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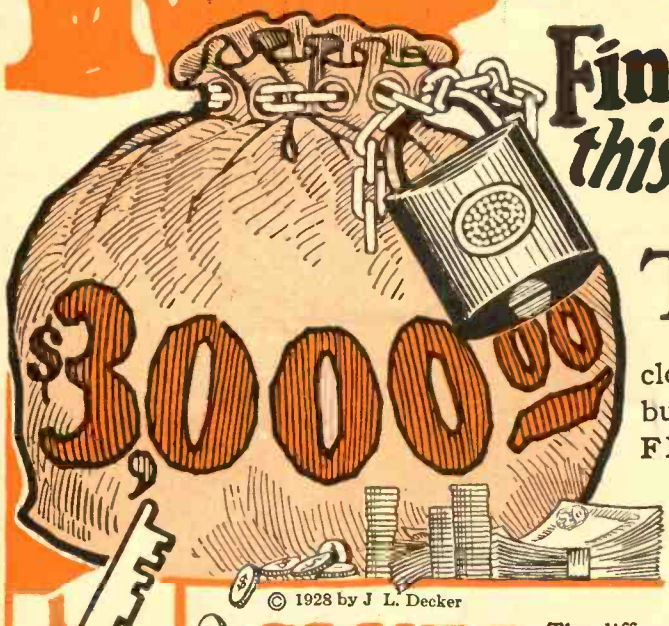

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CLUES

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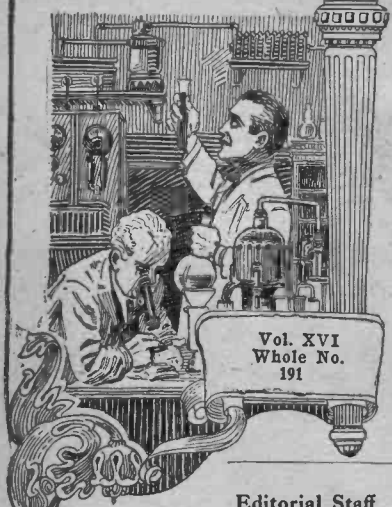

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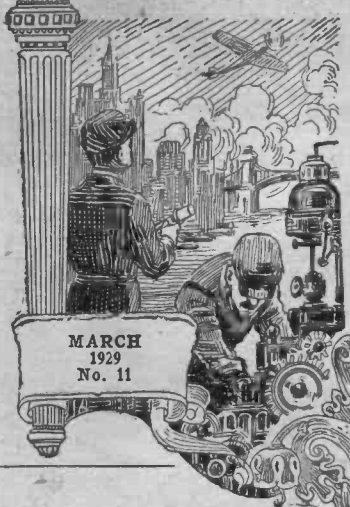

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A new high speed mode of travel through the atmosphere which science predicts will make possible Berlin to New York trip in 26 minutes.

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Roger K. Babson, world famous financial writer and analyzer of American business, tells what you should invent to make money.

Ancient Versus Modern Wonders
A pictorial comparison of the wonders of ancient and modern times.

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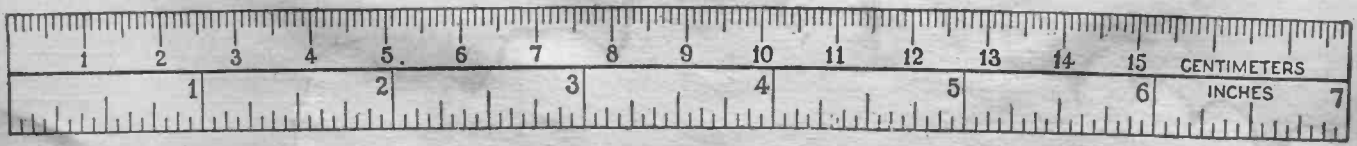

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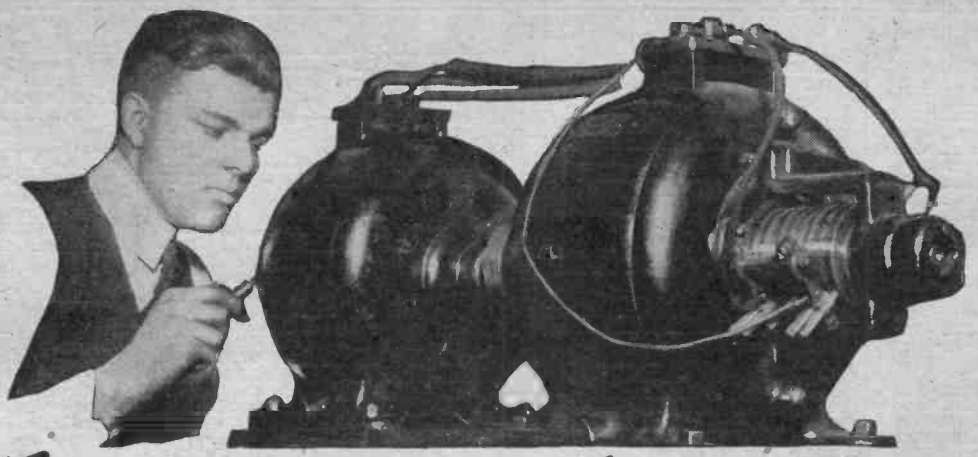

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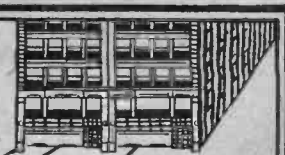

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More Trained Radio Men Needed

A famous Radio expert says there are four good jobs for every man trained to hold them. Radio has grown so fast that it simply has not got the number of trained men it needs. Every year there are hundreds of fine jobs among its many branches such as broadcasting stations, Radio factories, jobbers, dealers, on board ship, commercial land stations, and many others. Many of the six to ten million receiving sets now in use are only 25% to 40% efficient. This has made your big chance for a spare time or full time business of your own selling, installing, repairing sets.

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Many of our students make $10, $20, $30 a week extra while learning. I'll show you the plans and ideas that have proved successful for them—show you how to begin making extra money shortly after you enroll. G. W. Page, 1807-21st Ave., S., Nashville, Tenn., made $935 in his spare time while taking my course.

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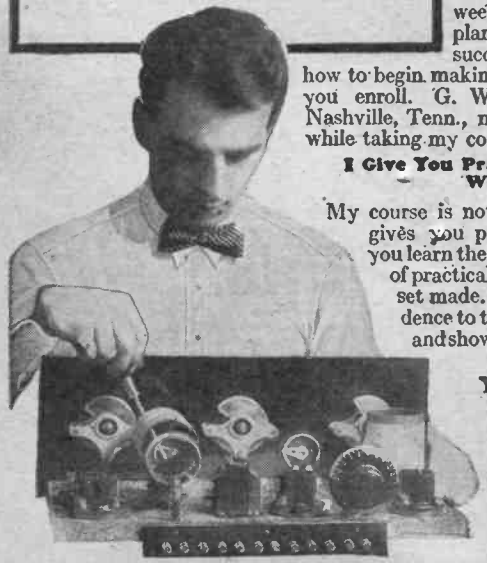

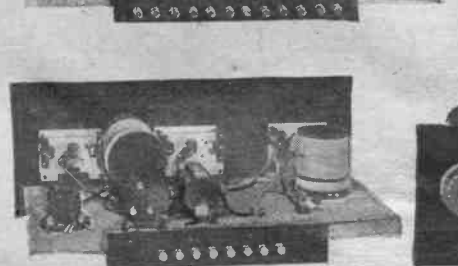

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"Your training has opened things to me that otherwise I would probably be years in acquiring. I now enjoy comforts that before I had to do without. It enabled me to have a wonderful little home, a fine laboratory of my own, and gave me a respected position in one of the foremost textile concerns in the country."
—J. J. Kelly.

"If it weren't for your course I wouldn't have the job I've got now."
—George Daynes.

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even sleight of hand, generally supposed to require long practice, is NOW made simple to learn. For Dr. Harlan Tarbell, one of the really Great Magicians, has finally opened up the secrets of his profession in a completely illustrated course offered at a merely nominal cost. Through the wonderful Tarbell system you will be able to mystify and entertain your friends. After that Dr. Harlan Tarbell takes you through the entire maze of sleight of hand, card tricks and elaborate state divertisements. The apparently superhuman doings of the accomplished magician becomes as simple as ABC.

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Please say you saw it in SCIENCE and INVENTION

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...Raised His Pay $4800* After Reading This Amazing Book Which Is Now FREE!

* Based on the combined experiences of F. B. Englehardt, Chattanooga, Tenn., A. F. Thompson, Sioux City, Iowa, B. F. Boilon, Columbus, Ohio, and many others.

Caught in a Rut

I wonder I put up with it as long as I did! Every day was filled with nothing but deadly routine and monotonous detail. No freedom or independence. No chance to get out and meet people, travel, nor have interesting experiences. I was just like a cog in a big machine with poor prospects of ever being anything more.

Long, Tiresome Hours

Every hour of the day I was under somebody's supervision. The TIME-CLOCK constantly laid in wait for me—a monument to unfulfilled hopes and dying ambition. Four times a day, promptly on the dot, it hurled its silent challenge at my self-respect, reminding me how unimportant I was and how little I really COUNTED in the business and social world!

Low Pay

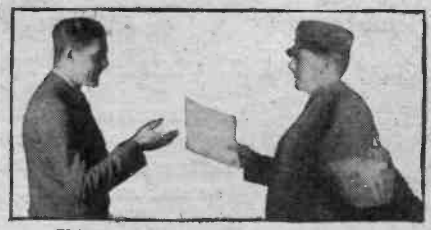
Paid just enough to keep going—but never enough to enjoy any of the GOOD things of life every man DESERVES for his family and himself. Always economizing and pinching pennies. Always wondering what I would do if I were laid off or lost my job. Always uncertain and apprehensive of the future.

Desperate

Happened to get a look at the payroll one day and was astonished to see what big salaries went to the sales force. Found that salesman Brown made $200 a week—and Jenkins $275! Would have given my right arm to make money that fast, but never dreamed I had any "gift" for salesmanship.

A Ray of Light

Stumbled across an article on salesmanship in a magazine that evening. Was surprised to discover that salesmen were made and not "born" as I had foolishly believed. Read about a former cowpuncher, Wm. Shore of California, making $525 in one week after learning the ins-and-outs of scientific salesmanship. Decided that if HE could do it, so could I!

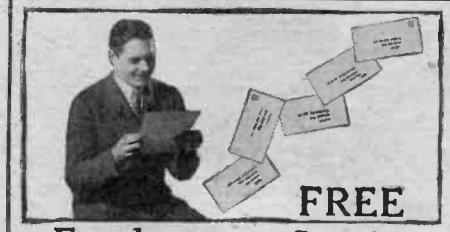


The Turning Point

My first step was to write for a certain little book which a famous business genius has called "The MOST AMAZING BOOK EVER PRINTED". It wasn't a very *big* book, but it certainly opened my eyes to things I had never *dreamed* of—and proved the turning point of my entire career!

What I Discovered

Between the pages of this remarkable volume, I discovered hundreds of little known facts and secrets that revealed the REAL TRUTH about the science of selling! It wasn't a bit as I had imagined. I found out that it was governed by simple rules and laws that almost ANY man can master as easily as he learned the alphabet. I even learned how to go about getting into this "highest paid of all professions". I found out exactly how Mark Barichievich of San Francisco was enabled to quit his $8 a week job as a restaurant-worker and start making $125 a week as a salesman; and how C. W. Birmingham of Dayton, Ohio, jumped from $15 a week to $7500 a year—these and *hundreds* of others! It certainly *was* a revelation!



Employment Service

Furthermore, I discovered that the National Salesmen's Training Association, which published the book, also operates a most effective employment service! Last year they received requests from all over the U. S. and Canada for more than 50,000 salesmen trained by their method. This service is FREE to both members and employers and thousands have secured positions this way!

Making Good At Last!

It didn't take me long to decide to cast my lot with N. S. T. A.—and after a few weeks I had mastered the secrets of Modern Salesmanship during spare time, without losing a day or a dollar from my old job. When I was ready, Mr. Greenslade (the president) found me over a dozen good openings to choose from—and I selected one which paid me over $70 a week to start!

Was It Worth It?

Today my salary is $4800 greater than ever before! No more punching time-clocks or worrying over dimes and quarters! NOW my services are in REAL DEMAND with bigger prospects for the future than I ever dared HOPE for back in those days when I was just another "name" on a pay-roll!

Get Your Copy Free

Right now the book—"Modern Salesmanship"—which banished all my fears and troubles and showed me how to get started on the road to success and independence—will be mailed as a gift to any ambitious man, absolutely FREE. And since there is no obligation, why not see for yourself what amazing facts it contains! Just mail the coupon now—for there is no better way in the world to invest a 2-cent stamp! I KNOW!

Mail It Today!

Simply fill this out and mail to the National Salesmen's Training Association, Dept. C-301, N. S. T. A. Bldg., Chicago, Ill. Your free copy of "Modern Salesmanship" will be sent you by return mail.

National Salesmen's Training Assn., Dept. C-301
N. S. T. A. Building, Chicago, Illinois
Without obligation, please send me a free copy of "Modern Salesmanship."

Name .....
Address .....
Town ..... State .....
Age ..... Occupation .....

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H. Winfield Secor, *Managing Editor* Hugo Gernsback, *Editor-in-Chief* Dr. T. O'Conor Sloane, Ph.D., *Associate Editor*

Volume XVI. Whole No. 191. March, 1929. Number 11.

Editorial

"Those Who Refuse to Go Beyond Fact Rarely Get as Far as Fact" - - HUXLEY

SCIENTIFIC HOBBIES

By Hugo Gernsback

DOCTORS and psychologists are all agreed that modern man requires some form of hobby. Our present mode of fast living, with the tremendous wear and tear and fatigue connected with it and our expenditure of nervous energy, requires that we reduce the daily grind and do something for a pastime.

Of course, not all men are constituted alike. Some take their recreation in athletics, others in sports, others in reading, and we might go on in an unending list.

It may be said that the white-collar workers, professional men and all those working in offices, require some sort of physical outlet for their surplus energies, which, otherwise become stagnant. While sports in general may fill this bill, not every one is inclined in this direction and an increasing army of men and women now take up some form of a scientific hobby, in order to create an outlet for their surplus energy, and so keep fit.

This was demonstrated vividly when the radio boom came along some years ago, and when seemingly everyone—bankers, bishops and business men, took to constructing radio sets. I know of two bankers who have built over six radio sets in the past few years, doing creditable work in the construction, and most of the sets serve a good purpose to-day.

Other individuals take to the building of all sorts of home appliances and furniture, such as bookcases, tables and other utility furniture, and inasmuch as the material cost usually is inconsiderable, these constructors usually get the best materials and as they presumably are endowed with some mechanical ability, they generally turn out a most creditable job, that in more cases than one is far above the grade of the ready-made articles that could be purchased.

Right now, we witness the craze of a vast number of people who are turning their ingenuity and efforts toward constructing the so-called new modern art furniture. Here, if ever, is a case where an individual can let loose his imagination and build the weirdest and oddest looking piece of furniture to surprise his friends. A few days ago, I saw a bookcase constructed in the form of a skyscraper, which looks as if it might have been bought at one of the most exclusive shops. Yet, the owner, a wealthy broker, had fashioned it entirely himself, in his cellar workshop, and had decorated it in gray, blue and gold. It was a fantastic looking piece of work, but artistic with all its startling effect, and it did credit to his suburban home.

The same thing is going on all over the country. The work is, of course, not confined to wood alone, as other individuals are taking to metals and turning out original and artistic pieces, such as modern andirons, clothes hangers, coat racks, ash trays, serving tables and many others, as the urge and necessity for certain pieces of furniture and art work dictate. And the curious part is, that no sooner have these constructors turned out a creditable piece, than their friends immediately want to know where it can be gotten and often the original constructor, just for the fun of it, will make a similar article for one of his friends.

Then, of course, we have the man who takes pride in his laboratory. I know of a high politician who has a very complete chemical laboratory which he shows with pride to his friends. He has become so adept in chemistry, that he has been able to analyze almost anything and is even going in for fractional distillation.

A big and well-known business man with large and varied interests has a complete machine shop in the basement of his house, where he turns out almost anything in metal, and builds small models and other machinery for his edification. If you saw him in his Fifth Avenue office, you would never recognize the same man with overalls, bespattered with oil, when you visit him during one of his free evenings.

Still others now take strongly to astronomy and construct their own telescopes and build their own modest observatories on top of their homes and in the back yards. Then, of course, there is the man with the photographic hobby, who has every conceivable photographic camera and motion picture machine that you could think of. He would not trust anyone with developing his films, so he does all the work himself. He does his own enlarging, his own toning, his own mounting and cutting and his own color work, and while his fingers may be stained perpetually from chemicals, it keeps his mind off his business and employs his mind with an entirely different line of endeavor.

Space forbids listing all of the scientific hobbies that could be enumerated. The list is endless and is growing steadily.

Mr. Hugo Gernsback speaks every Tuesday at 9.30 P. M. from Stations WRN Y (297 meters) and W2XAL (30.91 meters) on various scientific subjects.

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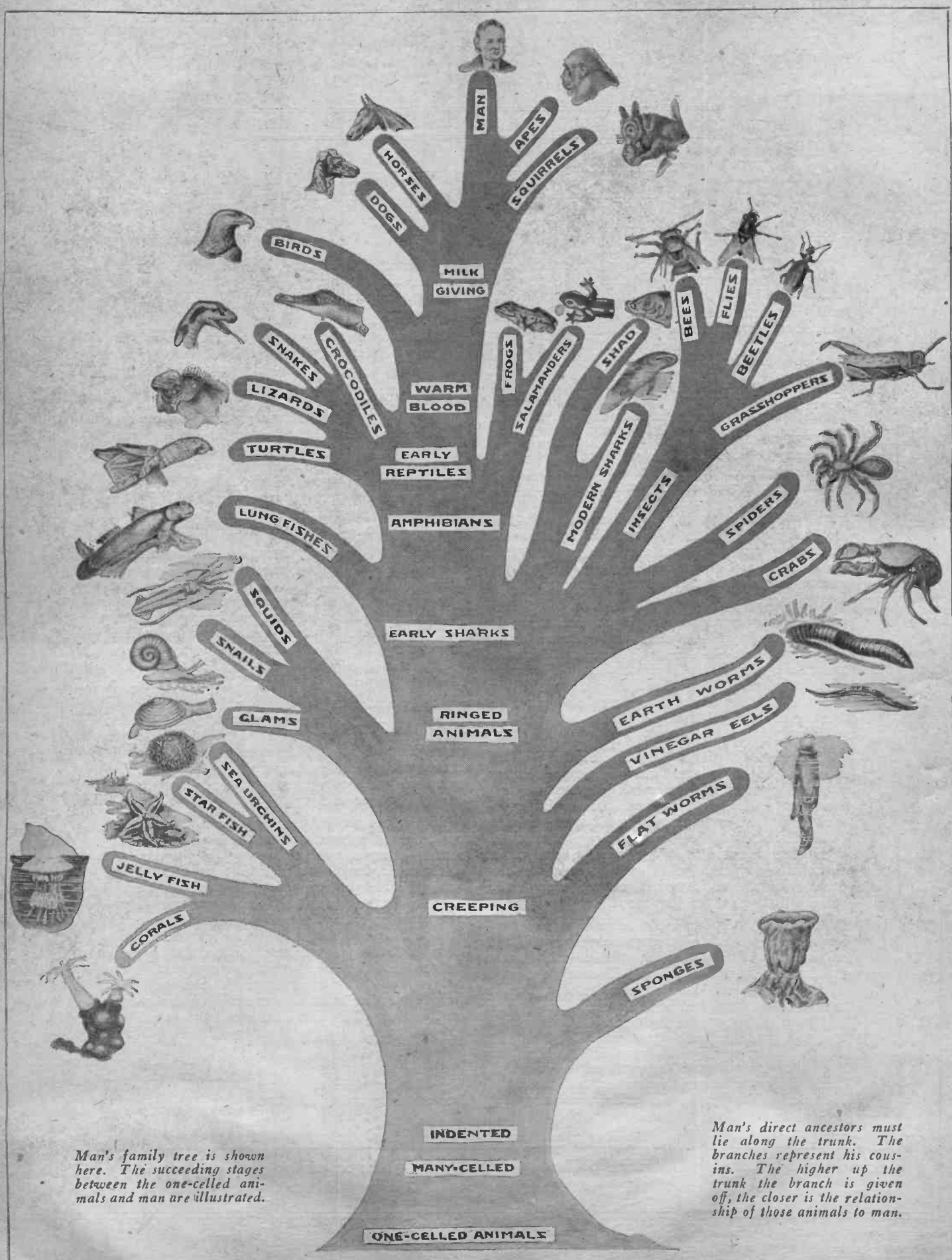
The Evolutionary Tree of Man



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.

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The Story of Man's Ancestry

SAMUEL C. SCHMUCKER, Ph.D., Sc.D., Emeritus Professor of Biology at State Teachers College, West Chester, Pennsylvania, is the author of this, the first of a series of popular articles on evolution. The author has devoted much of his time to the study of man's beginning, which makes the article authoritative and scientifically correct. The subject is treated in such a manner as to be readily comprehended by the lay reader. Biological and medical terminology has been dispensed with wherever possible and we feel sure that our readers will find much of interest in this article, both from an educative and scientific standpoint. The theory of evolution is coming to the attention of the public more and more, and we believe a new treatment of the subject is timely.

Dr. Samuel C. Schmucker, Ph.D., Sc.D.

First of a Series of Articles on Evolution

THE ORIGIN OF MAN

IN speaking of a man newly attracting public attention, we are likely to place him by saying he is so-and-so's son. Few of us are interested to go back of that.

So when we talk about the ancestry of mankind, most of us go back only one step. We talk earnestly or heatedly or scornfully of the possibility of man's being "descended from a monkey." But what did the monkey descend from? If there is anything in evolution, man's ancestry runs back to creatures so lowly that the ape (who, though not our ancestor, is certainly our nearest cousin) seems almost a twin to man, beside these humble beginnings.

