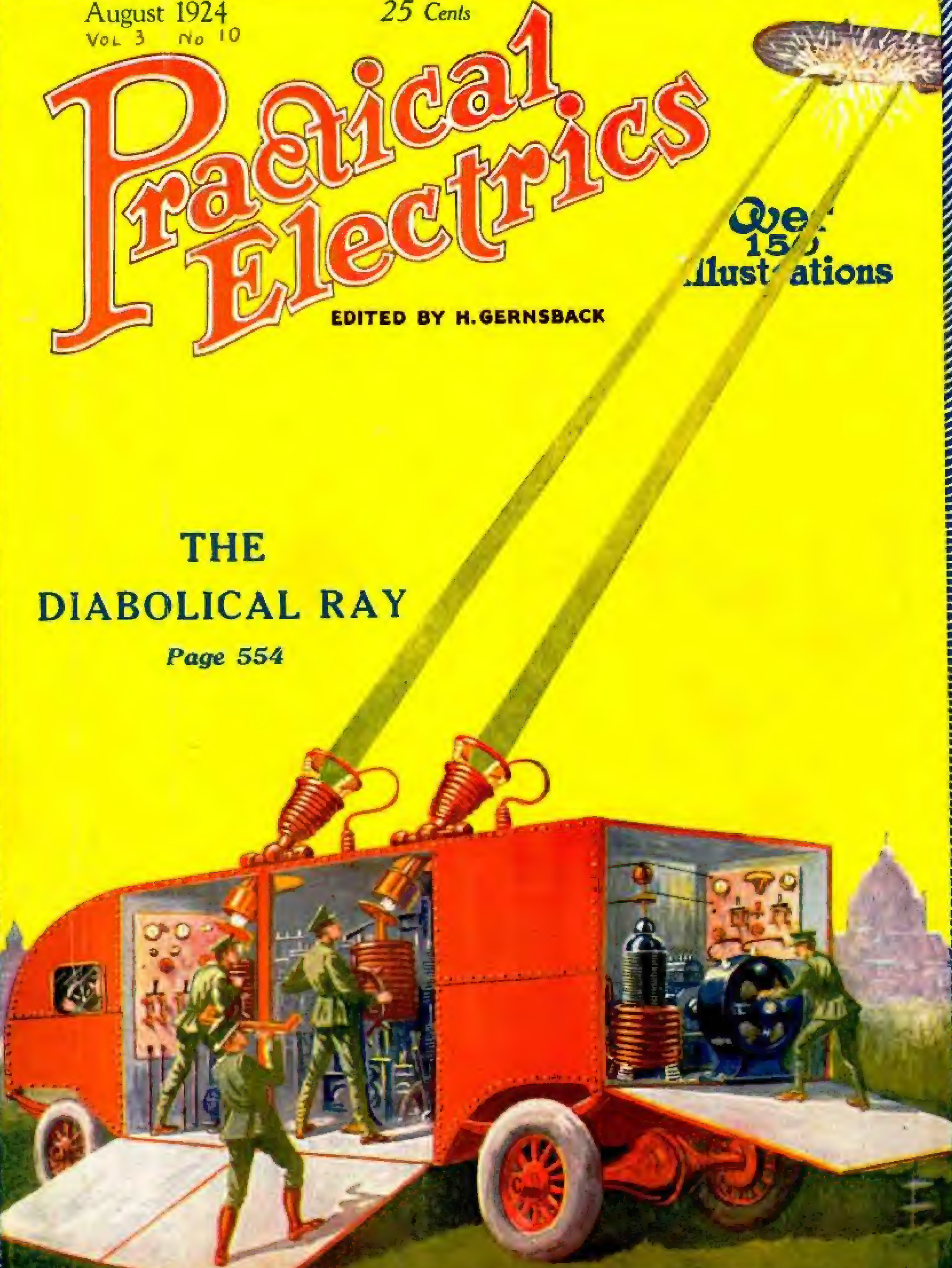
Practical Electrics

EDITED BY H. GERNSBACK

Over 15[illegible] Illustrations

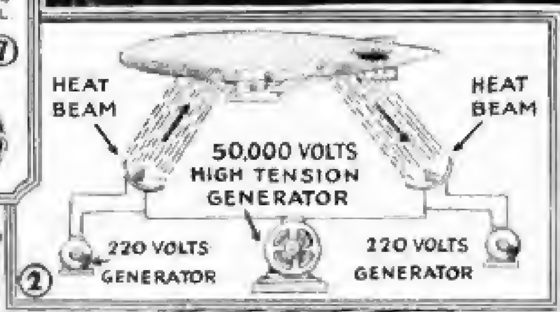


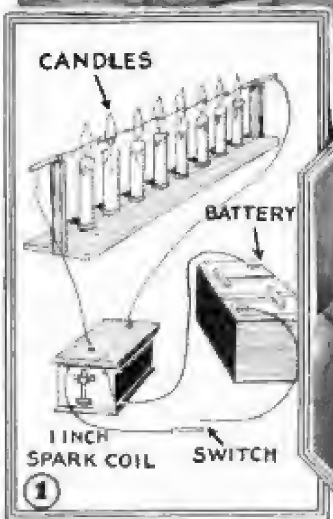
THE
DIABOLICAL RAY

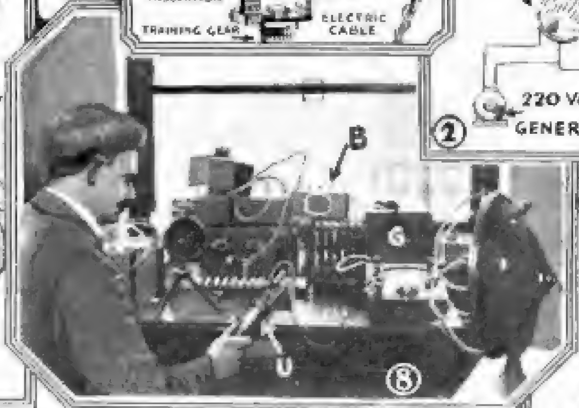
Page 554

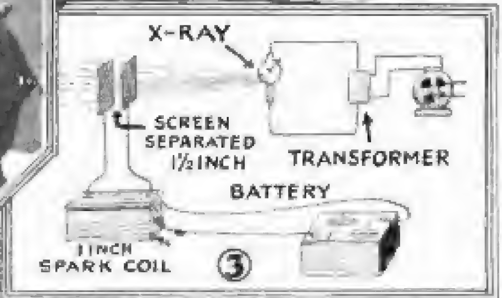
The Diabolic Ray

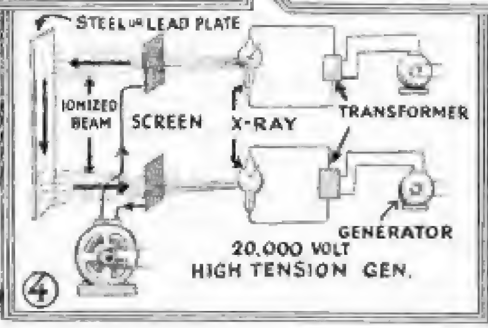
By Hugo Gernsback



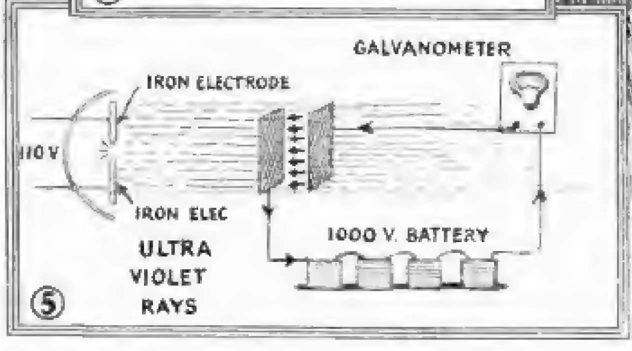








Interesting presentation of the author's experiments in the investigation of the Grindell-Matthews claims. None of the experiments yielded results.