Some time ago I took my family to the mountains. There we spent the summer, living in a strange mixture of the simplicity of the savage and the sophistication of modern life.

One day our party walked to the top of a mountain. We found an old log cabin. When the children playing before the door saw us, they ran into the house and peeped shyly out of the corners of the windows. A grandmother came to the door. She told us she had not been off the mountain for many years. These people lived largely on what they themselves produced. On the floor lay deer skins for rugs. The chairs were home-made and seated with woven hickory splints. The source of heat for warmth and cooking was a wood fire in a big open fireplace. Above the chimney jamb hung the rifle, which furnished most of their meat. Here was a corner of colonial America.

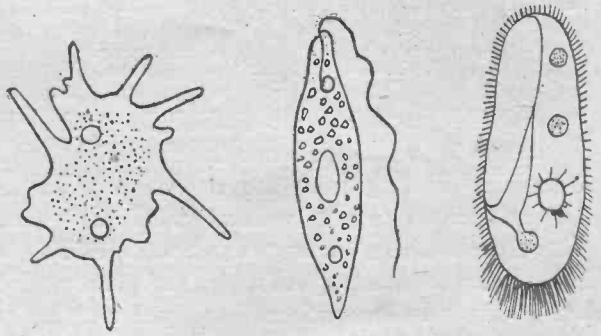

Fig. 1.—The simplest present-day animals, doubtless much like man's earliest ancestors, are shown above.

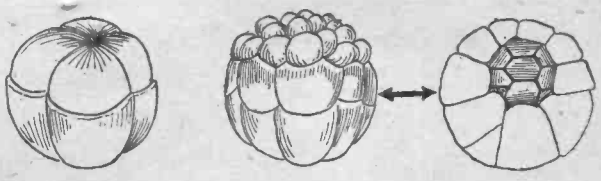

Fig. 2.—Two steps in the development of an individual higher animal from the egg are illustrated above. Line illustrations by Mrs. S. C. Schmucker.

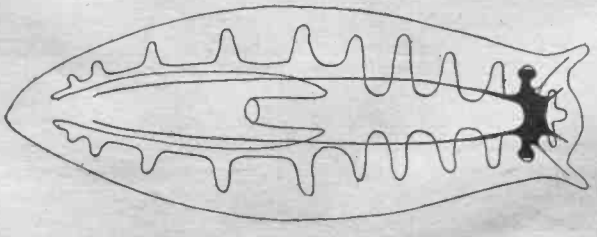

Fig. 3.—A flat worm shown above is a lowly water animal, but it represents a stage in the evolutionary process, to which we owe a great deal.

Now the biologist believes just that has happened in the animal world. Every pool of standing water swarms with very simple animals. The scientist believes these can tell him more than he can otherwise hope to find concerning his earliest and simplest animal ancestors. His line has gone on developing. These backward cousins have stayed almost where they were.

Our safest, while not our liveliest, evidence as to our human ancestry is furnished by the fossils found in the rocks. They consist often only of shells or scales or teeth. At best, they are little more than skeletons. These can only be built up by our imagination from the study of living animals which correspond to them most nearly in the parts we find.

When we get halfway back through the geological history, the rocks in which these fossils are found have been so altered by heating and bending that much of the evidence of life in them is very hard to interpret. I doubt not we will learn more in the next twenty-five years, in these matters, than we have in the last seventy-five. If we do, the whole general line of man's ancestry will be pretty certainly outlined and the last half of it reasonably well known.

OF course the biggest problem, and as yet the one with the

(*Continued on next page*)

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least satisfactory conclusion is "How did life begin?" We find no life originating to-day, by studying which we might hope to answer our question. Hence, the best we can do is to surmise "how it must have happened." This leaves so much to the personal bias of the scientist as to furnish, at least so far, little more than a guess.

Let us then start with simple life and try to tell the story as nearly as we can, tracing the course that seems most likely to the largest number of scientists. The first half of it may be much altered as the result of later discovery. The second half is fairly well worked out.

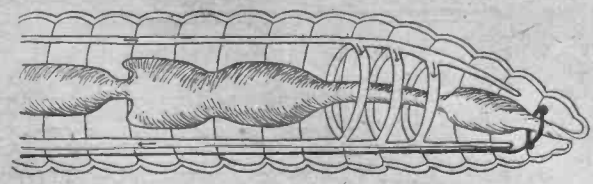


Fig. 4.—Above is the forward part of an earthworm with one side removed, showing the food canal, ring brain, nerve cord and blood vessels.

The simplest animals all live in the water. They are all microscopic in size. (See Fig. 1.) A period on this page would be enormously big for most of them. They are made of the one living material with which we are acquainted, a gelatinous, spongy substance called protoplasm. Each small mass of this material has about it a somewhat denser outer skin, and near its center, a firmer "nucleus." This is already so organized as to make it sure we are here not any too near the "beginning."

From these lowly creatures we have inherited the basis of all our powers. These have become much developed and specialized, but the beginnings are here.

If we take one of the simplest of them, the Amoeba, (Fig. 1, left) we find it has the power to project, at any point of its body, a dull lobe into which the rest flows, and it is in the new place. It possesses the power of self-guided locomotion. If it pushes against a pointed sliver of glass, it draws back. It has sensation. It engulfs a minute plant cell, which slowly dissolves inside of it. It has the power of digestion. It takes in oxygen through its skin. It has the power of respiration. From its outside, it also throws off its wastes. After a while its nucleus divides in two, and then the cell also divides, each part taking half of the nucleus. The mother cell has become two daughter cells, each of which will grow to full size and again divide. Here is reproduction and inheritance. It seems incredible that all these powers should reside in so small a piece of protoplasm. Here surely is something closely like the basis of all animal life. Here we are looking upon our most distant cousin, who has not left off the early ancestral form and habit.

Fig. 2. The first step up our ancestors took was when they ceased this utterly isolated, terribly individualistic life, and began the habit of co-operation. When the cell had divided into two, these did not separate, but remaining in a cluster, again divided! Thus the colony, instead of the individual, became the unit though each cell still did what all the rest did.

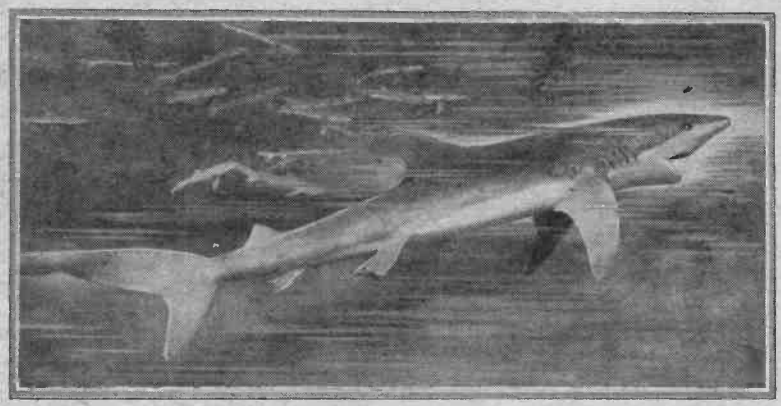
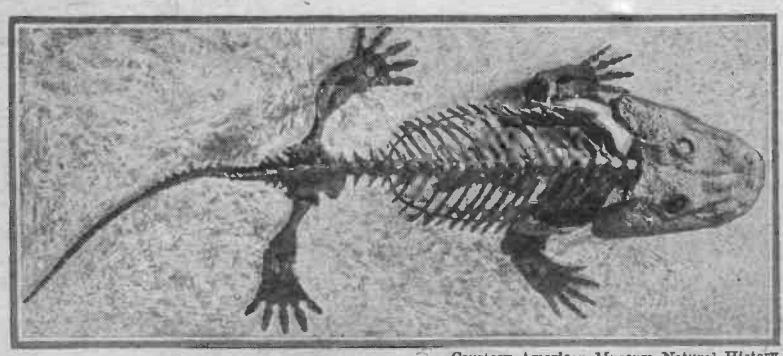


Fig. 5.—The shark laid down the plan for much higher followers. Photos on this and facing page courtesy of the American Museum of Natural History.

Science and Invention Evolution Series

SCIENCE AND INVENTION Magazine is presenting with this issue the first of a series of articles dealing with the evolution of man. Eminent scientists well versed in this field will write these articles for our readers. We believe that we are the first publication to present the theory of evolution written in popular style by eminent experts.



Courtesy American Museum Natural History.

Fig. 6.—A coal age ancestor whose skeleton leaves little to add, but much to alter. This early ancestor was known as Eryops.

After a while a further step came in. The number of cells grew so steadily that some ran the risk of being buried by the others, and thus failing to get a proper supply of oxygen and food. So each cell moved to the outside and the colony became a hollow ball of perhaps a hundred co-operating cells. (Fig. 2, center and left.)

Now came another critical change. The upper half of such a hollow ball divided more quickly and grew faster than the lower. Then the lower half became indented and sunk against the upper. The colony of one-celled animals has now become a many-celled individual animal. Its outside layer provides it with motion and feeling. Its inside layer digests and breathes and throws off wastes. This is the beginning of that division of labor that is carried so far in higher forms. This indented ball is still found as an early stage in the development of all higher animals from the egg to the adult, and is known as the goblet or gastrula stage.

THREE lines of later development depended on the behavior of various animals at this stage. When one set of gastrulas settled mouth down, they closed their hope of advance and their descendants have become the sponges. These are not in the line of our ancestry.

Others settled down mouth up and have given rise to the corals and their kin.

Our ancestors, instead of settling, learned to move, mouth down. At first perhaps, being round, they moved in any direction. But soon they learned to keep one end forward. This gave a new form to the body. It is to this ancestor that we owe our under (now front) side different from our upper (now back). This came because the under and upper sides had a different experience and each became fitted to its own condition. The end that went forward grew far more experienced than the rear end and it became the most highly developed end, particularly in the increase of

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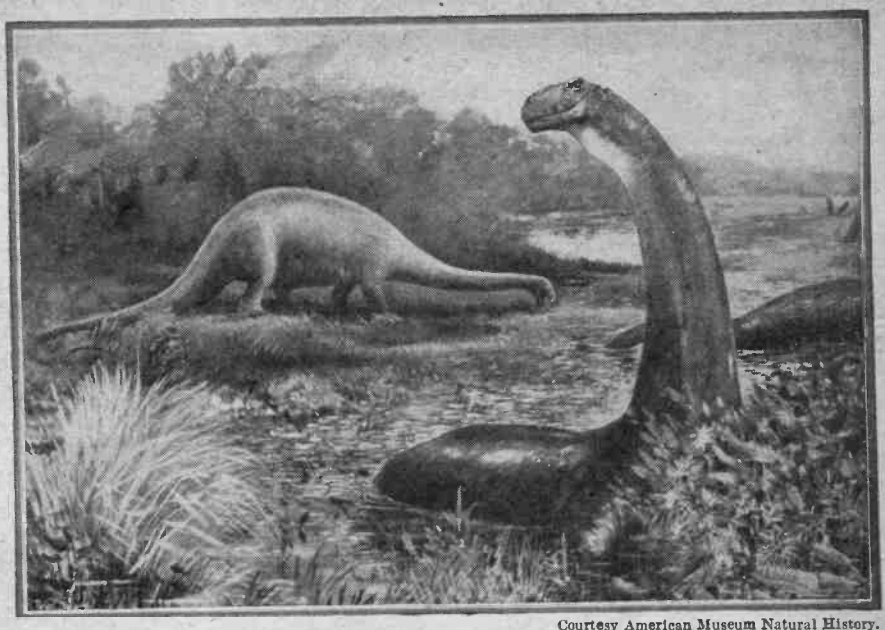
its sensitiveness. The right and left sides, getting similar experiences grew alike.

The present day representative of this stage is the flat worm. It is a creature half an inch or a little more in length (Fig. 3). It is found on the underside of floating wood in streams and ponds, and in the vegetation at the bottom of the water. Its mouth is near the middle of the underside and it mumbles off vegetable scum from the surfaces over which it is moving. It has nerve knots in its head, and has two projections that can be pushed forward and act as feelers. It also has two dark spots one on each half of its brain. These are sensitive to light, though it has no true eyes.



Courtesy American Museum Natural History.

Fig. 7.—Above is a reptile, the Dinosaur, who lived when reptiles ruled and there were doubtlessly no other higher animals.

A DISTINCTLY higher stage arrives when we get to the sort of creature known most familiarly as the common earth worm. (See Fig. 4). The body is built as if a series of spools had been strung together. This structure shows in rings marking the outside. It is really as if an animal had reproduced copy after copy of itself, until there was a colony of individuals in a line, as is truly the case in a tape worm. Then the colony becomes a new individual of a higher order by the parts staying together, and the front ones becoming specialized much beyond the rest. Such an animal is said to be segmented. While we show no rings on the outside, and the various regions of our bodies have grown to be widely different, the branching nerves, as well as the pieces of the backbone and the ribs show that we are segmented. But our ringed worm ancestor gave us much beside. The mouth on the underside disappeared. A new mouth broke in from the head end, and a rectum from the back. The food canal became much specialized in parts. Blood vessels appear for the first time and the pulsating part of several of these serve as hearts to drive the blood throughout the body. A complicated nerve collar becomes the brain.

Courtesy American Museum Natural History.

Fig. 8.—Above is an early mammal not yet hoofed, or flesh-eating, or gnawing, but on the way. This is known as the Phenacodus.

There is quite a diversity of opinion as to how this lowly ringed creature got its rod of gristle that finally broke up into a backbone. How the nerve chord, which in the worm is on the underside, got to the upper side is even more difficult to realize. The whole question is complicated, technical and uncertain as yet.

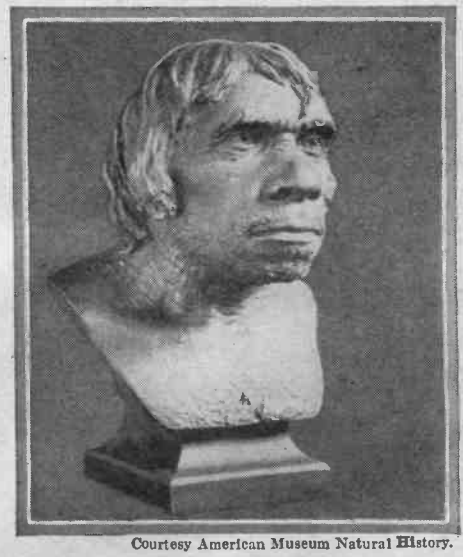
ONCE we reach the fishes, the line is quite reasonably clear in its general course, though many details remain to be worked out. Here however we have much clearer evidence and there is consequently a closer agreement amongst biologists.

With the sharks, we gain many new features. (See Fig. 5.) One of the finest is a backbone, giving strength and suppleness, permitting rapid motion which is much helped by four paddles. This skeleton also covers the brain which is becoming complicated and delicate. This framework runs out also into the limbs giving them a new kind of leverage. One big pulsating pump drives the blood to the gills, where it gets its oxygen. Then it passes over the body from which it flows back to the heart. This path is a simple, single round. In the shark the eyes and the nostrils, used only for smell not breathing, are laid down. There is an organ of balance there too which may hear a little at its upper end though this is quite uncertain. Later it becomes the ear.

Then came another wonderful change. A sort of bladder in most fishes helps in floating them. In South America and in Australia, we find what are known as lung fishes. These live in swamps during the rainy season. When the hot season comes, they lie in cavities in the dried mud. They keep from suffocating by swallowing air, passing it into this swim bladder and there giving oxygen to the blood. Our ancestors who learned this trick lived in the period before the coal was laid down (the Devonian).

Previous to this all vegetation so far as we can tell had been beneath the surface of the water. Now land plants appear. In the next period they flourish and the forests of the coal swamps spread far and wide. In these our backboned ancestors first came out on land. Some of them had lines of bones in their fins and on these they supported themselves. A few of these lines developed into the bones of our limbs.

Our skeleton is now complete, though the details will be modified with later growth. Almost every bone in our bodies has its counterpart in the skeleton of this early ancestor known as Eryops (Fig. 6). (*Continued on page* 1088)



Courtesy American Museum Natural History.

Fig. 9.—The head of one of our prehistoric ancestors, known as the Neanderthal Man, is shown above.

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Animal Facts Stranger

Many strange stories are told about animals.

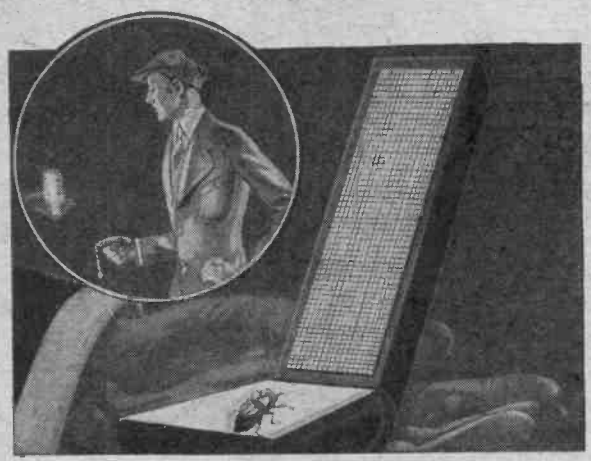
Facts frequently surpass myths from point of strangeness.

IT seems curious that the really astonishing things in Nature have not crowded some of the fallacies to the wall. Yet we hear more of the myths than of strange facts.

There is a flying snake; fishes that climb trees; fishes that squirt drops of water at insects like shooting an air gun and knock them off leaves so they can pick them up in the water; fish that deal dangerous electric shocks; frogs so big they can swallow a rat; tiny frogs with a voice so penerating they are actually a thousand times stronger, vocally, in proportion to their size, than a man; small creatures that knew all about smoke screens and gas attacks ages before man dreamed of such things; ants that understand the science of running a dairy; insects that humans use for flashlamps; animals that run sixty miles an hour; birds that can fly even faster; insects which are still fleeter; animals which practically never lie down, but sleep on their feet; others which always walk upside-down; big animals, with rumbling voices, which roll along the ground for miles; and others, large and majestic types which are absolutely dumb. All of this may sound like the ravings of a disturbed mind, but let us review the list and substantiate every case.

Flying Snake

AS for the flying snake, this creature lives in the East Indies. It is strictly arboreal and an adult specimen is about two feet long. Its favorite roost is a high, horizontal branch, protruding from one of those mammoth trees that rise above the general tangle of the jungle. Here it lies in wait for scampering lizards, which form its prey. The lizards are fleet, restless things. They can run so fast they look like a streak. When insects are scarce on certain trees, the lizards scamper down the great trunk and go to another tree. This would be a long and arduous journey for the snake. It must find spiral vines for a staircase, and these may be alive with fire ants. There is an easier way for this particular kind of snake. It flattens its body by moving forward its hundred or more pairs of delicate, curved ribs. As much depressed as if it had been rolled out under a giant wheel, it slides off the branch. An observer seeing the thing might think that some extremely elongated, sword-like leaf of a curious tree had broken off and gone scaling into the air. The glide brings the serpent soaring into branches a goodly distance away, to again ascend and seek good hunting grounds.



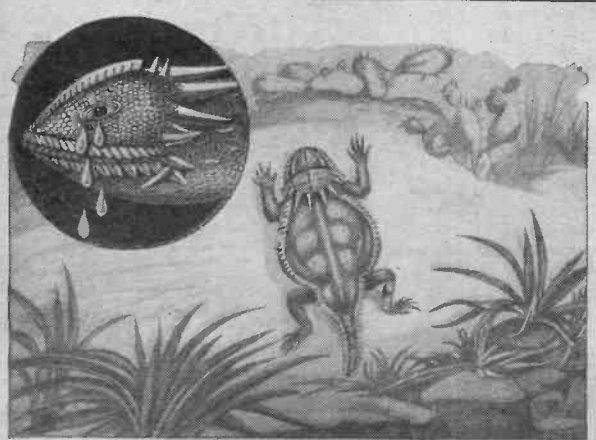
Nature's flashlights are different than those we employ. A box containing a bug, when tapped will brilliantly illuminate the face of a watch, even if the insect is held a foot away.

SEVERAL months ago, the writer gave a broadcast talk from WRNY on "Animal Myths." As a number of people appeared to be much interested, the subject was more extensively covered in an article which I prepared for SCIENCE AND INVENTION. That article gave me a lot of work. Not in the preparation, but the answering of queries and letters of objection to my classing of several long-standing stories as myths. It was interesting, however, to note the varied points of view. There is no doubt that many correspondents were satisfied with the explanations made to clarify their observations; and some dissatisfied, in criticisms of stories that have been handed down through several human generations and cherished as pet traditions.

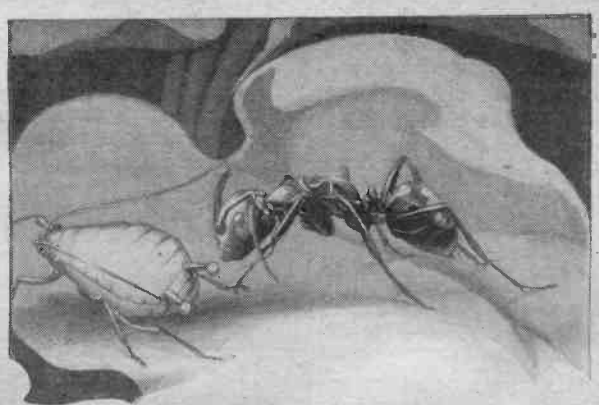
The object of this article is to note a number of remarkable things that have been proven from every angle—and most of them personally observed by the writer.

Climbing Fish and Archer Fish

INDIA and the East Indies furnish a number of freakish creatures. I mentioned a climbing fish, of which there are actually several species. The fins at the breast are strong and stiffened and alter-



It has been claimed that the horned toad can be sealed up, and made to survive in air-tight pockets in a rock. This story always makes a hit; there are really very few who know that these animals eject quite copious jets of blood from their eyes at intruders.