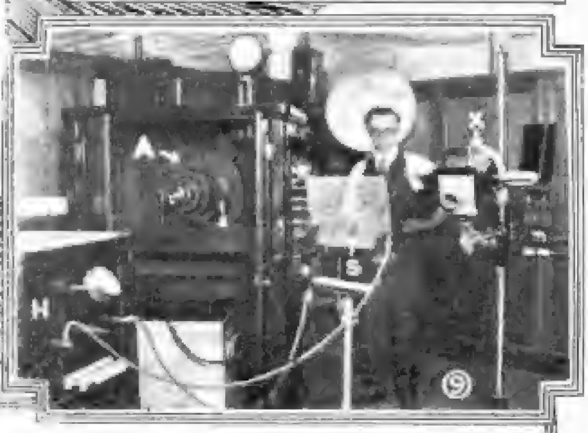


Fig. 1 is of special interest; the old college experiment of the writer gave a real result. The attempts illustrated in the other experiments, Figs. 3 to 6 were futile. The photographs, Figs. 8 and 9 are reproductions of laboratory work. Figs. 2 and 6 show what the diabolic ray is supposed to be able to do.

The Diabolic Ray

By Hugo Gernsback

Member, American Physical Society

As our readers are aware, an English electrician named Grindell-Matthews has recently made himself heard from one end of the world to the other in connection with his so-called "Diabolic Ray." From what we are expected to believe in reports from eye witnesses, Mr. Grindell-Matthews was able to electrocute a rat from a distance of 15 feet by this mysterious ray. He is also credited with having stopped a motorcycle with it at a distance of about 50 feet. It is, however, quite significant that when the British Government asked him to duplicate the experiment in the British Laboratory, substituting their own motorcycle, Mr. Grindell-Matthews refused the offer, although his government gave every assurance that he could keep the invention secret. This of course does not speak well for the invention.

Let us go back and see what has been done in the past in connection with so-called "death" rays. Mr. H. G. Wells in his book the "War of the Worlds" was probably one of the first to make use of the problematic death dealing ray.

The present writer in his story, the "Magnetic Storm" which appeared in the ELECTRICAL EXPERIMENTER, November, 1918, outlined a scheme whereby the entire German Army was made to capitulate by highly induced Tesla currents, the underlying idea of the writer's scheme at that time being to surround the entire battle front from the North Sea down to Switzerland with a highly charged electrical "fence." This "fence" was the *primary* of a number of titanic Tesla coils. Curving around in a huge semi-circle, the fence was so highly charged that any electrical mechanism for miles around that had any electrical winding would become the *secondary* to the Tesla coil and would immediately become burned out the instant a current was started in the primary.

While purely fantastic, the idea is, nevertheless, sound and Dr. Nikola Tesla endorsed it as feasible, at least within the range of a few miles.

In trying to determine if Grindell-Matthews really has an invention or a hoax, it is best to enumerate all possibilities of the case, for even if Grindell-Matthews has not at present the death-dealing ray, such a ray will be found sooner or later. It is all in the realms of physics and just because we do not actually know how to produce it today is no reason why it will not be produced tomorrow. The case for us to decide is if Grindell-Matthews has a new ray, or whether he is making use of the already well-known properties of present-day rays and the laws of present-day physics.

On the table shown in this page we see a list of vibrations. We may dismiss octave 1 to 15 which embrace sound waves. We do not think that by means of these low vibrations electrical currents can be super-posed on such sound waves. The 20th octave is known to us. Its properties are hidden from us. The same is the case with the 40, 45, 51, 57 and the 62nd octaves. Has Grindell-Matthews discovered a new ray that comes within any of these unknown frequencies, one composed of any of these unknown vibrations? Frankly we do not believe that he has; as a matter of fact, he says so himself. *In other words he has discovered no new ray*, no new physical principle, but he does claim to make use of present-day devices and present-day facilities to achieve his ends. But let us see if this holds forth any promise. What can any good scientist do with present-day means? The writer asked himself this question and he performed a number of experiments as will be indicated below.

Refer to illustration No. 1. This is an old college experiment of the writer's. Eight candles were placed on a board so that they almost touched. At each end candle there was a wooden support upon which electrodes were fastened which reached into the flame of the first and last candles. By means of a coil giving a one-inch spark when energized by a battery, it was possible to make the spark leap over a distance of about five or six inches.

What does this experiment mean? Just this—that if you have a sufficient amount of hot gases or hot air it is possible to make an electrical discharge leap over a large gap, which it would be unable to do in free air. As everyone knows, a spark coil giving a one-inch spark cannot be made to give more than that one-inch spark in the open air. By using heated gases we can increase the distances.

TABLE OF VIBRATIONS

Octave	Number of Vibrations per Second	
1st	2	
2nd	4	
3rd	8	
4th	16	Sound
5th	32	
6th	64	
7th	128	
8th	256	
9th	512	
10th	1,024	
16th	32,768	
20th	1,047,576	Unknown
25th	33,554,432	Electricity
30th	1,073,741,824	
35th	34,359,738,368	
40th	1,099,511,627,776	Unknown
45th	35,184,372,088,832	
46th	70,368,744,177,644	Heat
47th	140,737,488,355,328	
48th	281,474,976,710,656	
49th	562,949,953,421,312	Light
50th	1 125,899,906,842,624	Chemical Rays
51st	2,251,799,813,685,248	Unkown
57th	144,115,118,075,855,872	
58th	288,230,376,151,711,744	X-Ray
59th	576,460,752,303,423,488	
60th	1,152,921,504,606,846,976	
61st	2,305,843,009,213,693,952	
62nd	4,611,686,018,427,387,904	Unknown

Now consider Fig. 2. Here we have the actual experiment of Fig. 1, duplicated in a hypothetical death-dealing ray. Imagine two large reflectors with two enormous electric heating elements, built along the lines of our electrical parabolic heaters, such as we use to heat our bathrooms on a chilly morning. These heaters are to be so powerful that they will throw a hot beam over a mile. We admit that they would have to be "some" heaters to do this, taking into account cold air currents, winds, etc., which would most surely affect the operations of the heat beams. But let us suppose the beams were sufficiently hot and powerful. We attach to each one of the heaters a 50,000-volt high tension generator or if you think that this is not sufficient we can step it up with transformers to a million volts if necessary. We can now see that if everything works, we could direct the two beams on an airship or airplane as shown and the high tension discharge would go via the parabolic reflectors, would follow the path through the heat and the ionizing heat beam up to the airship and down through the other heat beam. The high intensity current would burn out all electrical windings and thus stop the machinery and cause fires, bringing down the machine.

A beautiful theory, but we do not think that it will work out very well over a distance of a mile or so. To be sure such results can be had over comparatively small distances, maybe 50 or 100 feet, but it would be far too expensive for the results that it would accomplish.

So much for heat rays. We next turn our attention to the most powerful ray known to science today. This is the X-ray. X-rays, as is well known, have the power of ionizing air, in other words, make air conductive to the electric current. For instance if you turn an X-ray on a charged electroscope, it will discharge almost immediately, proving the conductivity of the air. When Grindell-Matthews first brought out his death-ray the writer thought to duplicate it and he rigged up the apparatus shown in Fig. 3. The photograph, Fig. 9, shows this apparatus of the experiments along similar lines.

Refer to Fig. 3. Here we have a powerful X-ray tube sending out its usual intense X-rays. In addition to this we have also a spark coil giving a one-inch spark, the high tension posts of which are connected to two pieces of metallic screening separated about 1½ inches. The spark coil was now energized by the battery and of course no spark jumped between the screens for the reason that the coil could only give one-inch sparks and no more. The idea behind this was to find out if the air between the screens could be sufficiently ionized to make the spark clear a gap of 1½ inches. The logic recalls the experiment shown in Fig. 1, in which we have a one-inch spark actually leaping over a distance of about five inches, so if the X-ray was as good an ionizer as were the gases of candles, we should not only get 1½-inch sparks between the screens, but a six-inch or seven-inch spark. But the writer was very much disappointed to find out that the results from this experiment were entirely nil. Evidently the ionizing, as powerful as it is, fails to make the air conductive enough, or otherwise a different kind of a current than that given by an induction coil must be used. Right here it may be stated that several other electrical currents were tried out with the same negative result. Not only did the spark refuse to leap the maximum distance, but no increase of the air gap could be bridged at all, not even one-sixteenth inch over the one inch.

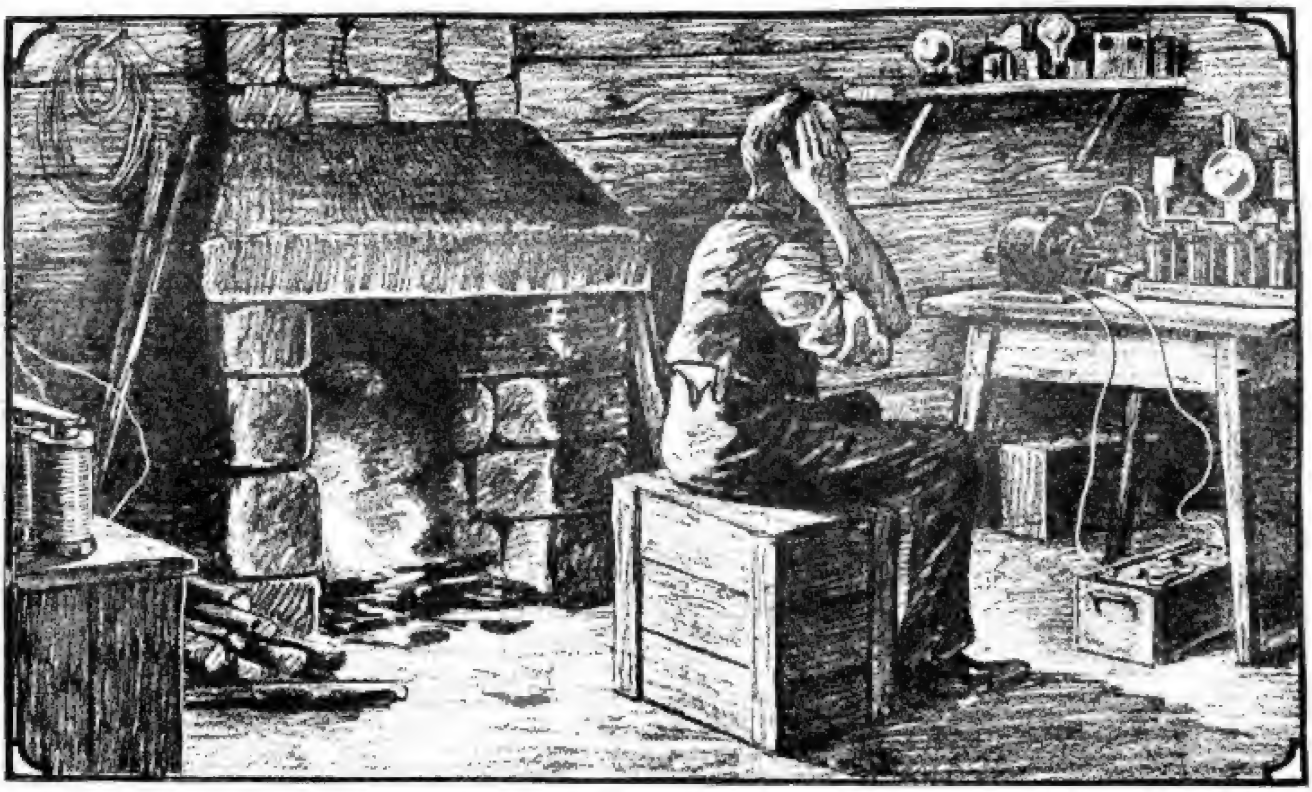
Then the experiment shown in Fig. 4 was tried. Two large and powerful Coolidge tubes were connected as shown, the two screens were put in position, while a 20,000-volt generator was connected to the two screens. The idea here again being to have the current go as shown by the arrows from one screen to the steel or lead plate, down the lead plate, then leaving the lead plate pass over the ionized beam to the lower screen and back to the generator. Nothing at all happened. There was no spark of any kind and as far as we could tell, no energy went over the beam. Then we attached the high tension generator direct to each one of the poles of the X-ray tubes with the hope that this might prove more successful, but with no result.

(Continued on page 601)

When Sound Was Annihilated

By Robert Joergensen

PALE with rage, with flaming eyes and clenched fists young Zerno sprang to his feet. Suddenly he seized his wine glass and threw it across the table, so that it broke in Captain Migel's face. This was his answer to the captain's insulting words. The young officers who sat around the table sprang to their feet and looked in alarm at Ilja Zerno. What had he done? Ruined his future, his coming career as an officer, put his young life in the balance by an ungoverned action. The prince had forbidden under penalty of death all dueling, but could no other solution for this situation be found than a duel? No. Then the result of such might for young Zerno be either death or exile.



"Poor as the hut was, a quantity of electrical apparatus was contained within it. . . . Weird sounds were produced in his experiments which excited the fears of the passers-by and which the experimenter himself could not endure."

The only one who in the general commotion kept perfectly quiet was Captain Migel. With a cold smile he remained sitting in his place and wiped off the red wine which sprinkled his face and uniform; now he rose, his face became severe, and with a voice cold as steel he said: "I shall kill you for this Mr. Ilja Zerno and I will do it as quickly as possible. Can my friends meet you within an hour to arrange time and place?" He threw a contemptuous glance of inquiry at Lieutenant Zerno, who for answer mechanically bowed his head, and with slow steps Captain Migel left the room.

Zerno remained standing at the table with hard staring eyes; it was as if the full meaning of what he had done only now stood clear before him. But as his comrades began to flock around him inquiring, warning and wondering, he suddenly roused himself, drew a deep sigh and hastily passed them on his way out of the room.

The Duel

The morning after, while the air was still cold and the morning sun shone white and dreary, a little assembly of men met in the Bernetz Forest and disappeared among the trees. Now, before the dew had disappeared from field and tree, one of them lay cold and dead on the grass and another was fleeing to a strange land.

The next morning Ilja Zerno awoke in the capital of a foreign country. There he remained for a long half year; it was known that he had vainly sought for occupation and then he suddenly disappeared from the city without telling anyone. Rumor told that he had been seen in the great commercial port but nothing positive was known. He had disappeared out of the world in which he had lived hitherto. But whether that was to go to a better or a worse, no one tried to determine with any degree of certainty.

And so year by year, the memory of Ilja Zerno grew fainter and fainter.

A Mysterious Being

The heath was awe-inspiring, deserted and cold. And the man who lived out there in the hut was alone, alone and mystical as nature that surrounded him.

Who was he? No one knew. Where did he come from? No one knew. No one knew his name, what he was doing, how he supported himself, nor why he lived so lonely out there in the deserted heath.

Superstition had deep roots in the souls of these people. For them the supernatural and unexplained was worse than death. The effect of it all was that they went in a wide circuit around the house on the lonely heath, and hastened away to the adjoining village.