Aphids have been called ant's cows. These small creatures eject sweet fluids of which ants are very fond. For that reason they are milked by the ants and are herded by them on delicate green branches. When their feeding ground becomes poor, they are transferred to others.

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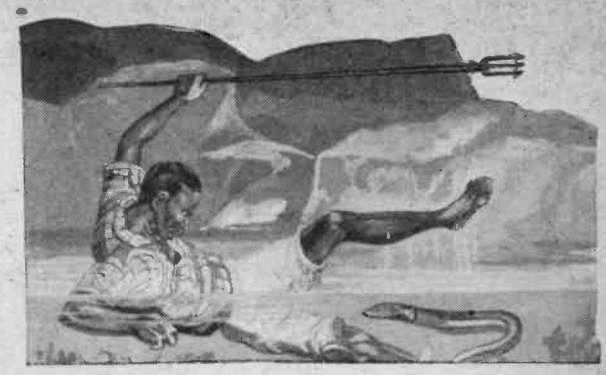
Than Myths

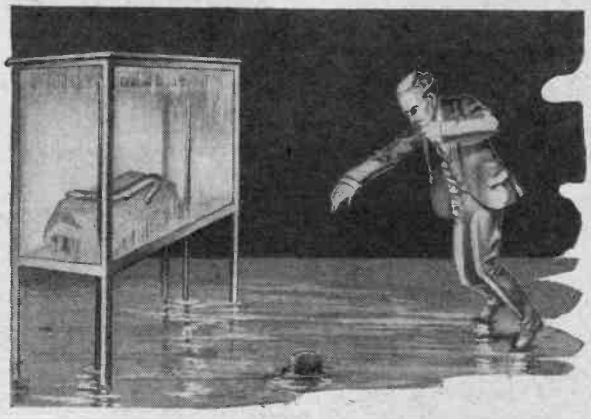
By RAYMOND L. DITMARS

Curator of Mammals and Reptiles, New York Zoological Park.



The fresh water electric cat fish and the electric eel can render a man unconscious by its crashing shock.

nately moved, carry the creature along in a firm and steady gait. These fishes come right out of the water and walk around on the trunks and branches of derelict trees in contact with the streams. They also come out of the water and cross from one pool to another. These are small, fresh-water species, as is the archer fish. The latter species appears to have the power of expanding and contracting the mouth and throat. It takes a generous "mouthful" of water and swims along the margin of the stream looking for some fat and luscious looking fly which might be taking a sunbath on a leaf. The fish raises just its snout from the surface and takes aim. It is an excellent marksman. The fly is hit with a squirt of water coming with such force that it is stunned and knocked off the leaf. The fish completes the episode. It is said of this fish that it is so keen of eye and expert of aim that it can shoot a spider out of a web span several feet above the water.



The writer of this article has been severly shocked by a three-foot electric eel. The eel was in an aquarium 6 feet away, the floor was wet. In this instance the eel did not even appear to move.

Most Ferocious Fish

ANOTHER fresh-water fish of astonishing habits lives in the waters of tropical South America. This is the piranha, which, while much larger than the former kinds, is not a very big fish as it does not grow to be longer than eighteen inches. It is not unlike a sunfish in shape, but the most ferocious fish in the world. These creatures have such strong teeth they will snap off one's finger, if a hand is trailed in the water; they will attack and mutilate swimmers so fearlessly that a few of them can overpower and mortally wound a man.

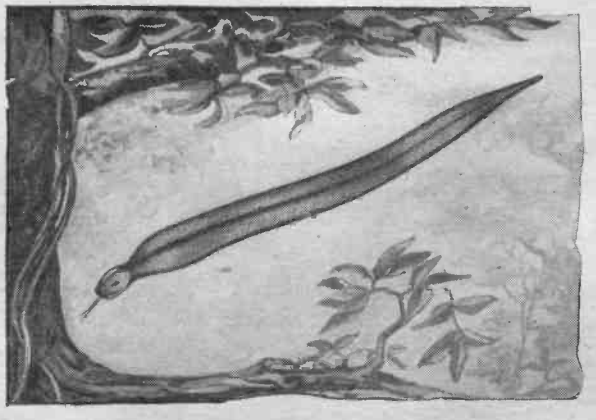
There is quite a large fish with a rather clumsy body and very slow of gait, which could never catch its food if it did not carry a fishing rod with it, the tip of which serves as bait to attract small fish into its mouth.

Sharpshooting fish, flying snakes, insects as flashlights, angler fish, ants' cows and other strange creatures are known to exist.

The archer fish which takes a generous mouthful of water, swims along the margin of the stream and when it sees a luscious fly, it squirts the water at the fly, knocks it into the stream, and eats it.

Fish Fishes for Food

THE sea has a legion of almost unbelievable fishes. A common type, found in European waters, is the fishing "frog." This is quite a large fish, with a very clumsy body, and very slow of gait. It feeds upon other fish, but could never catch them if it had to pursue the prey. It has an enormous mouth, which can be quickly opened; its body blends with the sea bottom, having filaments and fringes like strips of seaweed. Immediately back of the head is a movable stalk, being a modification of the anterior portion of the dorsal fin. Attached to the end of this is a soft and irregular fragment of cartilage. The appendage is no more or less than a fishing rod—the tip serving as bait. When the fishing "frog" is hungry, it raises the rod, expands the moving filament and opens its gaping mouth, which looks like a hole in the sand. Ready to "fish," it swings the rod and bait directly over its cavernous mouth—and woe betide the inquisitive little fishes that are lured to this device.



There is a reptile which "flies." This creature lives in East India and it slides off one branch to that of another.

Bitten by Frog

IN the preliminary paragraph of curious types, I mentioned a giant frog which could swallow a rat. This creature lives in the Cameroons, in the equatorial area of western Africa, and from what I have seen of the few specimens that have been brought out, it attains a weight of about five pounds.

(*Continued on page* 1095)

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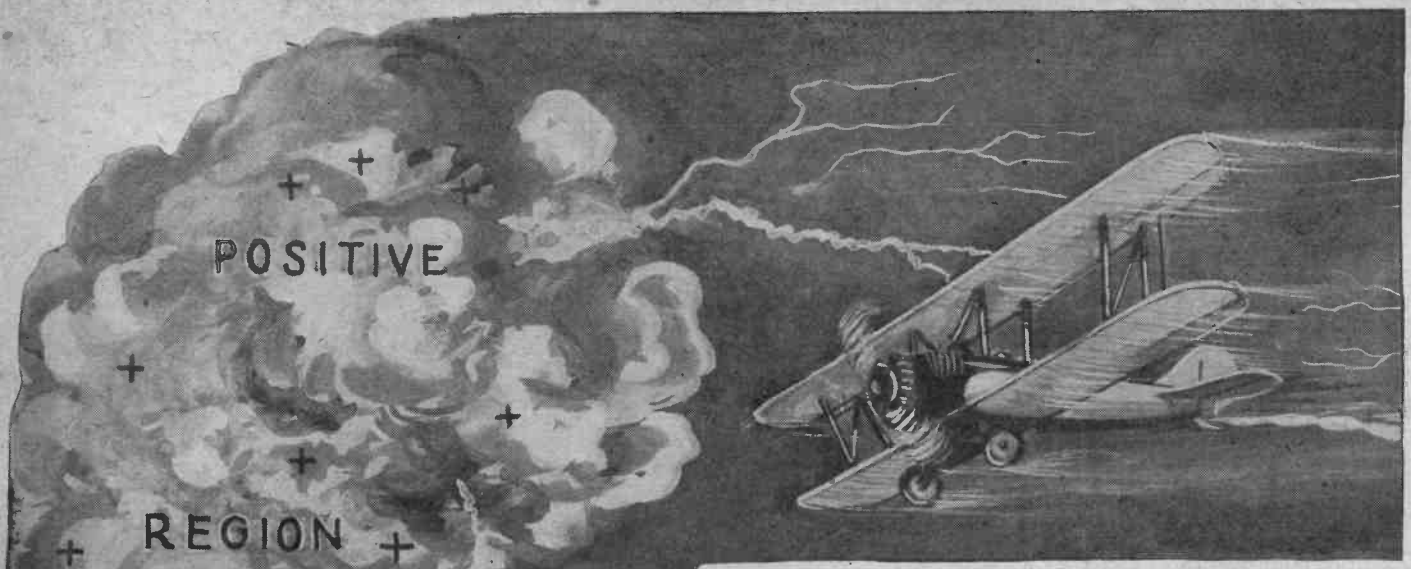

This illustration at the left shows how a plane shortens the path of lightning between two clouds.

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 obtacles 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

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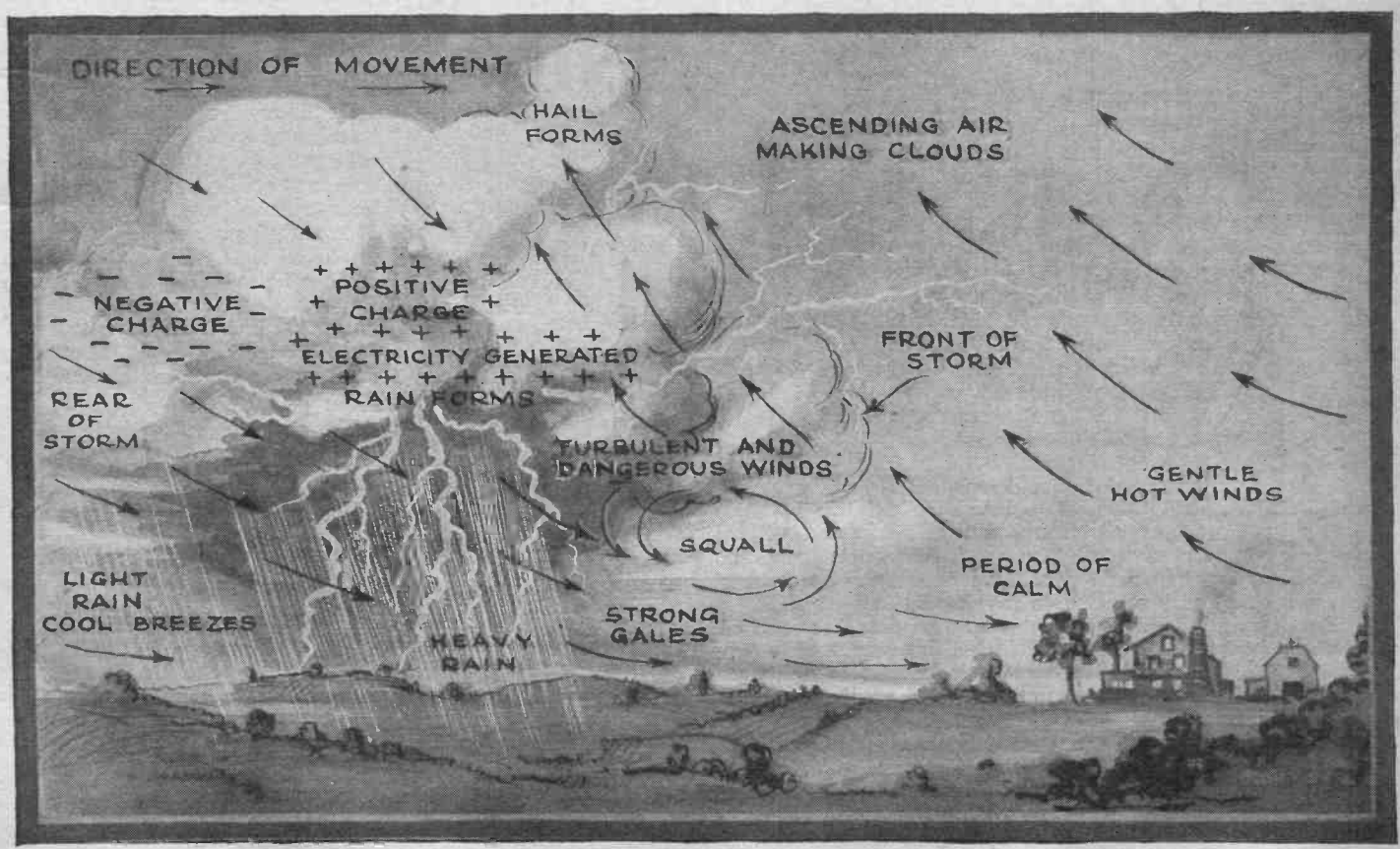
Above we see how lightning follows along the path of a plane. Frequently the exhaust gases shorten the lightning path because of the increased conductivity of those gases due to carbon particles and heat. Thus a greater risk occurs under such conditions.

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.

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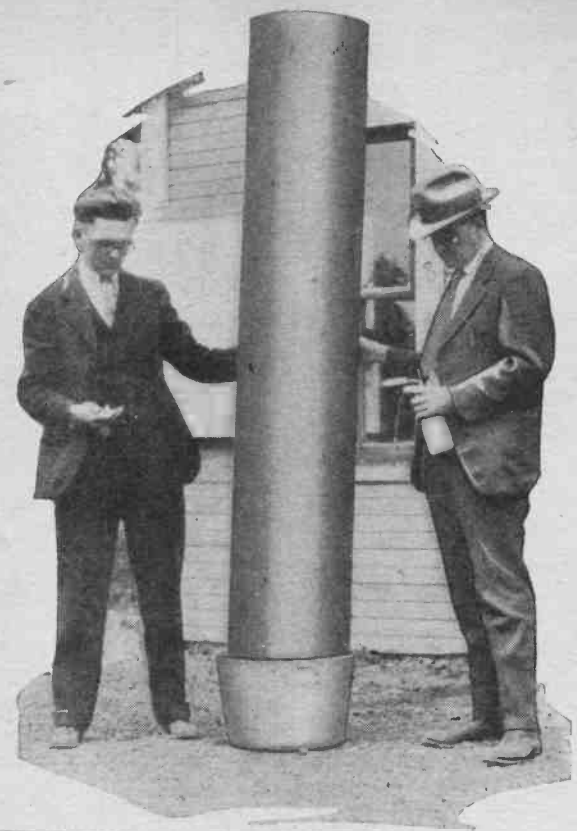
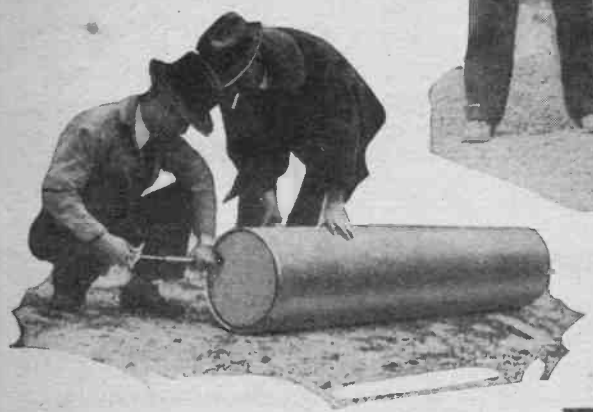
Saving the Lives of Crews of Disabled Submarines

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.*

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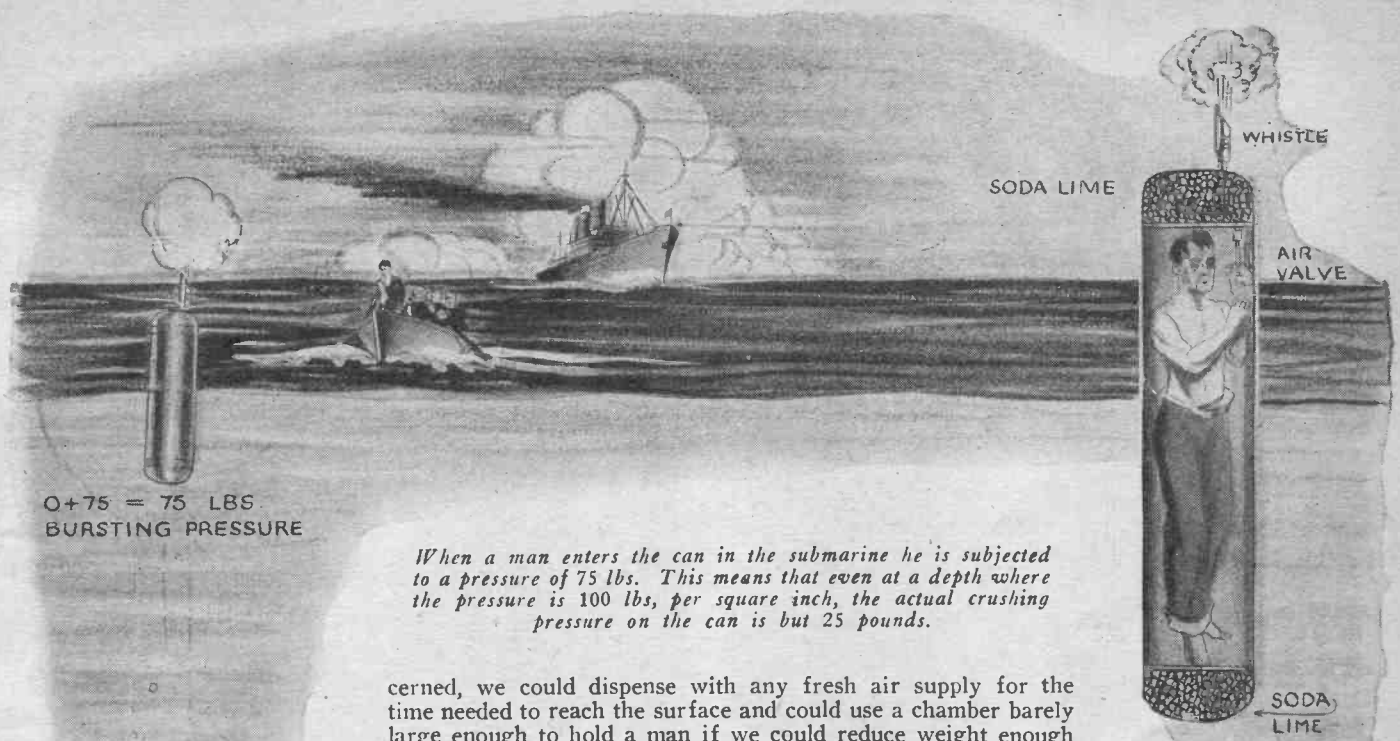
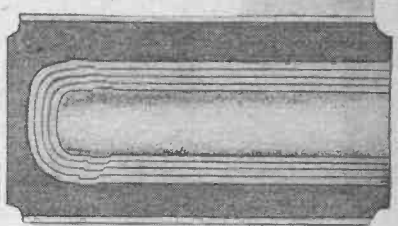


When a man enters the can in the submarine he is subjected to a pressure of 75 lbs. This means that even at a depth where the pressure is 100 lbs, per square inch, the actual crushing pressure on the can is but 25 pounds.

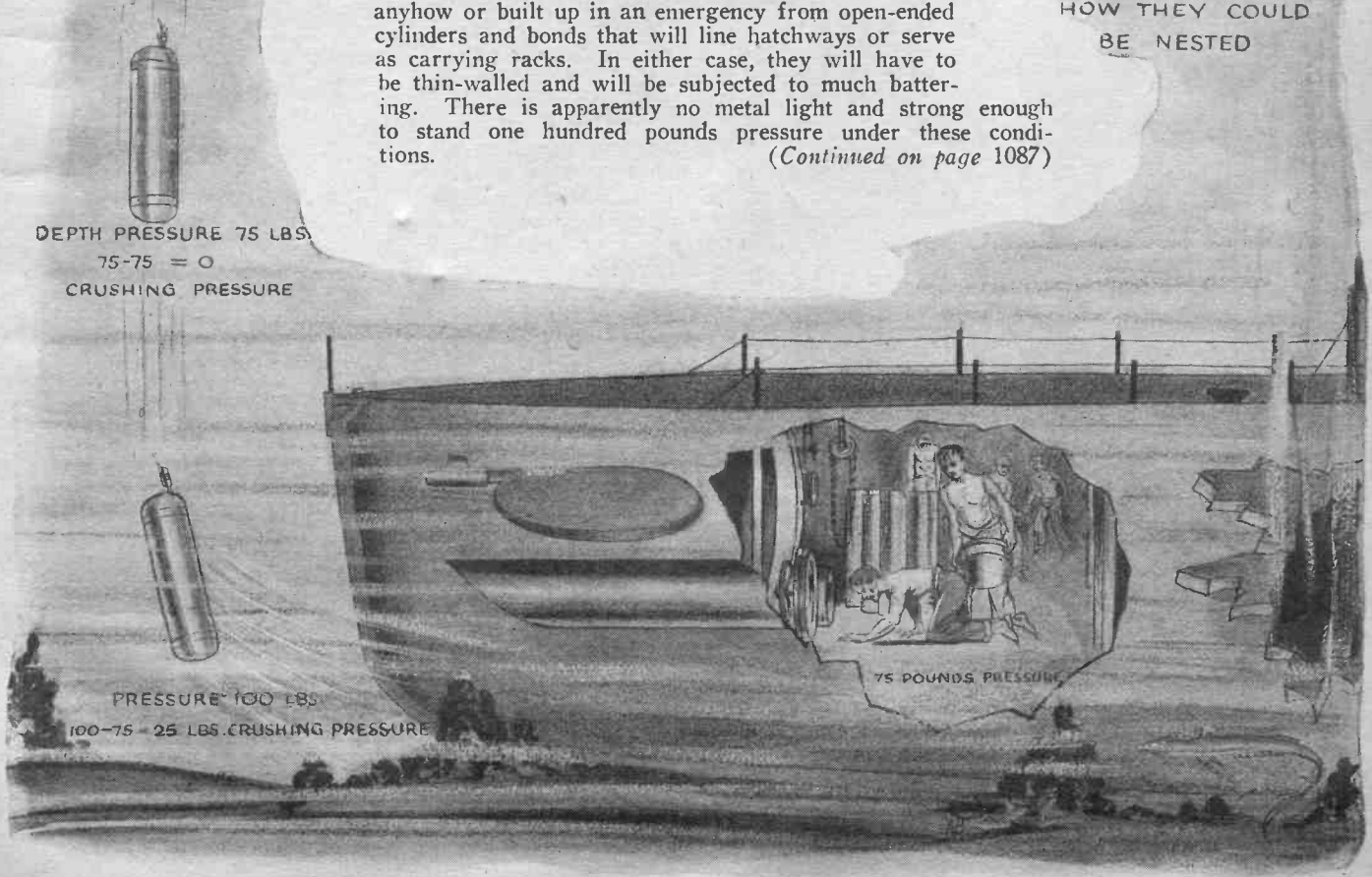
cerned, we could dispense with any fresh air supply for the time needed to reach the surface and could use a chamber barely large enough to hold a man if we could reduce weight enough to give buoyancy. This apparently simple problem gave more trouble than black ants at a picnic. Theoretically, a perfect 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)



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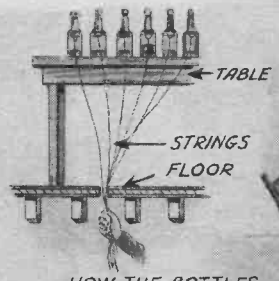
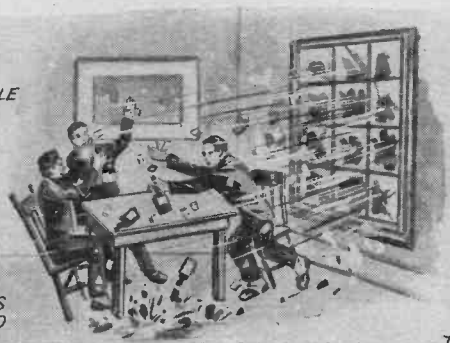
How Stage Noises Are Produced

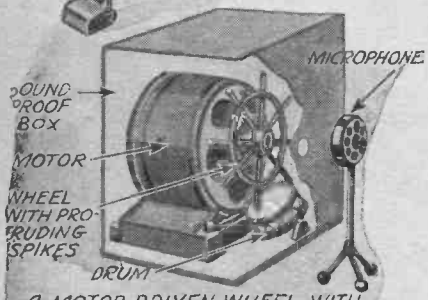
Sound effects obtained by mechanical and electrical means

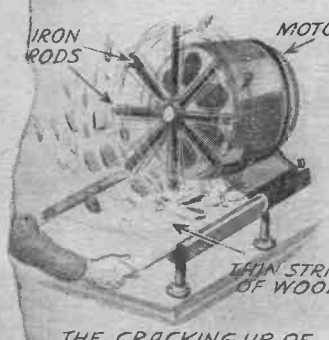




THE off-stage acousticians are called upon to display their ingenuity in the production of sounds in keeping with our present-day civilization and the difficulty in technique increases each year. For instance, the sound of a bursting bomb is simulated by discharging a gun within a wine cask containing about four inches of water. With our present number of *gang war* plays, it is ofttimes necessary to imitate a machine gun breaking glass; a ball on a spring is released, breaking the window panes as shown above. Bottles are crashed to the floor by pulling them down with strings. The rattle of a machine gun is produced by rapidly striking blank cartridges. In "The Silent House," the hero drops through a skylight made of very thin wood. The villain in this play attempts to kill the victims with a poisonous gas exuding through the nostrils of two dragons. Hydrochloric acid and ammonia vaporized through the nostrils produced the necessary effect.