The heath was awe-inspiring, deserted and cold. The man there was unknown and charged with secrecy; the hut he lived in was wretched and ready to fall into ruin. A fire burned in the great open fireplace; out of the darkness the fantastic contours of machines, glass vessels, working tools and instruments of physics emerged. The man himself sat bent over and meditating by the fire; the flames cast a mystic glow over his old and energetic features, was reflected from his deep, luminous eyes, lighted up his whole form, and then would suddenly go down to disclose no longer the poverty that came into view.

He stared into the fire with a dreaming, seeking look; he thought and murmured half aloud to himself, in the way common to those who live much alone: "Home again; home; but no one must know it, not even those nearest to me. I must always live alone; but it is home in my own land with my own people; it is my own language which I hear spoken on the streets of my city. When I wish, I can visit the places where I lived as a child and a young man.

The Soliloquy

"What might I not go through in a foreign city—struggle, in need of everything, and living in poverty. And it is not yet over; the hour of relief is not yet near. It is as far away today as on the morning when the victim fell. But one must be patient; one must set his teeth and make the best possible out of circumstances, even if all appears hopeless.

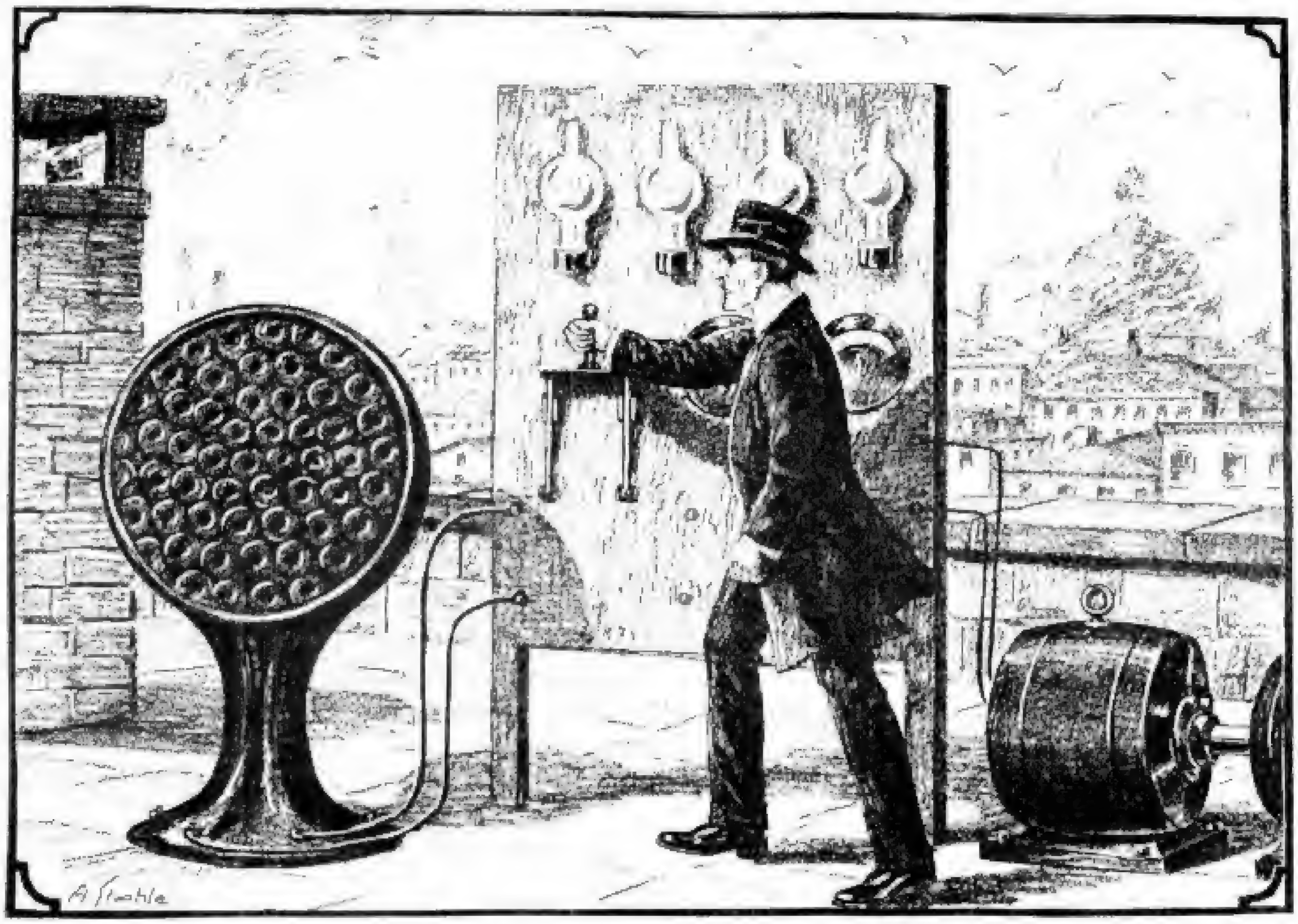
"What a hell was that, the wharf I worked on! An inferno, not of smoking fire, but of noise and sounds, the shriek of steam whistles, the hammering of riveting machines, clangor and noise everywhere, and everywhere and on all sides the hammering of the riveting machine.

"Could anything be found which would so enslave a man, dull his brain and split his nerves, like a constant abode in such a hell of noise. If the thought came to one: 'I am unhappy!' the riveting machines would rivet that fast into the heart and close it in.

"And if the noise in the machine shop and workshop could be abolished, if all the men could work without sound, what a paradise such a place would be in comparison with this where I worked. The workmen could sit in quiet and at peace at his bench, his nerves would be spared and he could find quiet to think out his own thoughts, without being deafened by the clangor of the machine.

"Is anything of this sort unthinkable? No, surely not. What is sound but a vibration of the air and as a weak light disappears before a stronger obscurity, a weak noise is unheard over a louder one. If one could now produce a tone so strong that it deafened all other sounds, and without weakening it any, let it rise into higher and ever higher frequency until it reached over 60,000 cycles per second, then all sound would disappear. All would be still as death. No human ear could perceive the least sound. . . . but then it would also be impossible for men to communicate with each other except by signs. Men who worked in such a place, where there was no sound, might as well be deaf and dumb, and that might be still more dreadful. . . ."

The speaker's voice dropped to an inaudible murmur. Thinking and sighing he sat long and stared into the fast expiring fire.



"The Colonel saw him. On the roof was installed the apparatus which had produced such a startling effect. A generator operated a bank of enormous audion bulbs connected to a reflector full of high pitched telephones, especially constructed to correspond with the ultra-audible frequency."

His Work in Electric Sound Production

Poor as the hut was, a quantity of electrical apparatus was contained in it, a noticeable feature of which were audion bulbs, induction coils, evidence of the idea of enforcing silence by the production of air vibrations beyond the range of the auditory nerve, to be carried out by high frequency oscillation of audions. Those of us who have heard, and who have not, the piercing sounds that can be produced by the little bulb of the radio apparatus will realize how powerful an agent is at hand in it for throwing the air into vibration. Audion bulbs can be made to produce any desired note but here the pitch was to be raised far above the range of the human ear. Weird sounds were produced in his experiments, which excited the fears of the passers-by and which the experimenter himself could not endure.

Distress in His Home Country

Distress spread over the country. Slowly it wormed its way in, insinuated itself everywhere, and obtained firm foothold, sometimes in one, sometimes in another district. From an intangible suspicion spreading everywhere, it quickly rose to frightful reality. War in a neighboring country, reducing exports and the operations of commerce and factories, which had to be closed, threw thousands and more thousands out of work, and they wandered back and forth through the streets in small groups, gathered on the street corners and great squares, discussing the latest news about home and foreign conditions. The voices were yet quiet, for the populace were spiritless, depressed and troubled over the sudden change in their life; they were unaccustomed to governing themselves and had no leader to guide them. Silent and passive they awaited the further development of affairs, but they did not have to wait long.

The country was soon cut off from importing the necessities of life and turned to their own insufficient harvest fields. This year the harvest failed; conditions became alarming. Ever greater crowds of pale shadows strode day and night through streets and market places, hungry and distracted. Here and there a voice was lifted up over the general murmur and the grey shadows willingly gathered around it to hear the story of their own need and poverty and to listen to hate inspired attacks upon those who controlled the government.

Conditions became alarming. The authorities saw with anxiety how it began to ferment in the people's mind, but still managed to keep in control of the situation. But they were anxious lest the day would soon come when hunger and need would drive the people out of themselves, and they were frightened lest the slight force of police and troops at the disposal of the city would be unable to hold back a revolution.

They were afraid that the day would come soon, only too soon.

The Impending Revolt

Colonel Becker, Commander of the City Military Forces, sat in his office in the castle and turned over the pages of his journal. He was not satisfied either with the general condition of things nor with the excitement in the city which was in his charge. What could he do, with his twelve hundred men, against the hundred thousand excited devils in men's form who had taken control and got it into their heads that they could only get bread, money, work and happiness by overthrowing the present government. What was he to do, he asked himself with a bitter smile. He could get no increase of troops, he could get together the little body of men who occupied the Castle and fight to the last man to hold it as long as possible. The Prince might withdraw to the innermost rooms and into those Colonel Becker asserted no one should come save over his dead body. A knock on the door was heard and at the Colonel's "Come In" his Adjutant stepped into the room.

The Adjutant's Report

"Is there anything new."

"Only that Lieutenant Jerko and his comrades have come back, Colonel."

"Let them come in."

Lieutenant Jerko and his two comrades had gone out into the city in disguise to find out how the people felt. It was now just darkening and they returned to give their report.

"Lieutenant Jerko," said the Colonel, "I have seen with pleasure that you undertook this little reconnaissance. Tell me now what you have seen."

"It is perfectly clear that the situation is ready to come to a head.

"I rambled over the city today and everywhere felt the general disquiet and threatening atmosphere; there has not as yet been any actual outbreak—it is known that a man was plundered in the open street, that a few shops in the smaller streets had their windows broken in, food was stolen and men went around into the houses and begged in a threatening manner, but there is no great violence ensuing as yet, and even if it were wished for by them, the groups on the market place were all dispersed by the police. It is as if men were wandering around and awaiting final orders to break loose."

One of the Leaders

"If you will give me permission," said one of Jerko's companions, "I can give you the latest news. Today when I stood on a corner and looked over the square I saw a man who went from group to group, stopping a moment with each of them and then going on. When he completed his circuit through the square and went down to the eastern side of the city, I decided to follow him. First it was very easy, there were so many people in the street. But it became more difficult as the man began to reach comparatively empty streets and lanes. He never stopped or realized that he might be followed; at last he stood still and turned around, but as he did this I sprang back into a doorway so that he never saw me. At last the man reached a poor little shop with a sign which announced that there was a cafe there. Here he knocked and at once the door opened. As I stood by his side I nodded to him as if I knew him, and went in before him. He looked somewhat astonished but as the doorkeeper said nothing he thought I was all right and as I was seen entering in known company he made no trouble.

"The place we came into was full of poorly dressed men; the air was full of bad tobacco smoke and of the odor of sour beer. The man I had followed seemed to be at home here and greeted everyone to right or to left and I went along with him and tried to appear to be in his company and I nodded to all that he greeted. He went through the crowd and knocked upon an inner door and disappeared therein, but as I didn't dare to repeat my maneuver, I cast myself down on an empty chair and tried to seem as stolid and uninterested as possible, while with tense attention I listened to the conversation around me.

A Conference of the Leaders

"I couldn't make much out of it; no one seemed to know anything definitely. There, thought I, it is best to wait until something or another happens that can give me some enlightenment.

"After I had waited for about two hours a party of men came out of the inner room. From the dead silence which fell as they emerged, I understood that they were the leaders of the impending revolution and that the crowd were expecting an important announcement. But they went directly through the room and out to the street; only the man I had followed stayed behind. He sprang up on the table, as all crowded around him, and began to speak.

An Interruption and a Letter

"Comrades," said he, "soon the day . . . ." A loud knocking at the door broke off the story. Lieutenant Jerko hurriedly unlocked the door and one of the sentinels stood there. "A letter to the Colonel," he announced. "It was brought down to the guardhouse by a workman who asked that it be taken to you immediately. He said that it referred to the revolution."

The Colonel hurriedly tore the letter open. It was very short. "Revolution is at the door. It can break out any day. The first step will be an attack on the Government Building and this you cannot prevent. But I can take care of everything and I will do so on one condition. No shot must be fired and no man's life must needlessly be put in peril. If you will accept my offer withdraw all sentinels in the city and all the soldiers in the castle and let them be prepared to go out at the critical moment and clear the market place. This they will be able to do in a few minutes without spilling a drop of blood.

"You will recognize the moment the critical time has come."

Signed ILJA ZERNO.

The Exile Returned!

The Colonel stared nonplussed at the name signed to the letter. He could easily remember Iljo Zerno, an accomplished but hot tempered and temperamental man. How could he, the exile, be here in the capital city? What did he mean by saying that he was the only one who could hold up a revolution. Was he in with the leaders? Hardly. Had he men enough to encounter the populace, so that they would understand that a revolution was impossible to carry out, so that each one would go to his own home without a blow? Hardly. Perhaps he had found a frightful weapon—the Colonel remembered that he had been interested in problems of this sort. Perhaps an explosive material that would destroy a whole swarm of men in one blow. But no, that could not be the solution; there in the letter it stood that not one human life was to be needlessly endangered. We must get in touch with Ilja Zerno and get better acquaintance with his plan, and if he was not to be found—then there was nothing to be done but to follow the advice in the letter—assemble the troops in the castle and await the results. If he only knew when the revolution would break out! If he only had time. Suddenly the Colonel remembered that the young Lieutenant had not told the whole of his adventures so he asked:

End of the Lieutenant's Story

"And now what did the man say?"

"Tomorrow at one o'clock the revolution is to break out. . . ."

The next day opened gray and gloomy. The sun was hiding behind thick, dark clouds; the mist hung dark and impenetrable over the roofs of the houses. The red banners which were carried through the streets seemed damp as though they had been dipped in blood.

Red Banners in the Square

Up and down the streets the red banners were borne, the crowds following them grew larger and larger, dark forms emerged from lanes and houses, joining the crowds and swallowed up by them. Weapons which they had hitherto concealed under their garments they no longer took the trouble to hide. They were now strong enough to show their intentions. Like a great deluge the mob swarmed through the streets, shrieking, howling, dragging with them everybody whom they met to show that it was hopeless to stand against their numbers.

The sea of humanity spread over the field of battle—the square before the Castle. If those in advance had the least doubt or fear they could not give an expression; those who were behind forced them on, and what any individual desired counted for nothing. The mass could only be treated as a unity, driven on by those who stood over them, the leaders of the riot.

The Leader's Speech

The square was filled with the cries of the multitude; now the leader appeared. The man who led the people and controlled them, mounted the pedestal of the statue in the square. He spoke and his voice carried over the whole crowd, ex-

(*Continued on page 598*)

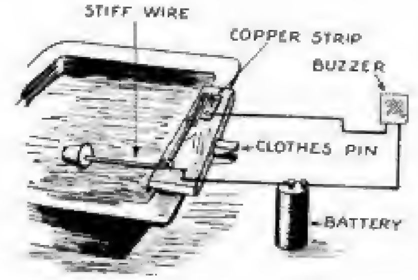
Refrigerator Alarm

THE occupant of the kitchen becomes preoccupied occasionally. As a result, the kitchen floor looks like a reproduction of the flood.