In war plays the noise of a vacuum cleaner serves to imitate the hum of an airplane motor. A motor-driven wheel with protruding spokes which beat on a small drum, give a realistic imitation of a plane when picked up by a microphone and amplified. Thin strips of wood broken by motor-driven iron rods give the effect of an airplane crash. The approach of an army tank is simulated by clanking a heavy chain upon a metal plate. Sound pictures, as well as stage productions, rely on these and many other effects for successful presentation.





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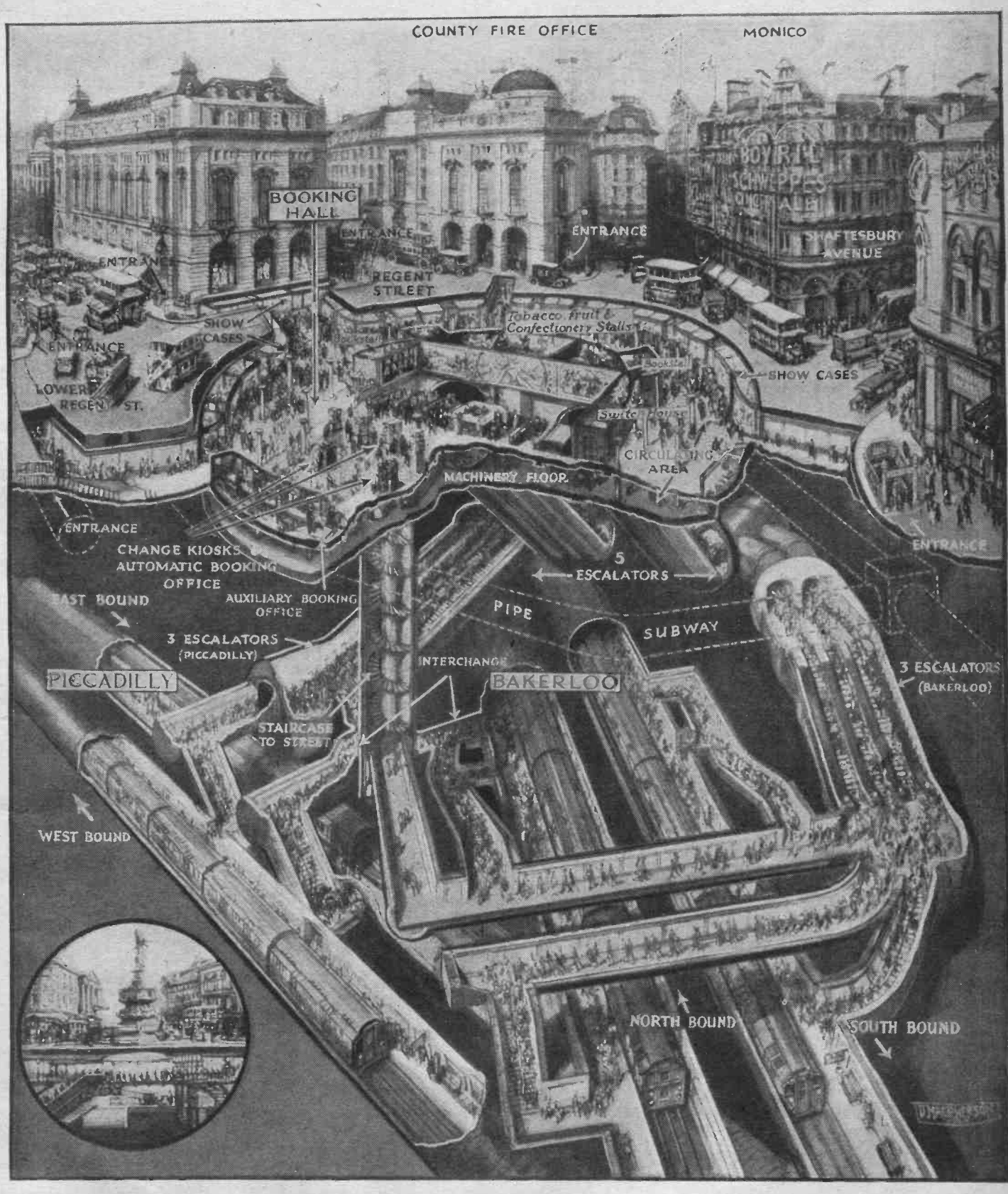
London Has Huge Subway Station



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.

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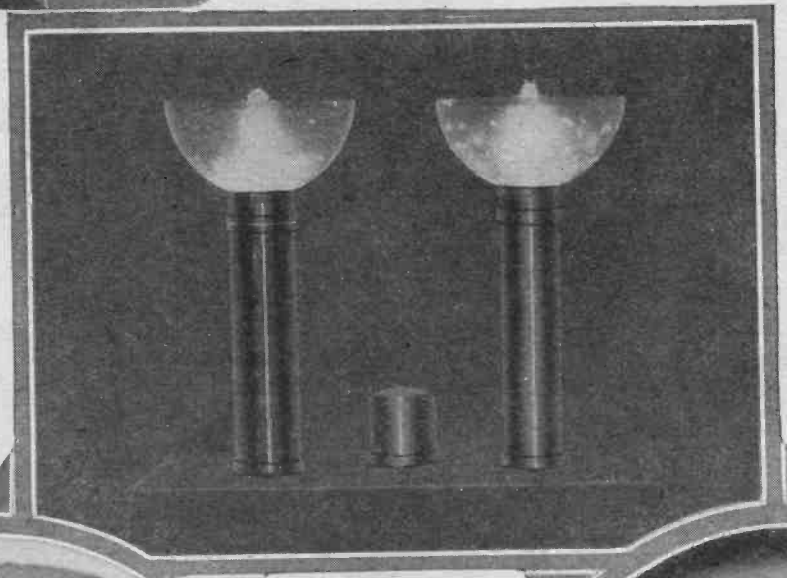
New Apparatus Reveals

PRECIOUS TESTED IN UNIVERSITY

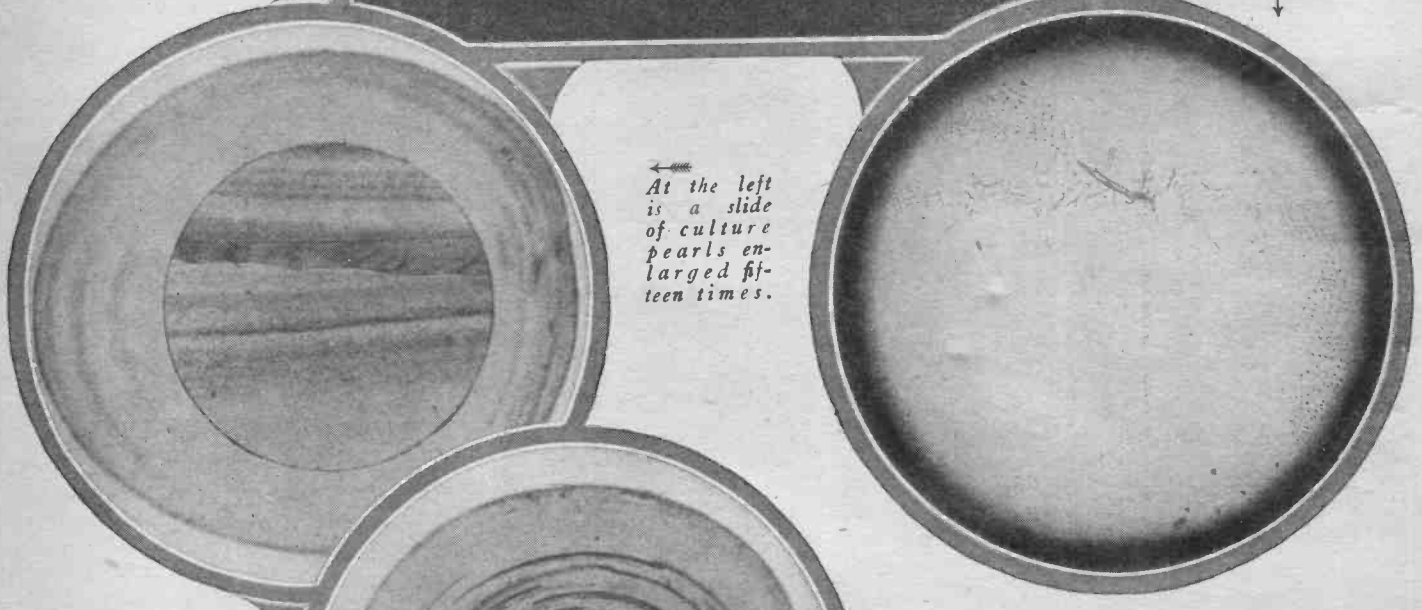
Above—Testing a pearl by the electro-magnetic process. The stone is suspended from a thin glass rod within a magnetic field.



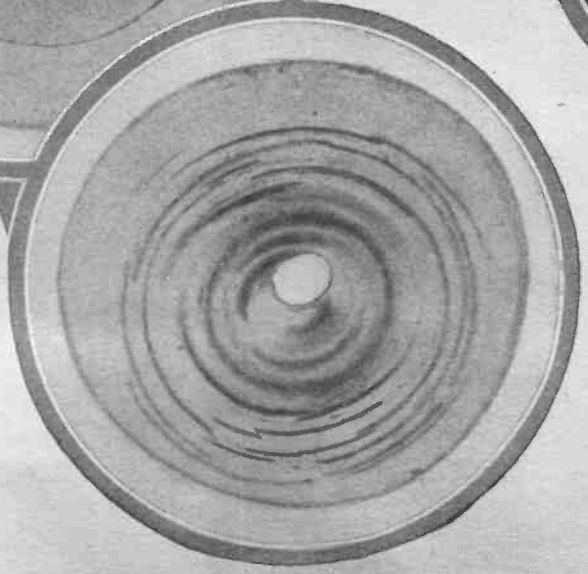
An instrument known as the "brilliantoscope" is shown at the left and will distinguish between diamonds and other precious stones. A diamond is at the right and a white sapphire at the left.

As will be noted in the photograph at the right, the diamond's reflected rays are more numerous and brilliant than those of the other stone.

Below is a photograph of an olivine chrysolith. The spots are pockets of liquid content which are often found in genuine stones.



At the left is a slide of culture pearls enlarged fifteen times.



The photograph of a natural pearl enlarged fifteen times may be seen at the right. Compare this with the photograph appearing above.

AN institute for the testing of precious stones employing new methods of research was opened recently in Berlin, Germany. Pearls are tested by electro-magnetic means and by a microscope, as well as with a supplementary apparatus, which permits pearls with bore holes to be examined. For examining other precious stones, a new instrument known as the "brilliantoscope" has been developed which enables the examiner to compare the brilliancy and different cuts of the stones.

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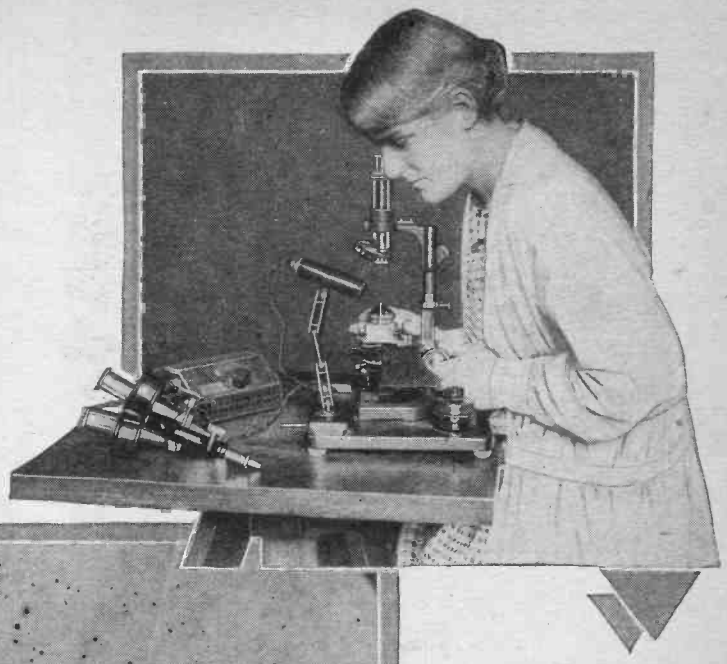
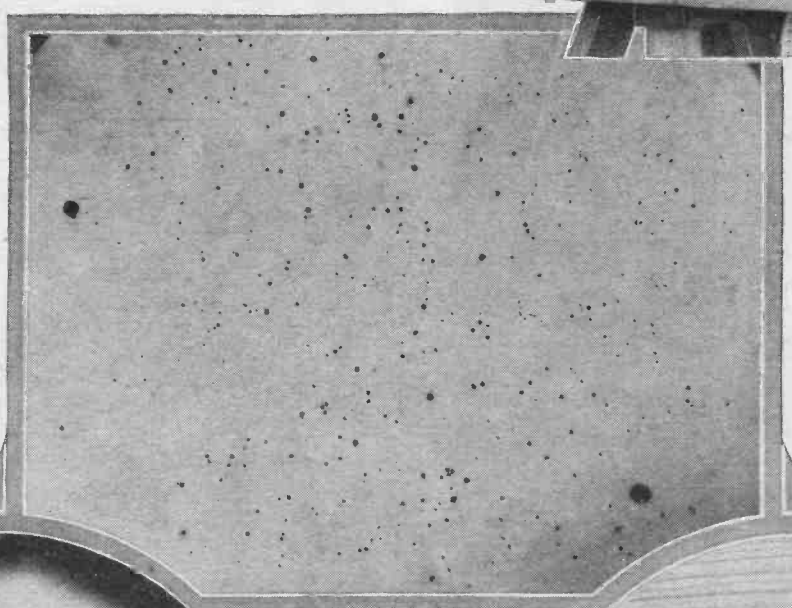
Flaws and Fake Gems

STONES BERLIN INSTITUTE

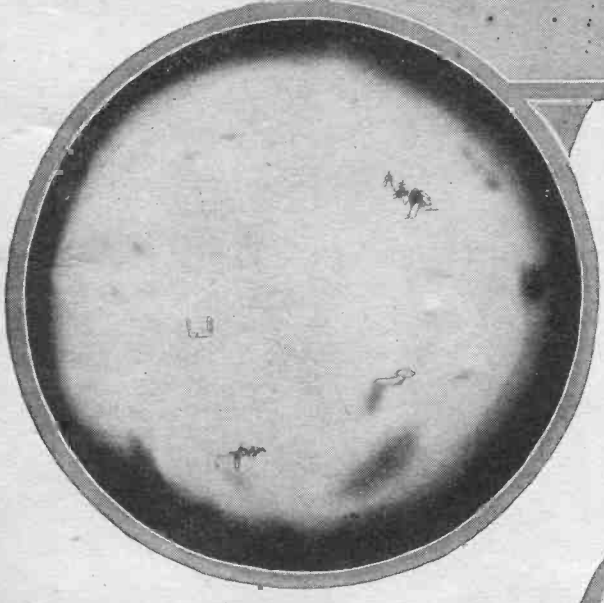


SYNTHETIC stones are revealed under the gem microscope and show air bubbles and strongly marked striations as may be seen in the photograph of the synthetic ruby. The natural stones have straight and angular striations. This is especially true of sapphires and rubies. Further, natural stones sometimes show small crystal formations, never found in artificial gems.

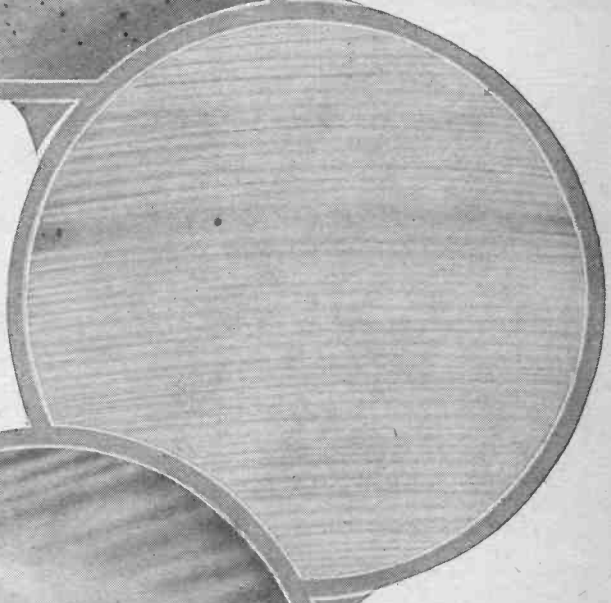
The above photo shows a special microscope for examining the core of pearls that are pierced. A small glass tube is threaded through the pearl which rests upon a revolving platform.

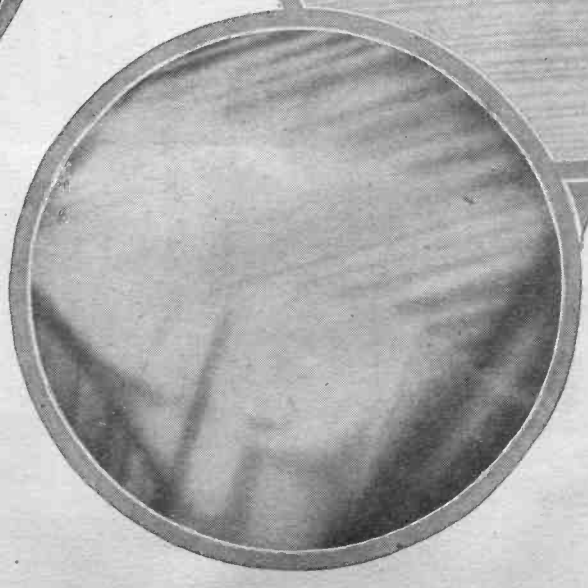


Synthetic stones usually show air bubbles similar to those above which are present in a synthetic sapphire.



Natural stones under the microscope sometimes show small inset crystal formations as illustrated above, never found in synthetic stones.





Above is a synthetic ruby enlarged thirty times and at the left is a natural ruby. Note the angular striations in this stone.

DIAMONDS can be distinguished at a glance from mountain crystals, aquamarines, or white sapphires when placed in the "brilliantoscope." The stone to be examined is placed with the biggest facet on the horizontal glass plate of the apparatus. The electric lamp is switched on and a pattern appears which consists of white or colored spots of light which by their regularity, number and color, form an indication of the nature of the gem and its condition.

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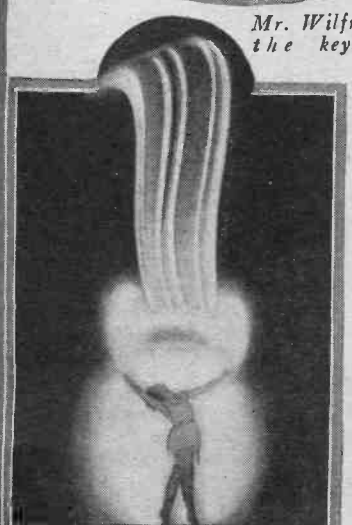
New Theatre Has Moving Murals

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.