After escorting a flood out of the back door one day I contrived a reminder. It's easy and simple to make and takes about ten minutes to complete.

Get a small piece of wood a little wider than the edge of the drip pan. Cut a slot half the thickness of an ordinary clothespin in the bottom of the wood piece. Take the clothespin apart and mount half of it in the slot with a screw.

Bend a piece of stiff wire as shown, put a cork on the end and fasten down with a couple of carpet tacks.



Place a small piece of copper strip under the other end of the wire so that contact will be established when the float rises.

A simple water alarm adapted for any receptacle which is liable to overflow, such as a refrigerator drip-pan.

Reassemble the clothespin and clamp the outfit to the edge of the drip pan. Run wires from the bell and battery to the copper strip and a carpet tack. Bend the wire so that contact will be made when the water has risen to the danger level.

Contributed by PERRY D. WILSON.

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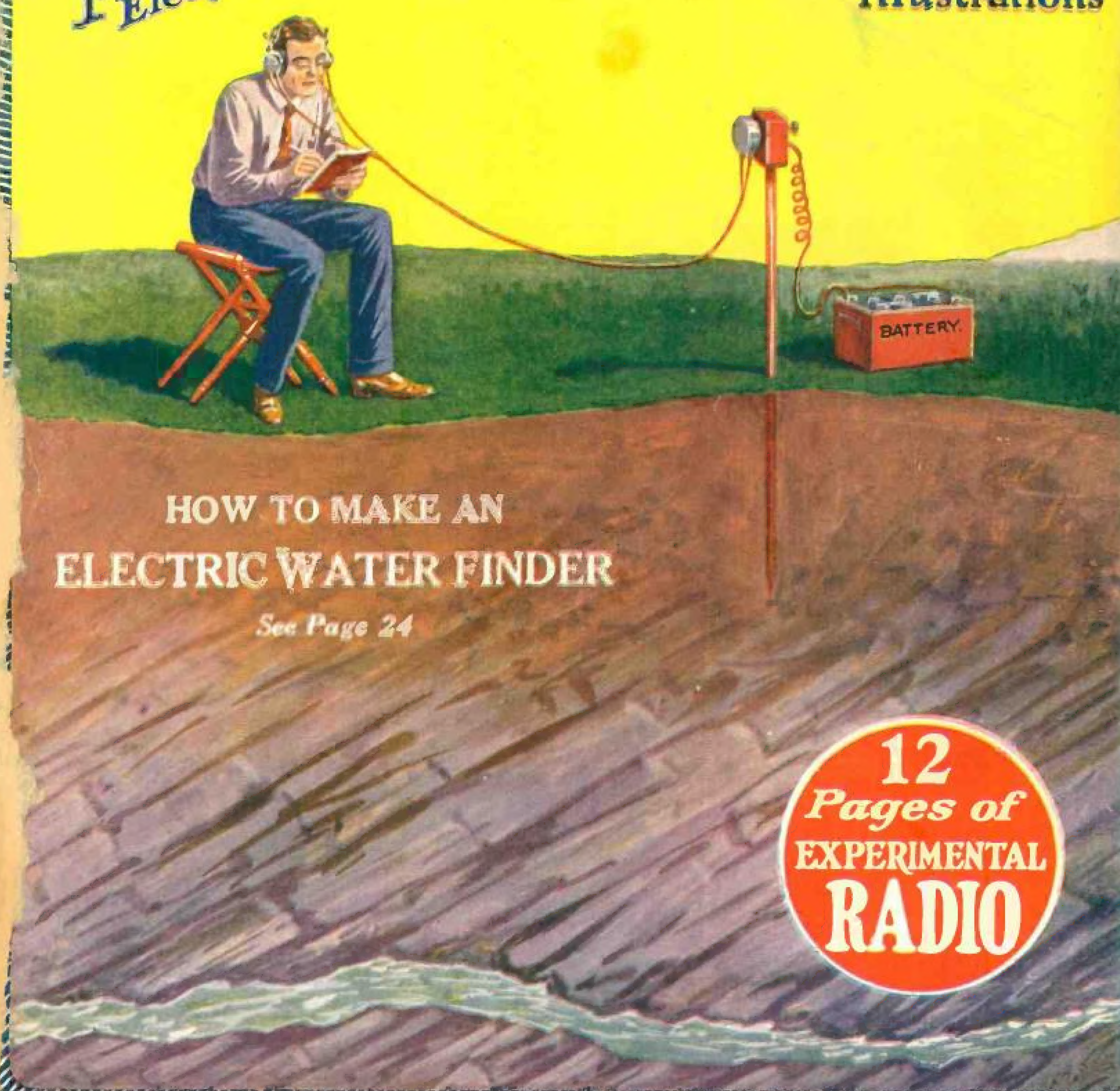
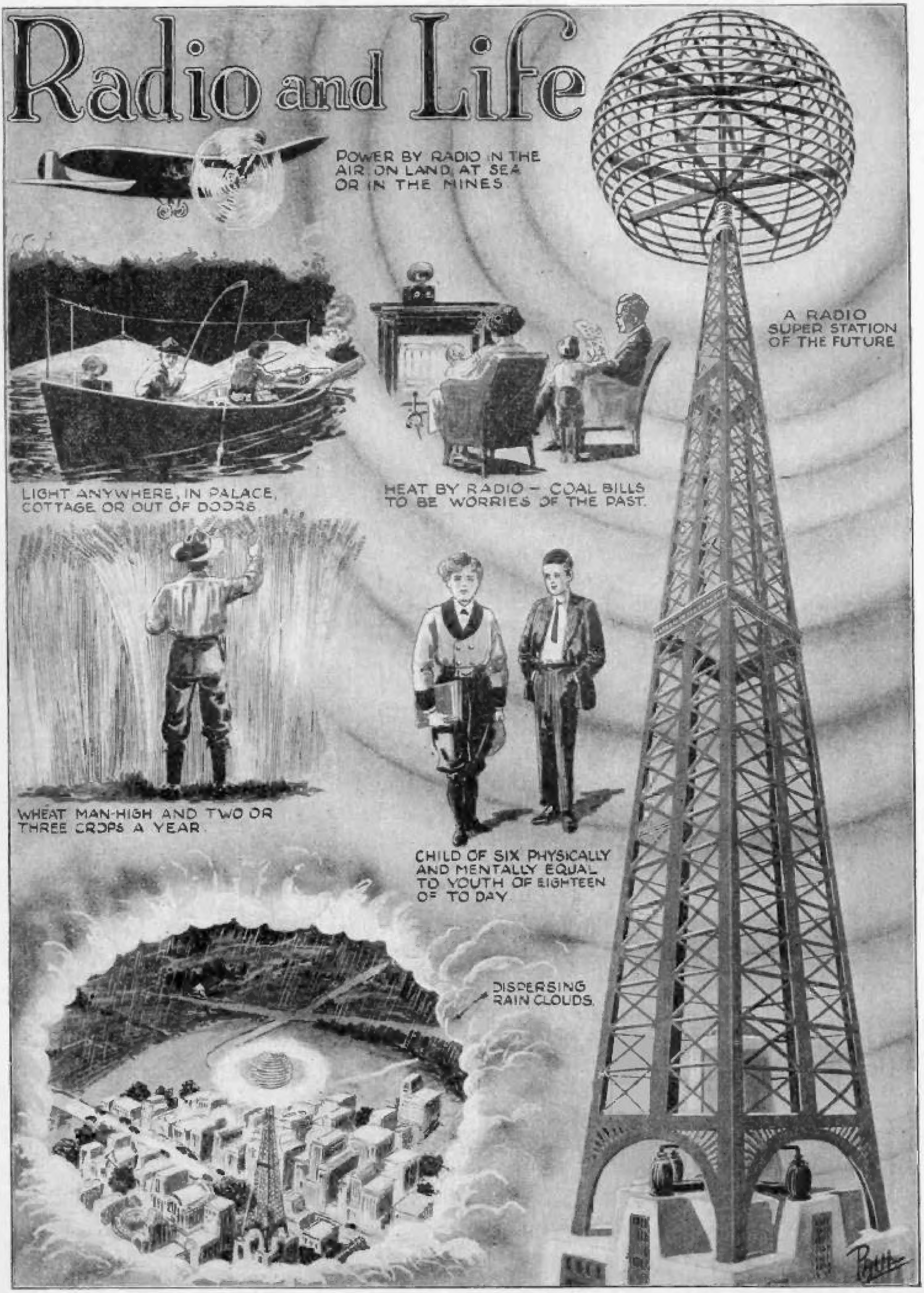


HOW TO MAKE AN ELECTRIC WATER FINDER

See Page 24

12 Pages of EXPERIMENTAL RADIO


Radio and Life
POWER BY RADIO IN THE AIR, ON LAND, AT SEA OR IN THE MINES
A RADIO SUPER STATION OF THE FUTURE
LIGHT ANYWHERE, IN PALACE, COTTAGE OR OUT OF DOORS
HEAT BY RADIO — COAL BILLS TO BE WORRIES OF THE PAST.
WHEAT MAN-HIGH AND TWO OR THREE CROPS A YEAR
CHILD OF SIX PHYSICALLY AND MENTALLY EQUAL TO YOUTH OF EIGHTEEN OF TO DAY
DISPERSING RAIN CLOUDS.

Microphone Used in Water Finding

By C. A. Oldroyd

TO detect underground streams and hidden springs, an Australian scientist made use of very sensitive microphones buried in the ground. (Fig. 1.) A small pit was dug a few feet deep, and a board was placed at the bottom of the pit. A large hole was cut through the wood, and over this hole a sensitive microphone was placed.

To protect the apparatus from the soil, a deep box-lid was placed over the microphone, and the pit was filled up again with soil. Cables from the microphone led to a battery and to a set of head-phones. To locate the hidden springs, the operator listened in at night when there were no external noises.

The sound made by the running water many feet from the ground surface was conducted to the microphone and reproduced very much stronger in the head-phones. By trying several positions of the microphone, a place was soon discovered where the sounds were strongest, and here a well was dug or boring operations begun. A great many springs and underground streams were tapped in this fashion, although these experiments were conducted a long time ago, when instruments were not as sensitive as they are nowadays.

It is rather interesting to compare this system with the methods employed by the Indians to find water; they used to lie down on the ground and apply the ear to the earth, and frequently succeeded in finding water in this fashion.

A very much more sensitive and far easier handled instrument of the writer's design is shown above. A steel rod or tube is driven into the soil for a few feet, and to the top a receiver is attached. Manipulation is much facilitated, as the receiver part is detachable, and can be fitted to a number of rods which have been driven into the soil in advance. Neither can the driving-in upset the adjustment of the delicate microphone, for the receiver is only put in position after the rod has been driven down.

For portable outfits, and where low weight is of importance, a steel tube fitted with a hardened steel spike might be used instead of the solid rod. A sectional view of the receiver is also given.

The body of the receiver consists of a short length of steel tube which easily fits over the rod driven into the soil. About two inches from its bottom, a stop-piece is screwed into the tube, to prevent the receiver tube sliding down the rod.

On the left hand side of the receiver tube a sensitive microphone is attached by a brass strip; between tube and microphone body a rubber disc is clamped to cut off external noises. A small pin just touches the diaphragm of the microphone; this pin is carried in a flat spring secured to the stop piece. The flat spring can be brought nearer the diaphragm or further away from it by an adjusting screw passing through the tube wall.

The operation is exceedingly simple: First of all, the rod is driven into the soil, and the receiver is placed on the top. The microphone is then connected to the battery and the head-telephones and the pin is brought up to the diaphragm, by means of the adjusting screw, until a click is heard in the phones; that means until the pin just touches the diaphragm.

Afterwards, the operator listens in for sounds that might be caused by running underground water.

As the receiver is in metallic connection with the steel rod, the faintest sounds will be transmitted to the microphone, and heard with far greater intensity in the head-phones. Still better results might be obtained if an amplifier is incorporated in the circuit.

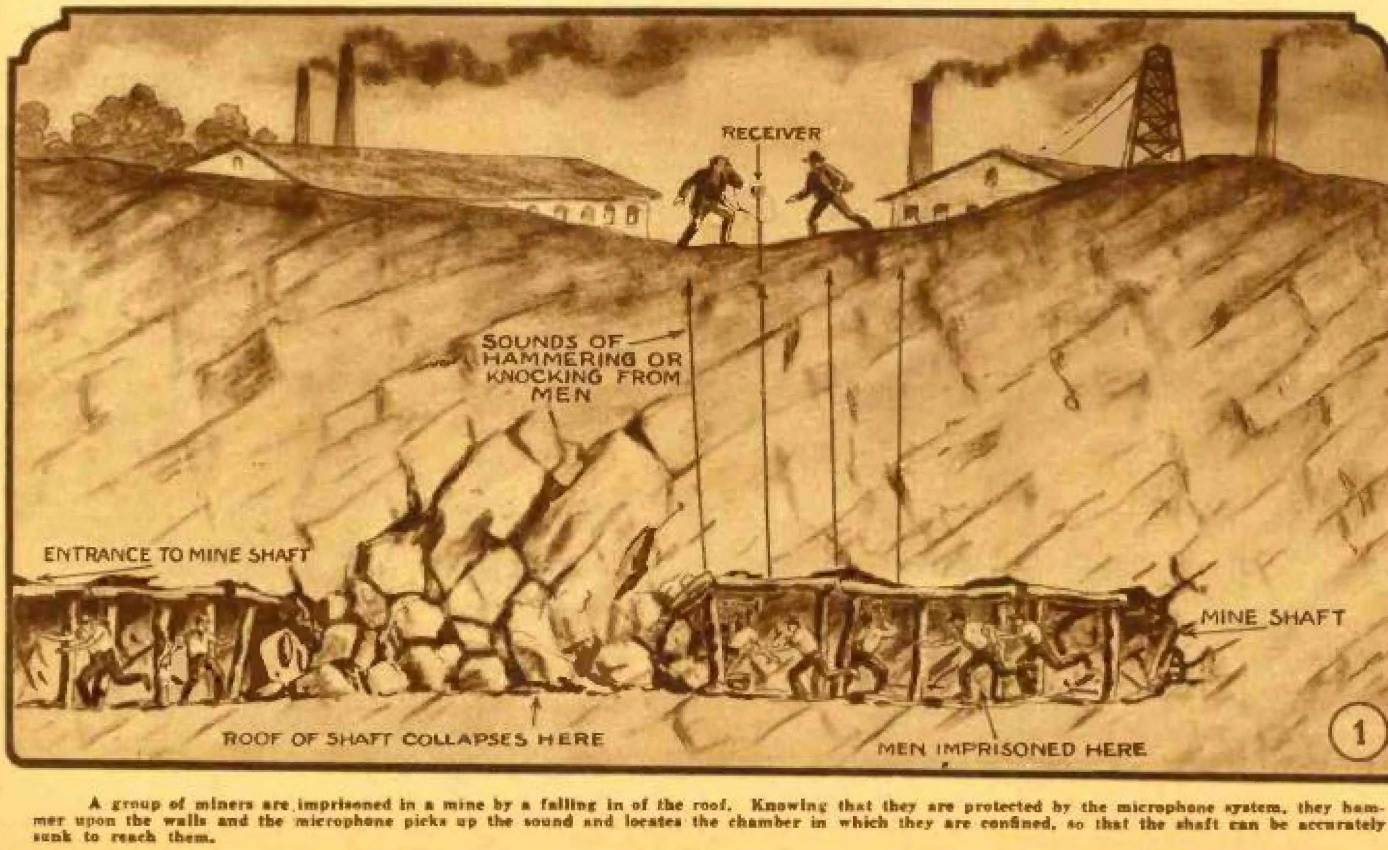
Such an instrument could be readily constructed by the experimenter, and might be used for other purposes besides water finding.