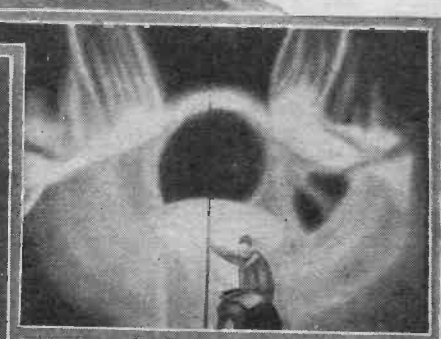
When the orchestra is rendering an overture or the organist playing a composition as a specialty, the murals on the walls become alive with motion and color.

Mr. Wilfred at the keyboard.

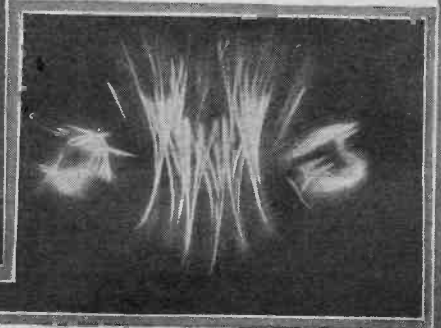


This is only one of the many different designs that can be produced with the color organ.

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.



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 the beginning of one of the effects which are produced by the mural color organ.

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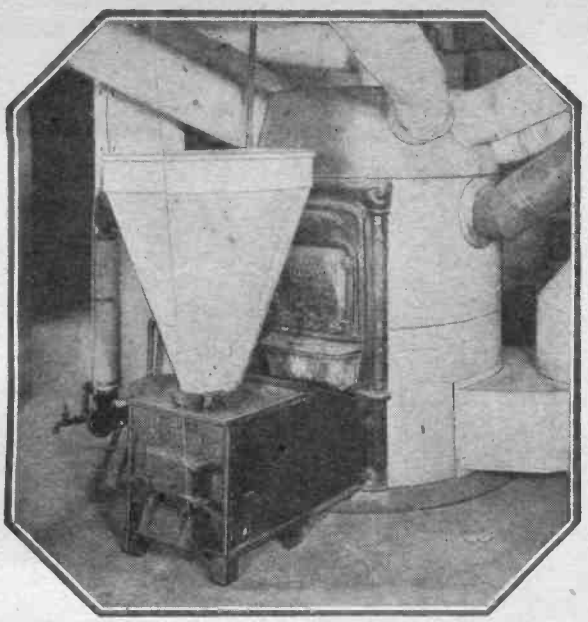


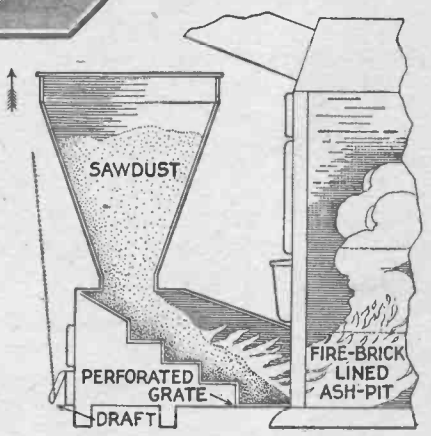
The photograph above shows a typical sawdust burner used for heating houses in Washington and Oregon. The sawdust hopper is the funnel-shaped arrangement attached to the front of the furnace. The small door at the bottom is the draft control. The heat is regulated by the amount of air admitted.

Mill Waste Supplants Coal as Fuel for Heating Homes

SAWDUST— A Coal Substitute

By M. MONROE

Stores and Residences in Pacific Northwest Employ New Heat Medium at a Cost of $1.00 Per Room Per Month



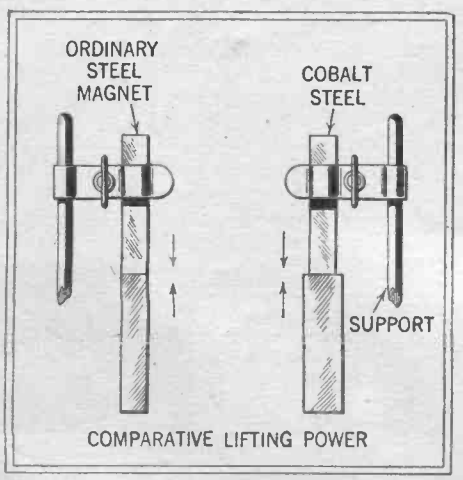
The drawing at the right shows a cross-sectional view of a sawdust-burning furnace. The fuel is fed by gravity. The ash residue is extremely small, as combustion is almost complete and amounts to 1 cubic foot per year.

SAWDUST-BURNING furnaces are now being used for heating residences and stores in the Pacific Northwest, where sawdust heretofore has been thrown away. The simplicity of this device makes for ease in operation and it is only necessary to fill the hopper when required. There are no grates to regulate, the automatic feed being entirely reliant upon gravity, and the amount of heat regulated by the draft. The volume of ash in one year is only about 1 cubic foot, which enables the cellar to be kept much cleaner. The cost of heating is estimated at about $1.00 a room per month. The sawdust burners cost from $50.00 to $150.00.

Magnet Defies Gravitation

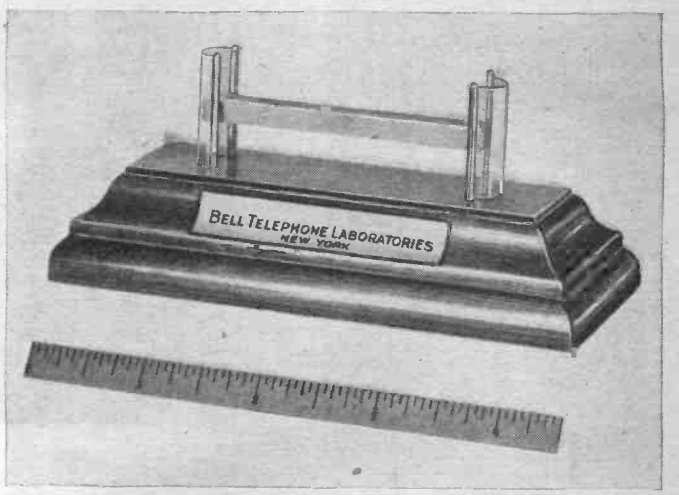
SUSPENDED in air by some invisible means, a bar of steel a few inches long seems to defy the law of gravitation. Pressure of a finger sends it down against the base-block, but when it is freed, it bobs up and down, suspended between earth and sky.

In common with most mysteries, this one has a simple explanation. The bar is highly magnetized, and is repelled by a similar bar embedded in the wooden base and also magnetized. Guiding channels at each end hold the movable bar in line, otherwise it would promptly turn end-for-end and line itself up with its "north" pole over the "south" pole of its mate.



The comparative lifting power of an ordinary steel magnet, shown at the left, and a cobalt steel magnet, at the right, is well illustrated in the above drawing.

The material of both bars is an alloy developed by Prof. K. Honda of the University of Tokyo. It contains about thirty-five parts cobalt, about eighty parts tungsten and about three parts chromium, the balance being iron. When properly heat-treated, this alloy is extremely retentive of magnetization, being about three or four times as good in this respect as its nearest competitor, tungsten magnet-steel. On this account it has been embodied by the Bell Telephone Laboratories in the design of the receiver for the new telephone handset, where a light-weight permanent magnet is desired. The laboratories have also made use of it in the phonograph reproducers used in talking motion pictures, and in certain relays.



The above photograph shows the cobalt steel magnet suspended in air as if by magic. The bar is highly magnetized and is repelled by a simiar bar embedded in the wooden base. Guiding channels at each end hold the levitated bar in place.

When free to move up and down in its guides, the "wobbly bar" takes up a position where the repulsive force exerted between it and its mate is just equal to the downward force of gravity. The earth is so big (*Continued on page* 1090)

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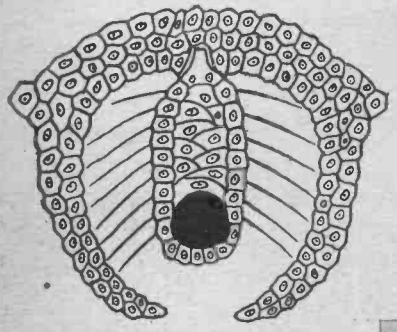
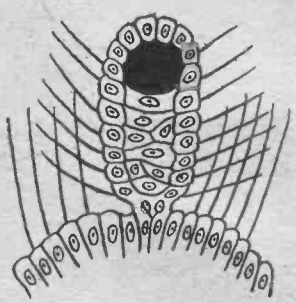
THE MAGNETIC LOBSTER

Crayfish respond to magnetic influence. The balance organ is filled with iron filings and the fish can be made to go through various motions. Without resorting to cutting the lobster, a scientist has overthrown its sense of balance.

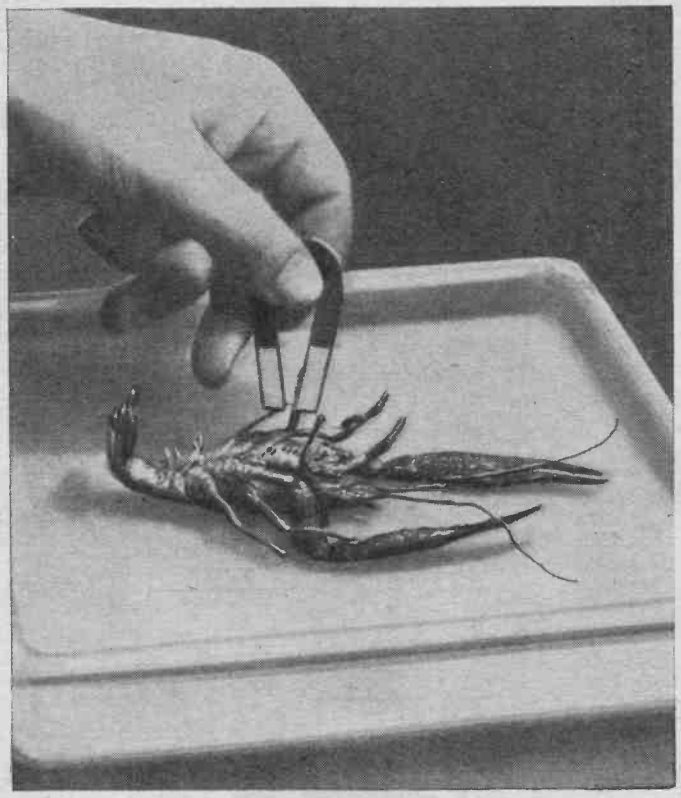
By
DR. ERNEST BADE



Above—The balancing organs as found on a low form of animal. The sense of balance is important.



The jelly fish has a balancing organ similar to that shown above and at the left.



The above photograph shows an experiment being made with a "magnetic" lobster. When the magnet is moved, the lobster also changes its position. With a little patience this experiment can be duplicated at home.

IN addition to the well-known five senses, man as well as animals have another one which is far more important to their well being. This is the sense of balance which is often combined with the organ of hearing. Due to the organ of balance any living being can place itself among its surroundings, that is, it is able to assume its normal position with regard to gravity.

Higher organisms, in addition to their sense of balance, place themselves in their normal position by means of the feel of their joints and the position of their head as well as the relation of surrounding objects to the eye. That this is true can easily be proven. Many of the thrillers on fairs and other amusement places which whirl and jerk one about so violently, displaces the sense of balance momentarily but in spite of this one instinctively gets to one's feet.

Importance of Balance

THE sense of balance is of special importance to those creatures which fly in the air or swim in the water. Here they must keep their balance although their weight has been practically neutralized. Swimmers will realize this from their own experience, for if this were not true they would be unable to change their direction while diving. Then, too, they would be unable to come out of the water head first. They depend, although unconsciously, upon their sense of balance.

Balance in Animals

THE organ of balance is a wonderful little device and well adapted for its purpose. Within the organ is a small heavy body which, although restricted, is able to move freely about within it. Its action depends upon the pressure that the free moving weight exerts upon certain delicate nerve ends which translate their impulse to the brain and so give the direction of gravity. In man as well as the higher animals the sense of balance is found within the ear and is situated within the curved paths of the labyrinth.

When the lower part of the balance organs are cut, on, for instance, a pigeon, the entire sense of balance will be destroyed. If the pigeon continues to live it usually learns how to walk again, but only after much trouble and many failures to stand upright. Even such a simple task as walking takes mores than a month to learn. Flight, after the destruction of the organ, is an impossibility. It can never fly again.

Even such creatures as jelly fish have these organs of balance and two distinct types are found. The simplest is nothing more than a chambered bubble, whose walls consist of cells. A heavy body is carried by the bubble and outside of it are a number of hairs. A number of these organs are carried near the outside circumference of the jelly fish. The other type is pendulus. The bubble hangs down and as side motion is imparted, the hairs brush one or the other side of the chamber. The stimulus is imparted to the creature and this soon causes it to reassume its correct position in the water.

Balance Organ in Crayfish

THE organ of balance is either a closed bag or a deep depression in the crayfish, a fresh water lobster. Here it is located just at the base of the front pair of feelers. In this particular case the heavy body is not produced by the animal, as in other forms of life, but the crayfish must select his own particular kind of material from his surroundings which he wishes to use. Sand is usually taken. When shedding his outer skeleton, the crayfish loses this heavy body and he must pick up another to use in the place of the one just lost so that he does not lose his balance.

Magnetic Experiment

IT was this peculiarity that induced a scientist to experiment with this creature and learn something about his sense of balance without resorting to the process of cutting this organ out. He brought the crayfish into a tank and waited until the creature was about to shed its shell. Then he removed all objects from the tank which the creature could possibly use as a weight. Then the scientist waited to see what would happen and how the crayfish would behave without his balancing organ, as a writer recently pointed out in "Wissen und Fortschritt."

At the appointed time the crayfish looked all around for some weight to use for his balancing organ and not finding anything, he used the only thing available, his own excrements and so caused his organ of balance to function again. The scientist had to acknowledge that he had not considered this peculiar possibility.

But man can think further ahead than a mere crayfish. The scientist left the creature within the tank and awaited the next time when it would again cast off its shell. Just before the time when this was to take place, he scattered iron filings within the tank. The time arrived (*Continued on page* 1074)

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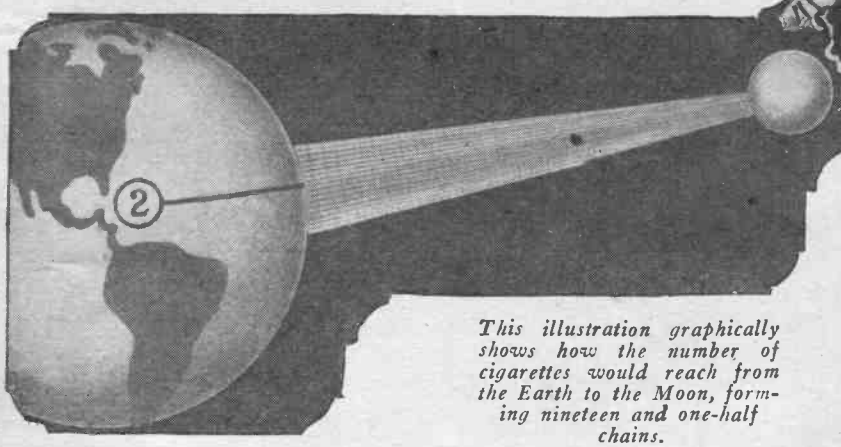
WE Consume

One Hundred and Six Billion Cigarettes a Year

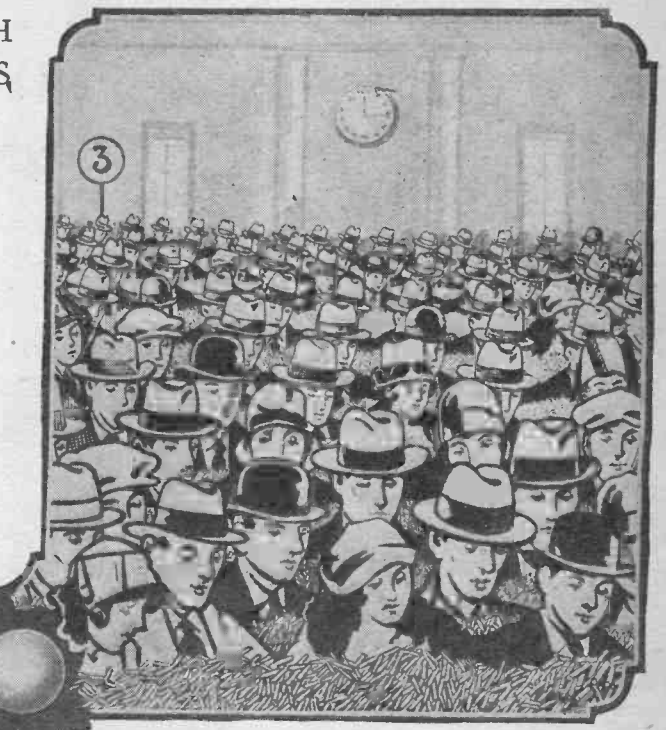
By JOSEPH H. KRAUS

The consumption of cigarettes in the United States is at a rate of more than a hundred billion a year and two hundred and three thousand cigarettes are consumed every minute.

If the cigarettes consumed in the United States during a period of twenty-four hours were placed end to end, they would reach nearly half-way around this world at the equator. If the cigarettes which are used every year in this country were placed end to end, they would form more than nineteen and one-half chains from the Earth to the Moon.



This illustration graphically shows how the number of cigarettes would reach from the Earth to the Moon, forming nineteen and one-half chains.



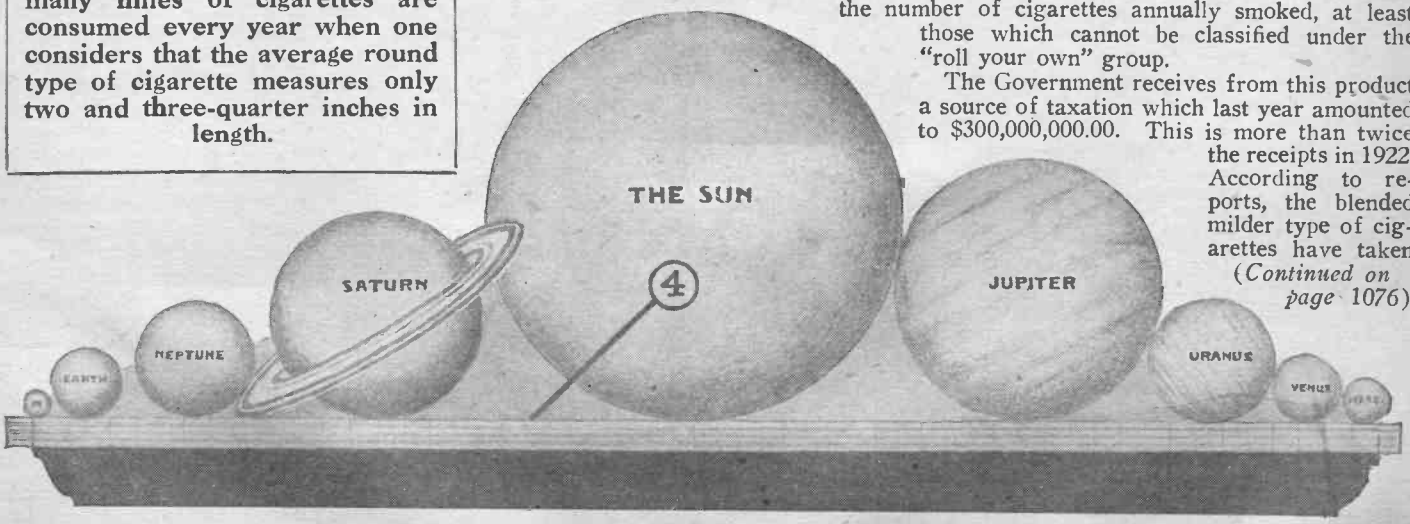
It would take one thousand persons counting at a rate of two hundred cigarettes a minute more than three years, working eight hours every day, including Sunday and Holidays, to check up on the cigarette consumption in one year.

WHEN statistics showed that the number of cigarettes which we smoked this year reached the one hundred and six billion mark, very few people understood what this meant. Reduced to easily visualized factors, it meant that for every minute of every day in the year, 203,000 cigarettes are lighted. What this means in the number of matches used to light each of those cigarettes, or the number of gallons of gasoline which go to supply cigar lighters, is something which even a statistician would not care to cogitate upon. But there is a good record on the number of cigarettes annually smoked, at least those which cannot be classified under the "roll your own" group.

The Government receives from this product a source of taxation which last year amounted to $300,000,000.00. This is more than twice the receipts in 1922. According to reports, the blended milder type of cigarettes have taken

(*Continued on page 1076*)

One would never believe so many miles of cigarettes are consumed every year when one considers that the average round type of cigarette measures only two and three-quarter inches in length.



The Sun with a diameter of 866,400 miles; Jupiter 86,500 miles; Saturn 73,000 miles; Neptune 34,800 miles; Uranus 31,900 miles; the Earth 7,917 miles; Venus 7,700 miles; Mars 4,230 miles and Mercury 3,030 miles, together with the Earth's moon, could all fit side by side on a blanket composed of four layers of cigarettes, consumed in the United States during a period of but one year.

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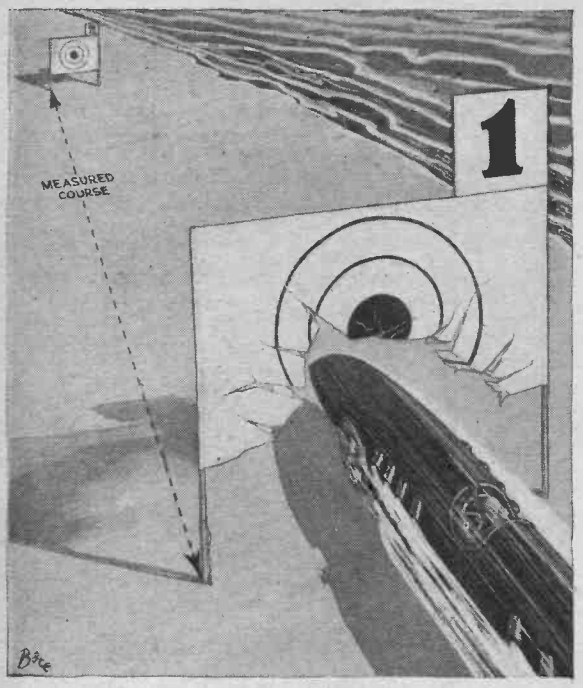
Automobile Targets

Targets and sights on racing auto help to keep a straight course. Segrave car designed to travel at 240 miles per hour.

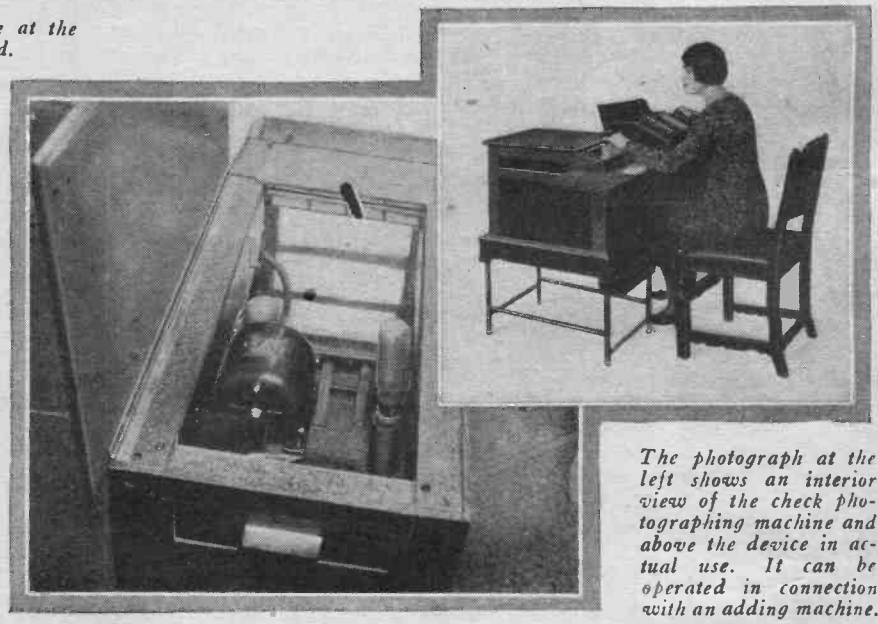
MAJOR H. O. D. SEGRAVE hopes to recapture the speed record at Daytona Beach, Florida, with a new 1,000 h.p. racing car. Its body is long and thin and it has been designed to attain a speed of 240 miles an hour with a possible maximum of 260. The car will be equipped with sights like a rifle and will be steered in the same manner that a bullet is directed to a target. It is estimated that a run of 4½ miles will be required to reach maximum speed. Two huge targets are to be erected above the timing wires both at the start and the finish of the course. The sights on the car and the target's bull's eye will be magnified by means of a telescope on the car. The driver will look through the telescope and align the car's sight with the bull's eye and drive straight toward the target. As the car crashes through the first target he will sight the second target at the end of the course. It is hoped that this arrangement will keep the racing car on a straight course. The length of the newest racing automobile is twenty-eight feet.



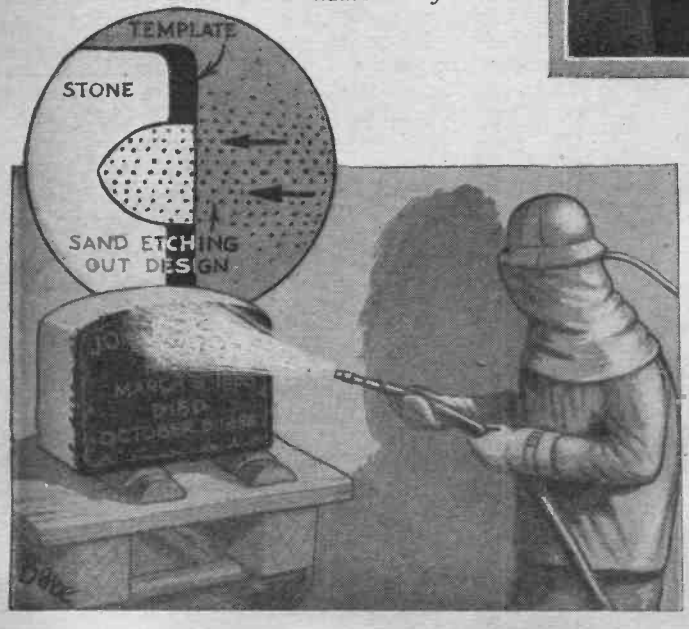
Two immense targets, one at the start and one at the finish of the measured course will be used.

Fraud Preventer

A DEVICE for photographing checks as a means for preventing frauds has been invented by George L. McCarthy, of the Recordak Corporation. The fundamental principle is a double camera, a miniature motion-picture machine capable of accommodating a roll of film 16 millimeters wide and 200 ft. long. Sixteen thousand photographic facsimiles can be impressed on the narrow celluloid strip and may be projected on a small screen. The machine can also be operated with an adding machine and take two pictures of each voucher. — *Abraham Jacoby.*



The photograph at the left shows an interior view of the check photographing machine and above the device in actual use. It can be operated in connection with an adding machine.



The above illustration shows a workman carving with the sand blast. A composition template or stencil is used as shown and the sand etches out the design or lettering. Needless to say, carving by this method is a much quicker process than when using the mallet and chisel.

Sand Blast Carving

COMPRESSED air finds many uses in our present day industries. The newest and probably the most unique use is in the adaptation of the sand blast to the carving or lettering of stone. Heretofore, the art required a skilled craftsman who patiently, with his mallet and tools, developed the lettering or design. The present method is radically different from the old and does not require a skilled stone cutter.

The surface to be ornamented or lettered is covered with a gluelike coating which is applied while hot in a fluid condition. It is put on the stone surface to a depth of one-eighth inch and when cooled and solidified, it resembles and feels very much like crude rubber. The design to be reproduced is made on transparent paper and is placed over the coating with the required portions cut away. The composition acts as a template and when the sand blast is directed at it, the proper portions of the stone are thus cut away. The new method of carving enables the work to be done in a short time with the consequent lowering of production cost and cheapening in the retail price.

In the cross-sectional view the arrangement of the template may be seen as well as the cut-out portion which allows the sand to reach the stone for etching.

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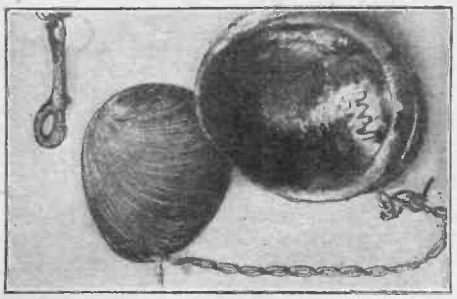
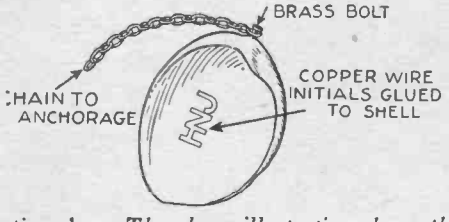
Nature Makes Pearl Objects

The Abalone "Writes"



The photograph at the left shows what can be done with the abalone in making it produce monograms and the like by coating them with mother-of-pearl. It takes about six months to completely cover the initials.

WHAT might be termed "pearly graphology" has been developed by Roy Walter James, of Long Beach, California. While working on a new method of pearl production, he hit upon the idea of putting monograms and small decorative motifs inside the shell of an abalone to be coated with mother-of-pearl. Confronted with the problem of retaining abalones for a long period, in order to study their habits, he perfected a chain which was held to the shell by a bolt passing through one of the breather holes. He first used pasteboard forms, but finally found that copper wire was the best. The form is pressed against the shell and kept in place by a special glue. It takes about six months to completely cover the form with mother-of-pearl.—*James C. Geggie.*



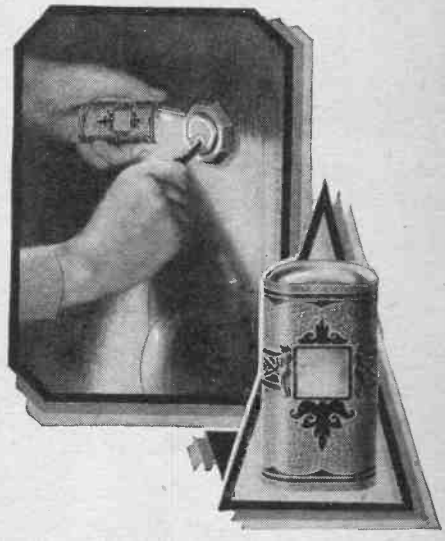
The above illustration shows the copper wire initials glued to the shell and the chain used to retain the abalones.

New Pocket Flashlamp

A Snap Flashlight

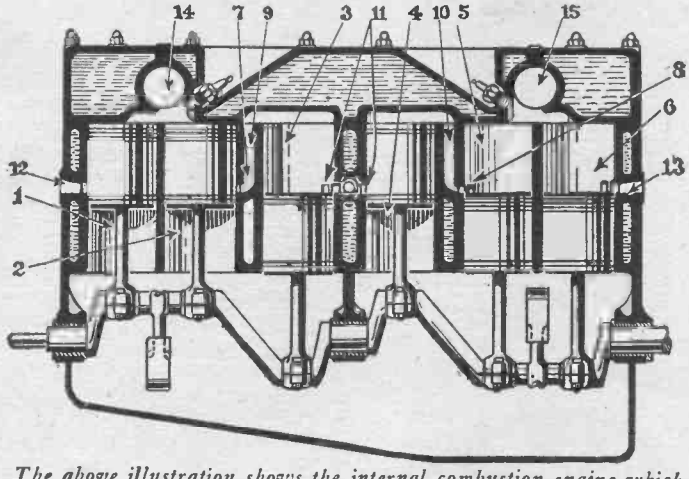
The photograph at the right shows the new snap flashlight, both closed and in use. There is no switch, and the lamp is prevented from breakage by the top.

The top of the light case is snapped up and the light thus switched on.—*Name of manufacturer supplied free upon request.*



Valveless Engine

A NEW valveless internal combustion engine with six cylinders cast in one block has appeared in Germany. Cylinders 1, 2, 5 and 6, are working cylinders; cylinders 3 and 4 draw in the gas mixture and supply it to the working cylinders through the passages 9 and 10 and openings 7 and 8. Openings 12 and 13 serve for exhaust. The right and left pairs of working cylinders have common combustion chambers 14 and 15, and a common ignition. The 6-cylinder motor is extremely simple in construction and noiseless in operation.



The above illustration shows the internal combustion engine which has no valves.—Courtesy Wissen Und Fortschritt.

Strange Electrical Accident

DURING a severe thunderstorm at Hudson Falls, New York, a bolt of lightning struck an electric light pole setting it afire at the base. A wagon drawn by two horses happened to be passing at the time and the horses suddenly dropped dead. The driver of the wagon was noticed sitting in a cramped position calling for help. Several men ran to him but quickly retreated when they received severe shocks through their feet. Several electricians tried to rescue the man in an automobile but the wet tires conducted the electricity and they turned about in haste. Boots also proved insufficient. He was finally rescued with the help of an automobile with dry tires and a number of rubber blankets. It is thought that the lightning partially grounded a 2,300-volt line through a street crossing beacon. The asphalt pavement would not allow the charge to reach the ground, so it covered the whole surface of the wet pavement, entering the ground through the catch basins. The wagon was partially made of steel with a steel tongue. In it lay another steel tongue, and the driver was afraid to move about for fear he would touch it in the darkness. He had received one severe shock when he tried to get down and see what was the matter with his horses. He remained in a cramped position with his feet in front of him for over an hour and it is an experience which he will never forget.—*LeRoy T. Rix.*

At the left is an illustration showing the method in which the driver of the wagon was severely shocked and both of his horses killed. This happened during a severe thunderstorm at Hudson Falls, New York

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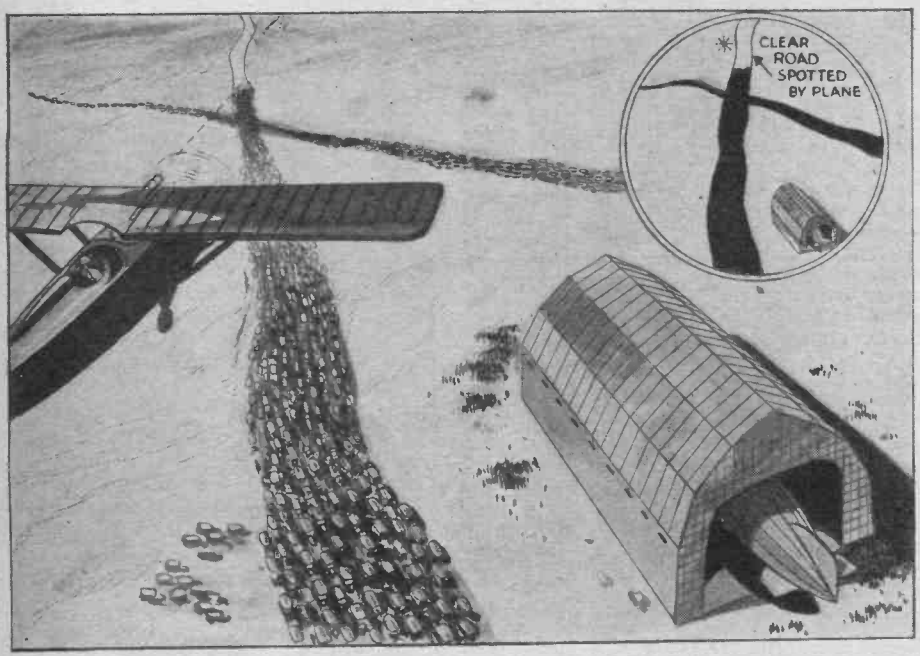
New Use for Airplane in Directing Traffic

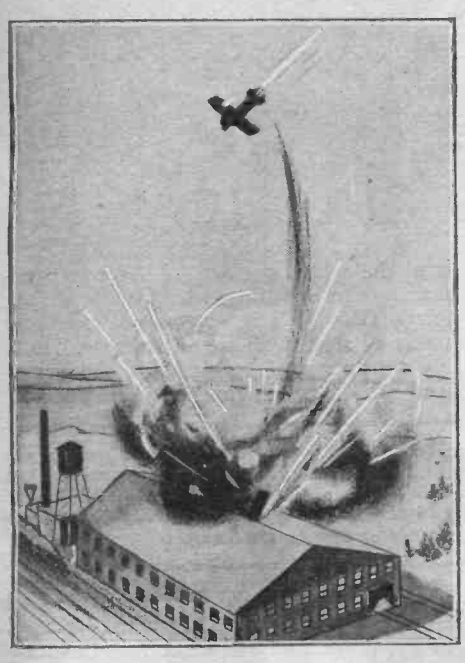


The above illustration shows how an airplane was used to advantage recently in directing motorized traffic upon the arrival of the "Graf Zeppelin," at Lakehurst, New Jersey. Clear portions of the road were thus easily detected by the aviator.

Airplane Directing Traffic

THE airplane "cop" now helps to direct ground traffic. Recently, upon the arrival of the "Graf Zeppelin," at Lakehurst, New Jersey, the roads were jammed with vehicles of all kinds which reached such a concentration that it was impossible for traffic to move in any direction. This deadlock remained for some time and from positions on the ground it was impossible to detect any clear portions of the road which might be used for relieving congestion. An aviator was sent up and in a few minutes spotted an open road. He immediately advised the police on the ground and traffic was shunted through this open space and enjoyed an uninterrupted flow.

Gasoline Tank "Explodes"?



It is recounted that in Russia, the fuel tank of an airplane accidentally became loosened and dropped upon a building—where it exploded. Impossible—unless it fell into a hot chimney.

World Scientific of the

By H. W.

A Talking Picture Substitute Used in Small Theaters Employs Stereopticon Pictures and Electric Phonograph. Gas Tank Falling from Plane "Explodes"?

Substitute Talking Movie

THE talking picture systems used at the present time necessitate the employment of expensive apparatus, which, when once installed, requires the services of an experienced operator. The smaller theaters in outlying districts have adapted an excellent substitute for legitimate talking pictures. A stereopticon picture of the performer, usually a singer, is thrown upon the screen. An electric phonograph employing a powerful amplifier is placed back stage and a record of the singer's voice is played upon it. With this arrangement it is not necessary to synchronize the image and voice, as the picture remains still upon the screen. The picture thrown upon the screen, although it does not move, gives the audience a sense of realism, which would be lacking if the phonograph alone were played. Managers of the smaller theaters are looking with favor upon this substitute for talking pictures.

In the smaller theater a "talkie" substitute is used with good results. The system is illustrated above and employs a stereopticon picture of the singer and an electric phonograph employing a powerful amplifier, upon which a record of the singer's voice is played. While this method is not as realistic as legitimate talking pictures, it forms an excellent substitute.

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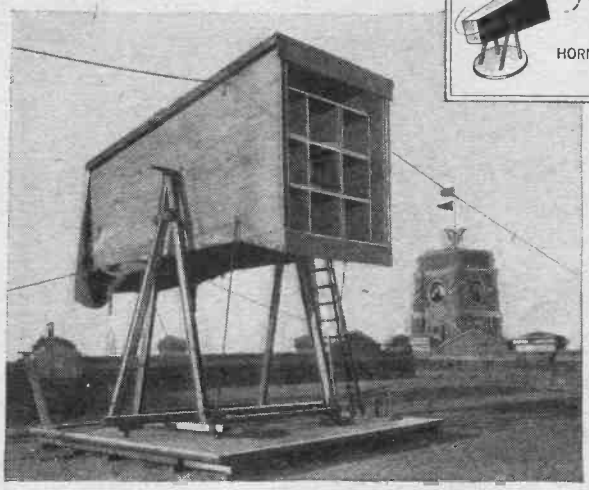
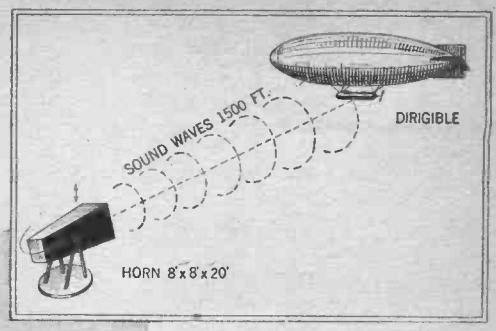
Directional Sound Beam

Wide News Month

SECOR

Sound Waves Concentrated by New Horn. Accident Reporter for Motorists and an Anti-Aircraft Gun which Computes and Holds Its Range Automatically.



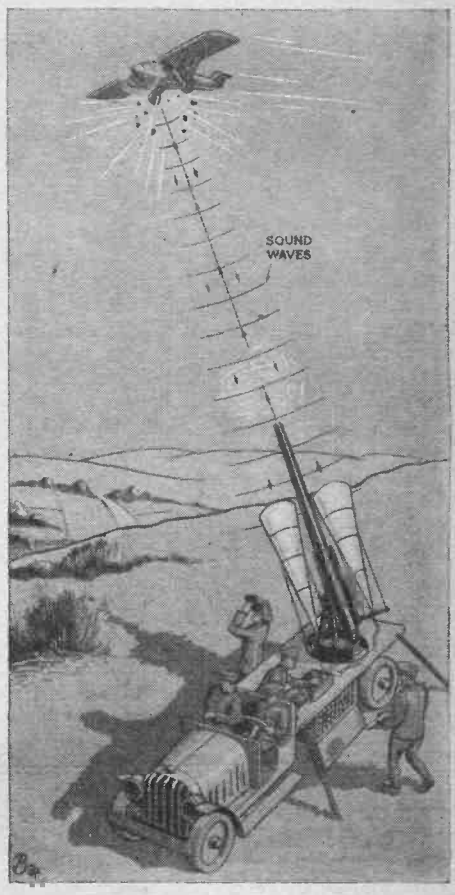


The above illustration shows the position of the large horn and dirigible during the experiment described here. The horn measured 8 ft. x 8 ft. x 20 ft. The dirigible flew above the horn at a height of 1,500 ft., and those on board distinctly heard voice as well as musical programs. The photograph at the left shows the huge horn mounted on the roof of the Victor Talking Machine Co. plant, at Camden, New Jersey.

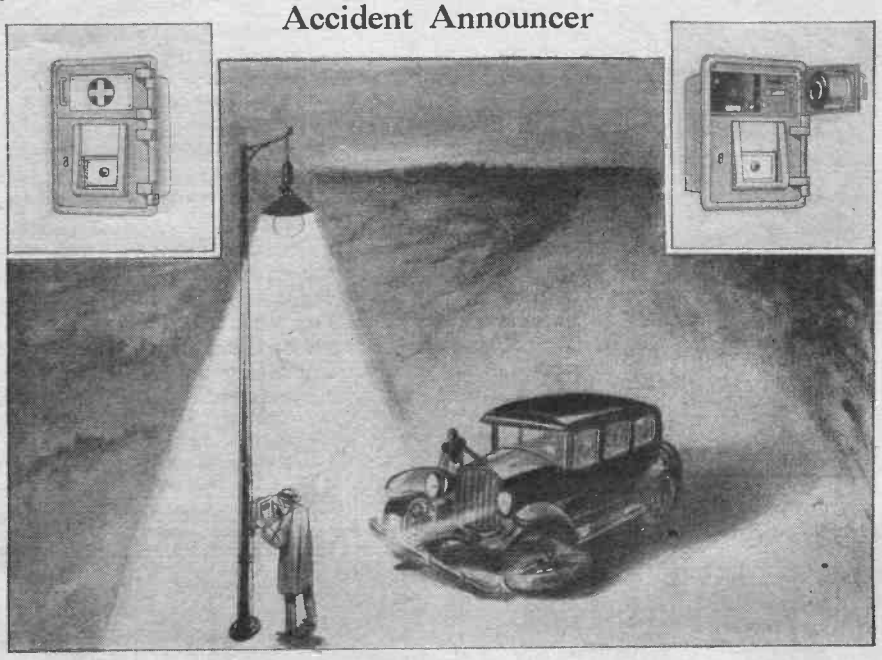
THE feasibility of directing sound waves was recently demonstrated when men aboard the U. S. Navy dirigible J14, flying at a height of 1,500 ft., heard voices and signals which were trained on the dirigible by a new directional horn developed by Mr. S. T. Williams, of the Victor company. This huge speaker comprises nine small-mouthed, conical horn units; each attached to a loud speaker and joined to a single straight-sided mouth without a flare. The whole assembly measures approximately 8 ft. sq. and 20 ft. long and is mounted on pivots and rotating tracks to permit turning in any direction. The experiment showed that the ground crew can communicate by direct sound with an airship in flight by using the new directional horn which concentrates sound at any predetermined point.