A suggestive example is given. A mine drift, driven close to the surface, has partly collapsed, imprisoning the workers inside. Without any delay, the best possible position for a rescue shaft is to be determined. For this purpose, the receiver is placed in various positions above the drift, and at numerous points the operator will hear the hammering of the imprisoned miners, attempting to signal to their comrades.

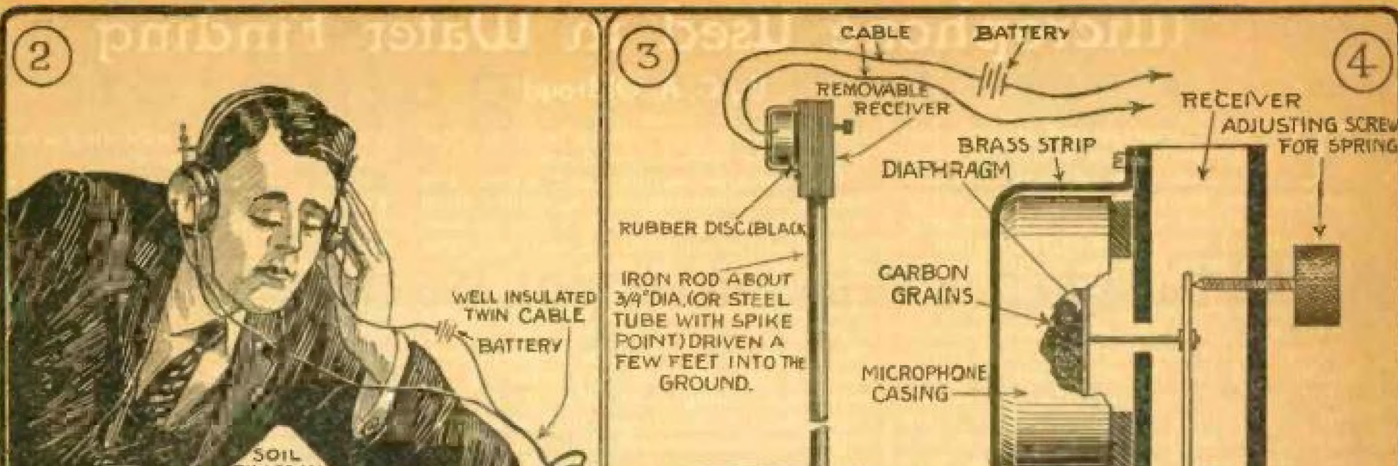
Where the signals are heard loudest, the receiver will be nearest to the imprisoned miners, and here the rescue shaft must be sunk.

If no complete apparatus is handy, a microphone alone might be used, and placed on the ground in various positions. In this manner, a simple rescue apparatus can be improvised in a very short time.

Another application is shown. A buried water pipe line has sunk and been broken, so that the water leaks out. The



A group of miners are imprisoned in a mine by a falling in of the roof. Knowing that they are protected by the microphone system, they hammer upon the walls and the microphone picks up the sound and locates the chamber in which they are confined, so that the shaft can be accurately sunk to reach them.



Water is searched for by a very sensitive microphone and telephone connection. The point is that noise has to be produced to make this method of searching effective, and it is the noise of running water which is relied on. In looking for the pipe leak, Fig. 5, there is also a flow of water. The details of the apparatus are shown in Figs. 3 and 4.

only way to find the position of the leak seems to dig up the whole line until the broken place is reached. With our microphone receiver, however, we can locate the fracture within a few yards. The sound of the escaping water will be heard in the phones, and where the signals appear loudest, the fracture will have occurred in the pipe line just below.

Or with a broken gas pipe concealed in a wall, for instance, the point of fracture may be found with the microphone. In this case the microphone casing is laid on the wall, and moved about until the loudest reception of the noise caused by the escaping gas is found. At that point the wall is demolished, and the fracture will be within a foot or so of the point indicated by the microphone.

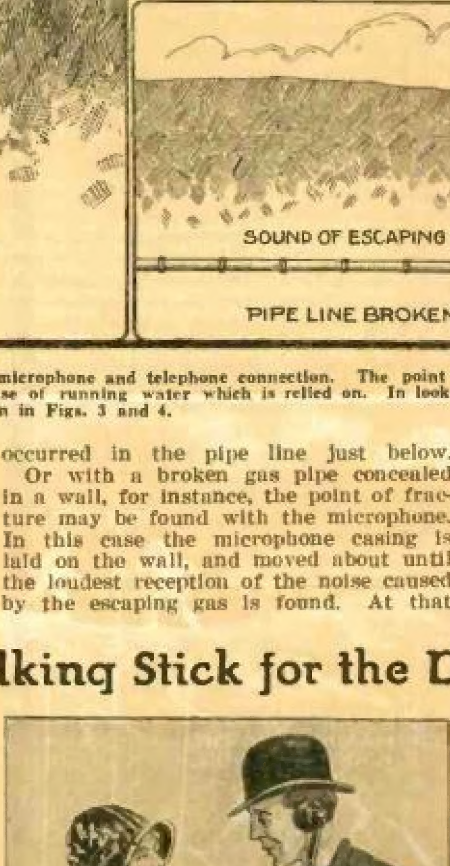
These examples do by no means exhaust the possibilities of the instrument described, and many others may be found by the experimenter who constructs such a receiver.

Walking Stick for the Deaf

THE old-fashioned ear trumpet for the use of the deaf is impossible for use on the streets. The new microphones for the deaf with their division into microphone, resonating plate and battery, are very awkward to carry about. The ear trumpet on a walking stick puts the telephone for the deaf in a better shape and in a form which will be less conspicuous in use.

The microphone is contained in the knob, whose sensitiveness can be adjusted by a little screw accessible from outside. Below the microphone there is a dry cell which is connected as in a pocket flashlight. The battery can be got at by unscrewing the knob along with the upper part of the stick proper.

The screw presses against the contact surface in the knob. The resonating plate is a small, saucer-shaped expansion of the stick. Our author says that the elegant instrument will be desired by many a deaf person on the street.



A convenient form of microphone for the deaf. Within the walking stick everything is contained, including a flashlight battery, so that the user does not have the trouble, or what to some would be the mortification, of carrying a clumsy apparatus about with him.

Many appliances have been devised for assisting the deaf to hear. One of the best known sufferers from the affliction is Thomas A. Edison. He can hardly hear if the words are shouted into his ear. He told the writer recently that he had an apparatus in his laboratory embodying two vacuum tubes with which he could hear a spider walk.

Of course, in the existence of so much idle talk deafness is not altogether an affliction, and the story is that the great inventor has upheld some such theory. But it would never be taken as a matter of choice, and the electricians have done much to improve the fate of the deaf.