Automatic Anti-Aircraft Gun

The self-ranging anti-aircraft gun is shown here. A horn with a microphone at the small end is arranged on either side of the gun for picking up the sound of the aircraft.



Accident Announcer



The above illustration shows auto accident announcer in use.

ACCIDENT alarms similar to "fire alarm boxes" have been placed at intervals along the roads in Germany. To summon help, it is merely necessary to strike a knob so as to break the glass on the front. This starts a disc turning which produces a make and break contact. In the same electrical circuit is a Morse code device and a bell to tell which alarm is being operated. A telephone is a needed feature.

AN anti-aircraft gun which computes and holds its own range was recently demonstrated at the Aberdeen Proving Ground, at Aberdeen, Maryland. The three-inch gun used even ascertained the altitude of the approaching airplane by picking up the sound with horn microphones. Planes flying at such a height that they could not be seen with the naked eye had their targets hit by the shells from this gun.

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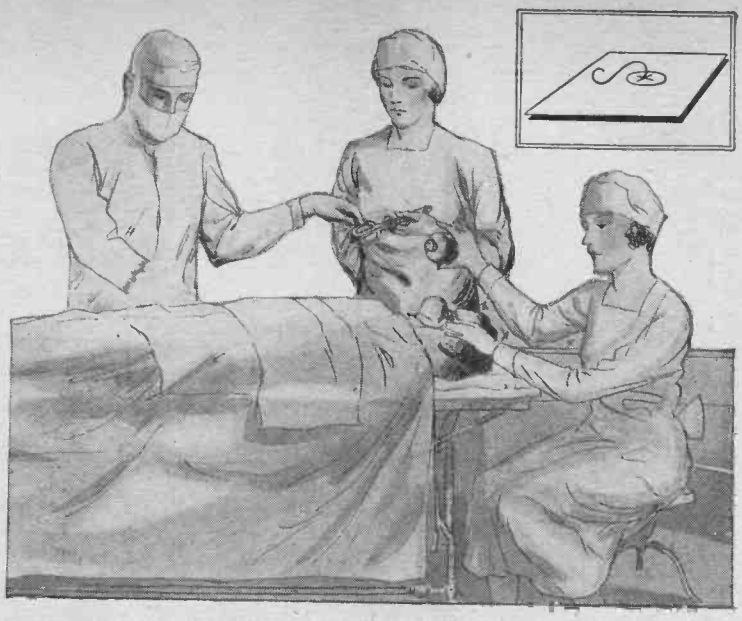


Fig. 5. The diagram shows how S, via the third dimension, could remove the appendix (at X) from O, without making any incision in O's boundary. By fourth-dimensional surgery, one could remove any organ without taking it through the skin; surgeon's unseen right hand is in the fourth dimension.

The "Mystery" of the Fourth Dimension Popularly Explained. In the Articles to Follow the Theory of Relativity Will Be Discussed

Space--Time *and* Relativity

By DONALD H. MENZEL, Ph. D.

USUALLY, when the "fourth dimension" creeps into daily conversation, as often happens in these days since the advent of Einstein's theory—there is lifting of eyebrows, mention of complex mathematics, talk of an Houdini escape from a barred and guarded room, a vague reference to Relativity, or a suggestion about the abode of departed spirits. In fact, an evesdropper upon such an occasion would hear a terrible mixture of fact, nonsense, superstition and misinformation, ludicrous, if it did not reveal so painfully the ignorance of the average person upon this subject.

There are certainly very few people in the world who understand what is meant by "the fourth dimension," yet it is by no means as mysterious as has frequently been made out. The dictionary defines *dimension* as any quantity that can be measured. According to this definition, the three familiar spacial dimensions are few indeed, compared to all the measurable quantities in the world. For example, a weather observer who reports the temperature, pressure, wind direction and velocity at a given time, latitude, longitude and altitude is dealing with eight dimensions, compared to which four are insignificant. Why, then, do we hear so much of the fourth dimension, when it can theoretically refer to the price of wheat, the population of China, the number of cigarettes smoked in a year, etc?

Fig. 1. The above drawing shows how three dimensions are represented by three pencils placed perpendicularly to each other.

Pencils Demonstrate Case

THE fourth dimension becomes mysterious only when the expression is used in a specially restricted sense—to denote a fourth *spacial* dimension. I lay one pencil along the side of this magazine, a second one across the bottom of this page, and still another perpendicular to the paper, so that the points meet at the corner. (Figure 1.) Here are three perpendicular directions, call them what you will —length, breadth, and height, or x, y, z. If, now, we could similarly place a fourth pencil so as to be perpendicular to each one of the other three, it would point toward the fourth dimension. Try it. Of course you cannot succeed for, if you could, the fourth dimension would no longer be an enigma.

Third Dimension Queer to Two-Dimensional Beings

AT first thought it may seem that our failure so to locate this hypothetical fourth direction would be certain proof that

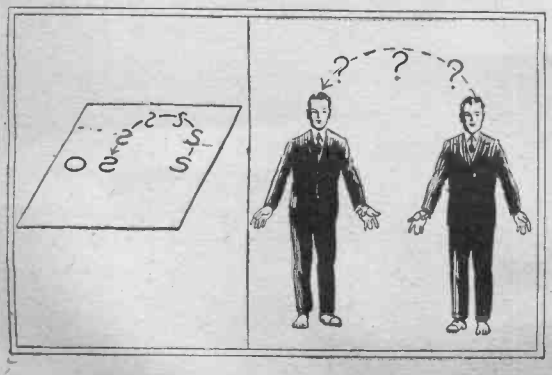
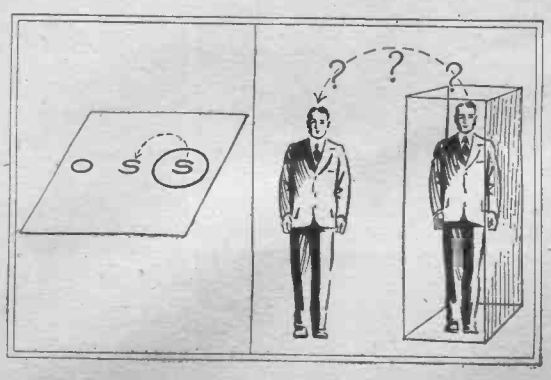


Fig. 3. A line drawn around S in the illustration at the right forms a prison from which he cannot escape as far as two dimensions are concerned.

Fig. 4. If S is required to move in the two dimensional plane shown at the left, he can never become a mirror image of himself. Rotation through the third dimension will accomplish this.



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it does not exist. This is not necessarily the case, as a simple analogy will demonstrate. Let us suppose that the letters upon this page are creatures endowed with life, reasoning faculties and powers of locomotion. Let us visit, in imagination, their world and look at existence through the eyes of the letters that inhabit the printed page.

Introducing Mr. Capital "O"

WE introduce Mr. Capital O, a firm believer in two dimensions, and Mr. Capital S, who announces that he has discovered a third dimension. Following is a stenographic report of an argument between them:

O. Preposterous, S. I shall never believe in anything but two dimensions! Look for yourself, there they are. Length and breadth. Show me a third.

S. You admit, theoretically at least, do you not, that there could be more than two dimensions?

O. Oh, yes, theoretically there can be any number—but practically, I mean. Can you devise any experiment that would prove to me their existence?

S. I can try. First of all let us consider ourselves. We as two dimensional beings, surfaces, possess one-dimensional boundaries. You see me as a line. You cannot see even the two dimensions that we represent. Here are three straight lines; two of them I place perpendicularly in the plane of our world, and the third I put straight up, for, as I told you, I have discovered the third dimension. As you notice, it vanishes. (Figure 2.)

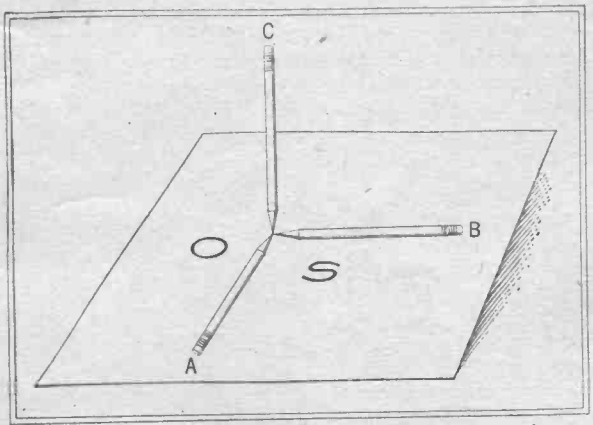

Fig. 2. The two mutually perpendicular pencils A and B can be comprehended by a two-dimensional being. The third, C, would be mysterious and invisible to him.

O. That is excellent sleight of hand indeed. Where did it go to? What do you mean by "up."

S. It went in the direction of the third dimension. As this is not in our plane, we, of course cannot see it. Look, I'll turn it back.

(The line suddenly reappears as though materialized from thin air.)

S. I'll give you another demonstration. Draw a line around me. . . . There, I'm in a two dimensional prison. Now for a sensational escape. (Figure 3.)

(Crawls up in the direction of the third dimension, over the wall of the jail, and then returns to the plane of the paper, reappearing suddenly in front of the astonished O.

O. Shades of Houdini! You're convincing me.

S. A couple of more demonstrations. (Again S vanishes, turns himself completely over so that when he again returns to the page he is reversed, thus?

O. Why, you've become a mirror image of yourself. Your right hand has become your left-hand. Doesn't it hurt?

S. Oh, no. Simple rotation through the third dimension produces the effect. The other day I heard you complaining about appendicitis. As I look at you now, being in your plane, I see only your boundary. I shall now demonstrate three dimensional surgery. Without cutting you at all, I shall reach inside your body and remove the diseased appendix.

O. That sounds like the height of idiocy.

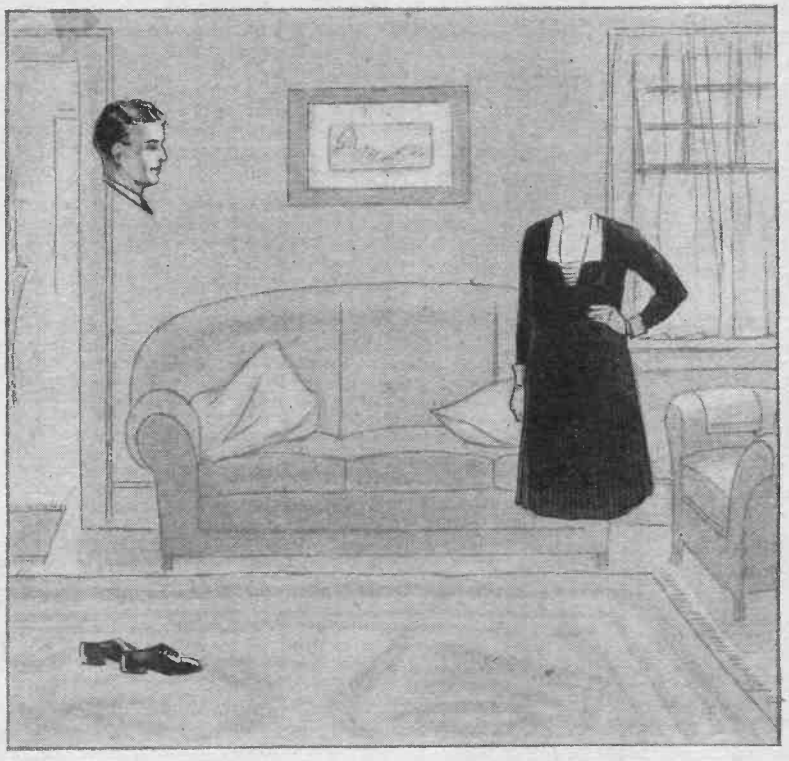

Fig. 6. The above individuals have turned parts of their bodies into the fourth dimension. The members in the fourth dimension are invisible.

S. Here goes. (Reaches over the edge of O and performs the operation from above, from the third dimension, and returns.

O. I'm convinced, now, that there is a third dimension but I'm just as ignorant as before as to what and where it is.

Other Considerations

IF you or I could discover the fourth dimension we could mystify our friends with baffling exhibitions such as enumerated in the above analogy. Our difficulty in placing the fourth pencil perpendicular to the other three is immediately explained, for, if we managed to do so, like S's third line, it would vanish from sight. A room sealed in three dimensions would be as open in the fourth direction, as the ring-like prison of S was in the third. (Figure 3.) No locks or chains could hold us. Lest there be any misunderstanding, however, I hasten to remark that Houdini (and other great magicians), though repeatedly so accused, have firmly denied that they use the fourth dimension in their sensational escapes.

S, by rotation through a third dimension, (inexplicably to O) changed from a right to a left handed individual without inconveniencing himself in the least. If we "turned ourselves over" through the fourth dimension we should undergo a similar transmutation. If we wore say but one glove or shoe, the operatoin would alter them from right to left. Every hair on our head or button on our coat would be reversed. We would appear exactly like our mirror image and yet being turned "inside out" in such a manner would cause us no more pain than a somersault in three dimensions. (Figure 4.)

Fourth Dimension Sight-Wonders

BEINGS in a two dimensional world see each other "edge on" according to three dimensional standards. They thus appear as lines. To an observer from the third dimension the interior of their prisons, bodies, etc., would be completely open to view. Analogously, we see only the boundaries of three dimensional beings, surfaces. True, binocular vision produces a stereoscopic effect of solidity but this is little more than an illusion. If a person could move into the fourth dimension, he would be able to see into closed rooms, or even into the human body. A surgeon possessed of such knowledge, would be enabled to perform true bloodless surgery. Via the fourth dimension, he could reach inside the human body and consummate an operation without making a single incision. (Figure 5.)

To the person hitherto unacquainted with the fourth-dimension, the foregoing reasoning may appear absurd—possibly completely devoid of meaning. Let him refer to the analogy, and O's similar difficulty in visualizing the third dimension which we know from experience (*Continued on page* 1097)

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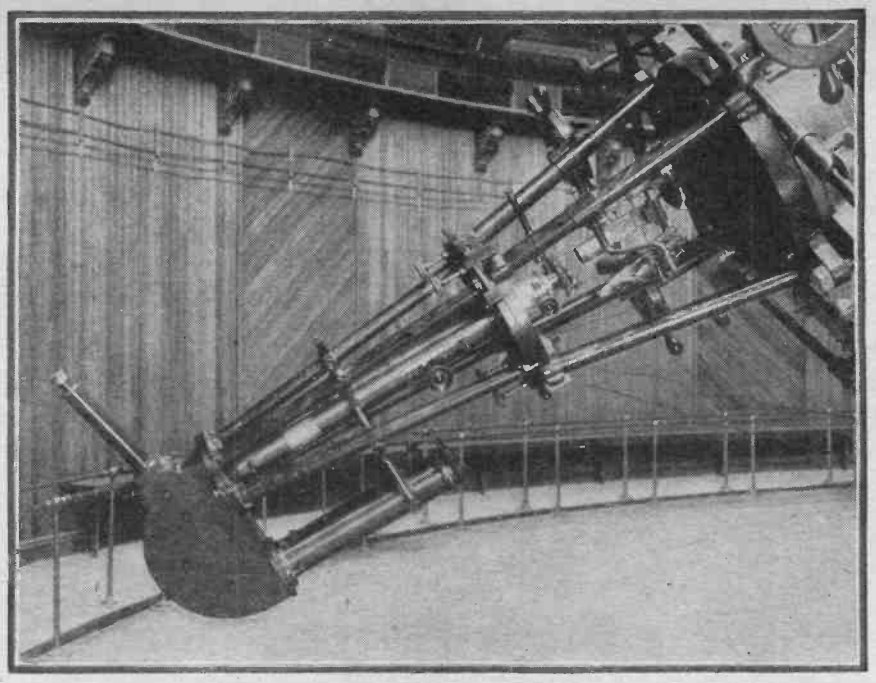
By DONALD H. MENZEL Ph. D.

Of the Lick Observatory



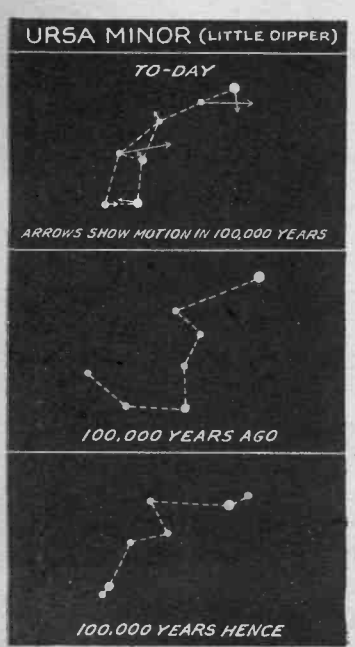
The photograph at the left shows the "Mills" three-prism spectrograph attached to the 36-inch Lick refractor.

THE SPEEDING STARS

The Heavenly Bodies Move With Incredible Velocities, Yet the Astronomer Knows Just How Fast They Are Going and Checks Up on Their Speed by the Colors Which the Stars Emit.

FOR more than a quarter of a century the astronomers of Lick Observatory have devoted a large share of their time and skill to the problem of determining how fast the stars are moving. The stupendous program included about three thousand stars, and its completion invites a review of the entire field of stellar velocities.

The enormous speeds attained by man with airplanes and motor cars sink into insignificance in the face of the tremendous velocities of the heavenly bodies. What is three hundred miles an hour compared with ten thousand or a hundred thousand! The earth, 25,000 miles in circumference, whirls dizzily on its axis once a day. Fortunately we are unconscious of this giddy speed; the earth's atmosphere banks against the solid surface and shares its movement. Only in the rising and setting of the distant stars do we find reflection of the rotation.



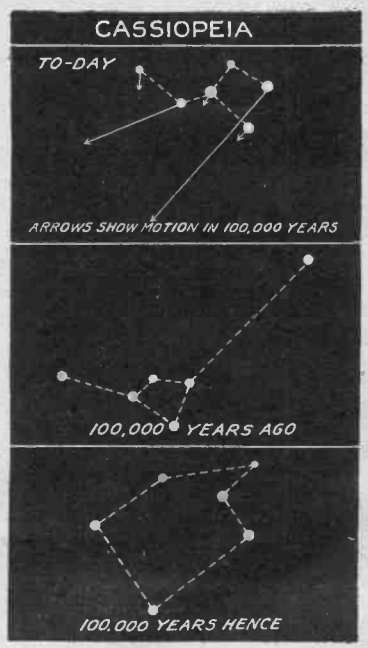
Startling Velocities

A POINT on the earth's equator is moving with a speed somewhat greater than one thousand miles an hour or about one-third of a mile a second. The earth is revolving about the sun nearly sixty times as fast, about eighteen and one-half miles a second. In addition, we find that the sun is traveling in space in a direction not far from that of the bright star Vega, with a velocity of some twelve miles a second, carrying all the planets of the solar system along with it.

But how are these enormous speeds measured? For they must indeed be measured if any confidence is to be placed in them. We are practically unconscious of our motion. The heavenly bodies glide smoothly as though on frictionless bearings. The earth has looped the loop about the sun for millions of years and will continue to do so for countless millions to come. A man on a train that has started to move evenly may have the sensation of being perfectly still, while the rest of the world glides past his view. In the same way, we, on our earth, gain our sense of motion by observing the world about us; of the daily rotation by the rising and setting stars, our yearly swing about the sun by the sun's annual circle of the sky, the motion of the system through space by the changing constellations.

Interstellar Character Reading

THE first two of these phenomena are obvious to anyone who will take the time to look for them. The constellations, however, look very much the same from year to year. In fact, could the astronomer be projected back in time two thousand years or so, his eye could distinguish no difference between the sky of the present and the past. Modern instruments could easily tell the shift; in fact, the great magnification obtained by large telescopes, which are also accurate, enables astronomers to detect the motion of certain stars within the space of months.



Let us imagine that we are on a boat at night, adrift and with no apparent means of telling how fast or in what direction we are moving. We are, however, in a ship-filled harbor, as indicated by the brilliant lights about us. These vessels should be sailing at various speeds, practically at random. If the boat we are on is motionless, as many ships should move to the left as to the right, whatever direction we face.

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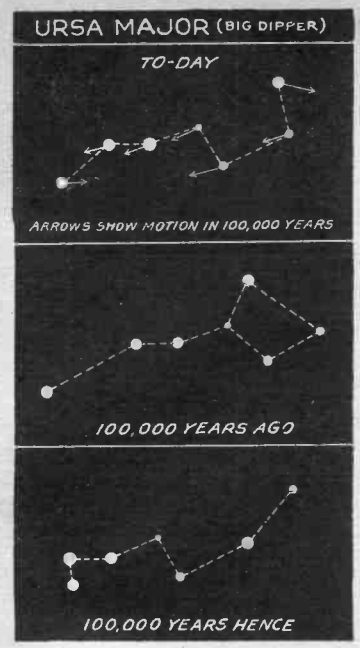


If, however, we find that more ships move toward the west than toward the east, we may reasonably conclude that we are moving eastward, which causes the ships, apparently, to drift westward.

Whither Are We Bound?

SO with the sun among the stars! The observations indicate just such a drift and the point from which the lines of stellar motions radiate is near the bright star Vega—hence the sun and planets are speeding in that direction. Let me hasten to add that Vega has nothing to do with the motion. To be sure, it exerts a minute force of attraction upon the sun, as do all the stars, but their combined influence has been insufficient, as yet, to cause the sun to deviate from its straight-line course. An old hypothesis, unfortunately more widespread than it deserved to be, has received no support whatever from modern observations—the idea that the universe has a central sun about which all the stars revolve. The motion of stars in space is far from a random circling, in fact almost at random—like fireflies in a swarm.

The Changing Heavens

A BILLION years, and the sun with its planets will have sped so far from its present location that most of the familiar stars will have faded into the distance. New vistas of celestial scenery will continually open up before us. Even in a hundred thousand years the constellations will be warped decidedly out of shape, many of them being unrecognizable. The stars of constellations are shown in the accompanying diagrams. The attached arrows representing their motions in a hundred thousand years. It will be seen that each stellar group is slowly falling to pieces but that certain members of it are moving almost exactly in the same direction and with similar velocities. They are, evidently, related in some way that astronomers do not yet understand.

If a star should be moving directly toward us it would appear stationary in the sky. After ages of waiting we should be able to recognize this fact by observing its increasing brightness. Its approach, however, is so gradual that our telescopes are far too insensitive to observe this change in any period of time reasonably short. The problem is to detect this motion toward or away from us by some other means.

A Simple Analogy

LET us suppose that you have made an agreement with a man upstream that he is to drop a chip of wood into the water every minute. If, with watch in hand, you note that the chips float by at exactly this rate, you conclude that the man above is standing still. If the chips pass more often, it proves that he is approaching, if less often that he is receding. In fact, if you know the velocity of the chips you could, by the simplest sort of arithmetic, figure out how fast the man upstream is moving.

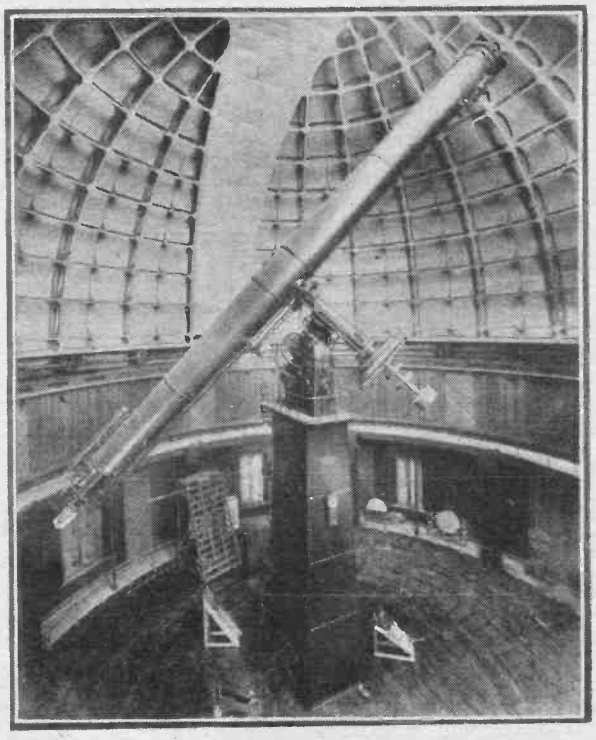
Now, a star, instead of tossing us a wood-chip a minute, is sending out an almost countless number of light waves every second. If 400 trillion waves strike our eye every second, we call the color red; if there are twice that number the light appears violet. Between these two extremes range all the colors of the rainbow. The astronomer collects the starlight with his great telescope and leads the ray, so gathered, through a glass prism which splits it up into a rainbow band—the spectrum. The collection of prisms and lenses is known as a spectroscope.

Star Colors Help Determine Velocity

AMONG the myriad colors that the stars emit we recognize certain ones due to well-known elements of the earth. A given number of waves a second, say 500 trillion, corresponds to a definite color; this number would produce a specific shade of yellow. The element sodium heated to incandescence of its vapor is known to produce almost exactly this color. We assume, therefore, that the sodium atoms of the star are sending out 500 trillion waves a second. If, by measurement of the color, we find that the same number of waves reach us each second, we conclude, as in the chip analogy, that the star is stationary; if we detect fewer waves the star is receding; if more, the star is approaching.

Christian Doppler, in 1842, was the first to suggest that the colors of starlight might possibly be shifted because of velocity. He even went so far as to conclude that the redness and blueness of various stars was due to their recession or approach, an explanation that is now known to be erroneous. The stars are not moving fast enough for that. Six years later Fizeau gave the principle correctly, but it was not until 1890 that astronomical instruments were perfected to the point where measurements of any accuracy could be obtained. Then Keeler, observing visually with the 36-inch Lick refractor, determined the velocities of several stars. Shortly afterwards, photographic methods were developed at Potsdam, Germany, enabling the speeds of many fainter stars to be found.

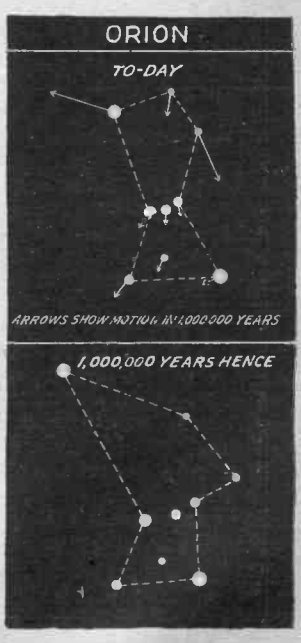
In the middle nineties, Dr. W. W. Campbell (famous astronomer, now president of the University of California) was offered the opportunity of applying the Lick telescope to the problem. He designed a new photographic spectroscope (more correctly termed a *spectrograph*) which proved to be extremely accurate and, after a long series of experiments, instituted a research program for the determination of the velocities of as many stars as could reasonably be photographed with the great instrument. The completion of this ambitious program has occupied the time and skill of many observers for a period of some thirty years.



The 36-inch telescope of the Lick Observatory with which the observations were secured is shown in the above photograph.

In order to extend the work to southern stars, not visible in this hemisphere, a branch observatory was built in Santiago, Chile. During this period about 15,000 photographs have been obtained at Lick and more than 10,000 at the Chile station. Most of the fainter stars have required exposures of from three to four hours for a single spectrum plate. Since 1903, Dr. J. H. Moore has collaborated with Dr. Campbell, having de-

(*Continued on page* 1105)



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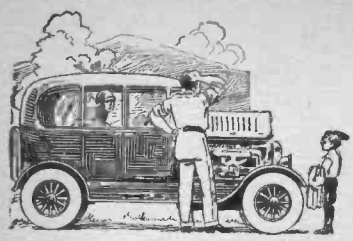
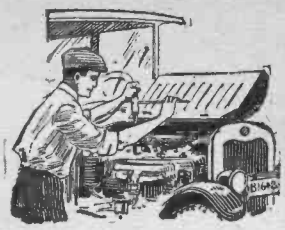


Motor Hints

Conducted by
GEORGE A. LUERS



Valuable pointers for the car owner to help keep auto in condition

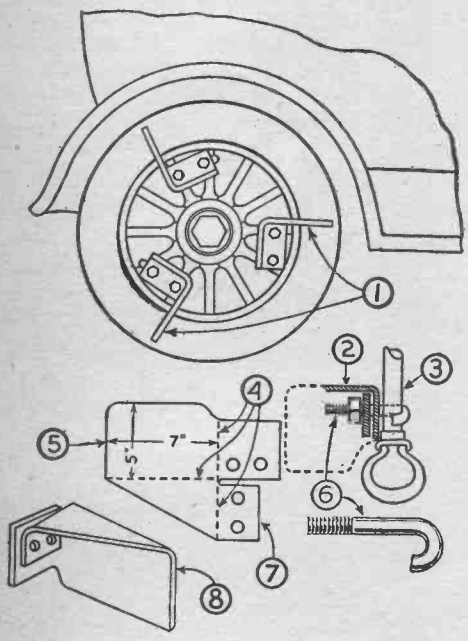
Snow Shoes for the Car

WHEN the deep snows of winter are stalling the sturdiest cars, and motor-driven vehicles of all types are being left in garages, the owner who must go regardless of snows, can find in the attached sketch a simple solution to snow-driving.

With heavy sheet iron, of one-eighth-inch or heavier, cut six plates to the pattern shown in the drawing.

Bend these to form scoops, with bolt holes for securing to the wheel spokes. Make hook type bolts of half inch or heavier rolled iron and provide the necessary nuts, for bolting these scoops to the wheels, as shown by the illustration.

One car owner has used these shoes for driving his car, when it was impossible to go with other cars. In conjunction with these, the usual tire chains are used.



In the above illustration, 1, shoes; 2, fastener; 3, spoke; 4, bend; 5, shoe pattern; 6, hook type bolts; 7, heavy gauge sheet metal; 8, shoe bent to shape.

Aids in Painting the Car

A method available for any car owner to be used in painting his car, is shown in the attached illustration. This system is exactly the same as used by one small capacity car painting shop.

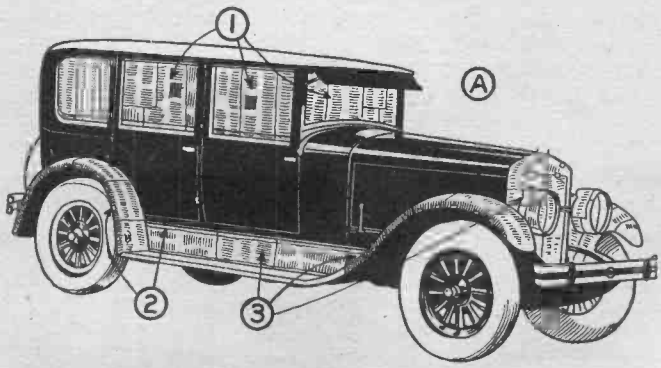
Paper, either news-print or ordinary brown paper, is secured to those parts of the car to be protected from paint splash or the overrunning brush, by a strip of paper or tape attached with thin glue, paste or mucilage.

These protectors are absolutely necessary when painting in contrasting colors with the spray brush. When painting with the hand brush the work can proceed more rapidly where the adjacent surface is protected.

When the paint job is dry, it is an easy matter to take off the tape with a sponge, moistened with warm water, and to wipe the glue from the surfaces.

The only precaution is to have the painted surface dry before putting on the tape holding the protecting paper in place.

Rubber cement can be used to hold paper on glass.



In the above illustration, 1 shows paper placed over all glass; 2, gummed tape holding paper in place; 3, mudguards and fenders protected from paint in the same manner. When painting the car, the use of paper as shown will keep the adjacent surfaces clean.

Tool for Removing Battery Lugs

Many methods have been given for the removal of tight battery terminals and the writer has previously given what he found at the time to be the best ideas on removal of terminals.

The method and tool shown in the sketch on page 1089 were recently found in use by the writer in an obscure country service station, and the writer is willing to award to this tool, the fullest credit for simplicity and serviceability.

Two pieces of rectangular bar iron, forged into the shape shown, and secured by a rivet hinge, were the full details of the tool. This was a shop made device, none too perfect in finish, but on the operation, finish did not cause any difference. The leverage afforded by the handles and the peculiar grip, were responsible for the effectiveness.

A similar tool can be made up of material from almost any scrap heap and will last the car owner a life-time. This saves hours in difficulties with terminals.

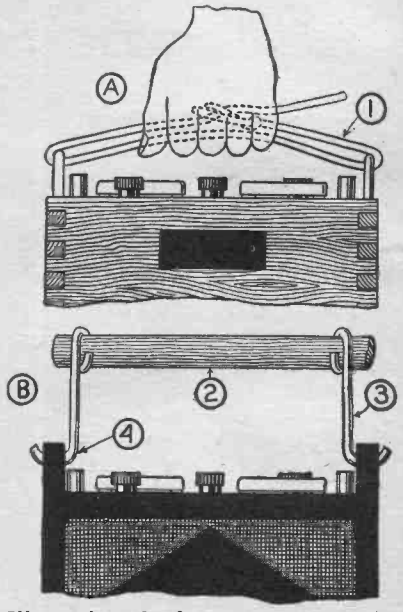


Illustration A above shows a carrier for a metal handle battery. The leather strap and buckle are shown at 1. Illustration B shows how a rubber case battery may be carried. A length of broom handle or wood is indicated at 2; 3 shows iron wire, and 4, the hook.

Use Care in Handling Storage Batteries

The storage battery must be lifted vertically to remove it from its place, and it should be carried upright to avoid spilling the electrolyte.

During the cold weather, it is necessary at times to remove the battery from the car, and connect to a charger. Some motorists do this once each week, thus maintaining the battery charge at full capacity.

Lifting a wooden case battery, with metal handles, from the battery bracket, is simply and expeditiously done with a leather strap, as in the upper part of the illustration.

The handling of a rubber case battery, should be done differently. Use a wooden handle, such as a section of a broom handle, with two hooks made of iron rod. This carrier handle is shown in the bottom of the sketch. Use this carrier to avoid strain on the handles of a rubber case battery, as these break off readily, especially in winter.

Licenses and Maps Stowed in Curtains

License cards and operator-

(*Continued on page* 1089)

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Tricks with lighted candles are a usual favorite with the average audience and always have a tendency of convincing spectators of the magician's ability, because of the fact that he is considered clever who is capable of handling burning objects. After displaying both hands empty, he reaches into his vest pocket and withdraws one lighted candle after the other. The illustration describes the effect. The candles are mounted in a clip and as one after the other is withdrawn, it is lighted in the same fashion as an ordinary pocket lighter. If desired, the top can be a feke, which can be removed and the candles passed for examination after each one is produced.

INTERESTING TRICKS FOR ANY ENTERTAINER

Tricks for Amateur, Parlor, Lyceum and Professional Entertainer

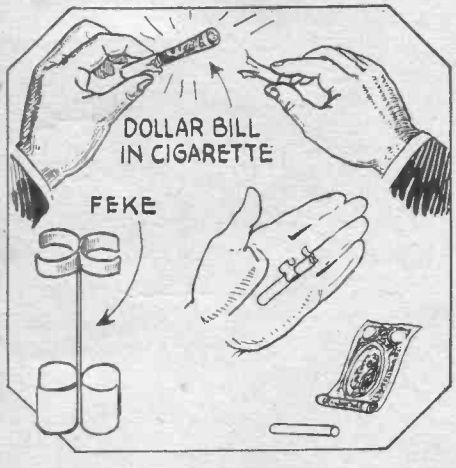
Magic

By DUNNINGER

NUMBER SIXTY-SEVEN OF A SERIES

Bill in Cigarette Trick

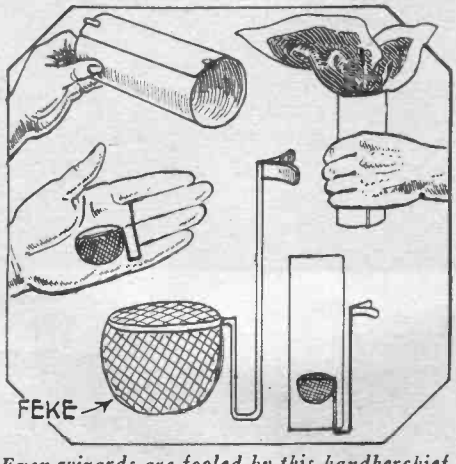
THIS is a very impressive after-dinner trick. The magician borrows a dollar bill and causes it to disappear (by means of a pull or any of the other methods previously mentioned). So as not to be different, he borrows a cigarette, then breaking this open, he withdraws the dollar bill previously vanished. The trick is performed by aid of the feke illustrated. A cigarette from which the tobacco has been removed is stuffed with a dollar bill, the numbers of which have been previously memorized. This cigarette is then put in the feke. When the performer borrows a cigarette, he substitutes it for one in the feke. In order to enhance the mystery, the performer on borrowing the dollar bill, reads its numbers aloud, but in reality calls off those numbers of his own concealed bill, which he has memorized.



By means of the feke here illustrated, the performer can cause a dollar bill to appear in a borrowed cigarette.

The Enchanted Cylinder

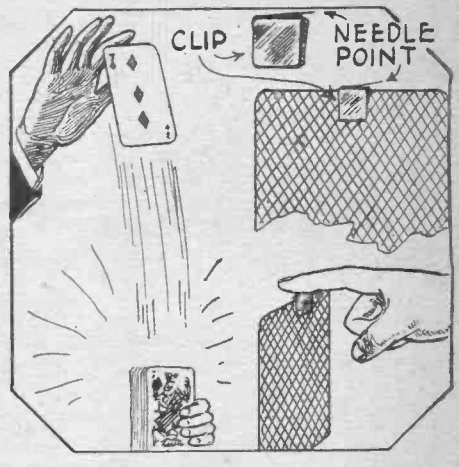
IN this effect the performer makes a cylinder of paper about 3 inches in diameter and 8 or 9 inches tall. This is held in shape by a couple of clips. After the cylinder is examined, it is returned to the performer, who, holding it in his outstretched hand, reaches into the tube with his other hand, and mysteriously produces a large silk handkerchief. The cylinder is ordinary, but the feke constructed similar to the illustration, supports a cloth cup which holds the handkerchief. The bent arm of flesh-colored wire permits the feke to be moved well up into the cylinder. While this stunt appears to be very simple, in reality the effect which it produces on the audience is unusual, to say the least. The feke can be passed from hand to hand, if needed, and for that reason the stunt has puzzled experts.



Even wizards are fooled by this handkerchief production easily accomplished by the feke shown.

The Magnetic Card

AN examined and an unprepared deck of cards is held fan-wise in the outstretched hand and offered to the spectator, who is requested to make a free selection, and remove the card thus chosen from the pack. Someone else is then asked to mark it with initials. The card is returned, shuffled into the deck, the magician rubs his finger across the top of the deck, and the chosen card mysteriously sticks to it. The effect is accomplished by aid of a small spring steel clip to which a needle point has been soldered. This clip is attached to the card as it is returned to the deck. It should fit the card firmly enough so that it will not shake loose in shuffling. The needle merely pricks the skin and consequently the card rises as the finger is lifted. The clip is removed from the card and palmed.



A clip attached to a card as indicated in this illustration causes the card to mysteriously cling to the finger.

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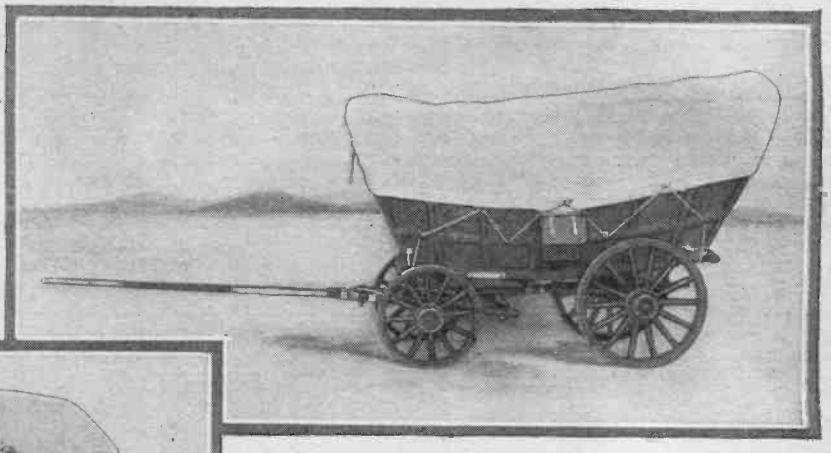
Model Department

Wagon Reminiscent of the Days When the California Gold Rush Occurred Wins This Month's Coveted Trophy Cup

HERE is a model which can easily be built by the model maker who is interested in woodworking. With the exception of a few pieces of cloth the rest of the construction is of wood. One does not need a completely equipped tool shop to duplicate this model, yet such an equipment always facilitates any job. While the photographs on this page show different views of this prairie schooner, the model must really be seen to be thoroughly appreciated. Painted with a flat color, its white cloth top and metal-banded wheels produce a striking contrast. The faithfulness of detail in this construction makes everyone who has once seen the model long to duplicate it.

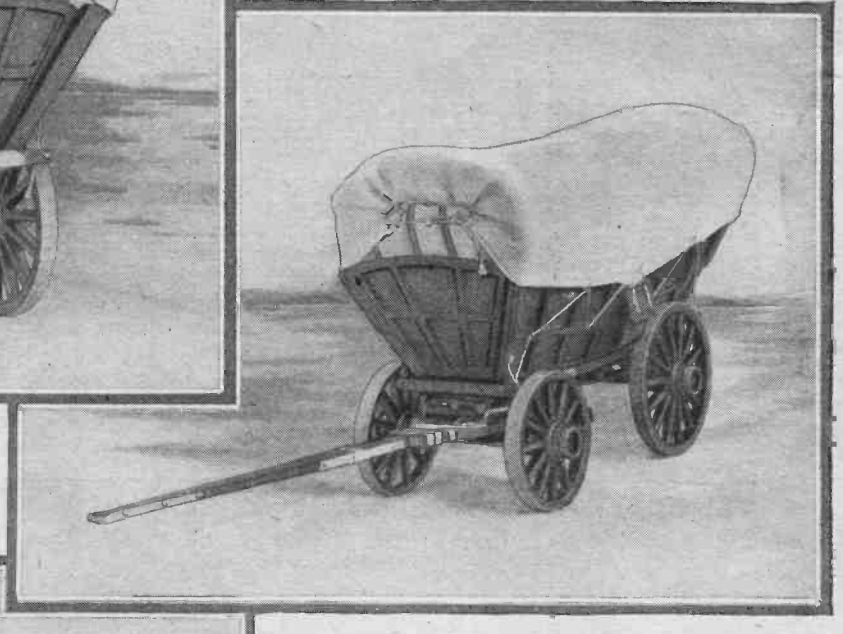
A trophy cup is monthly awarded by this publication for the best model submitted during any one month. In the present issue the award goes to Mr. Alfred Slater, of Cleveland, Ohio.

For rules of the model contest, see page 1100.

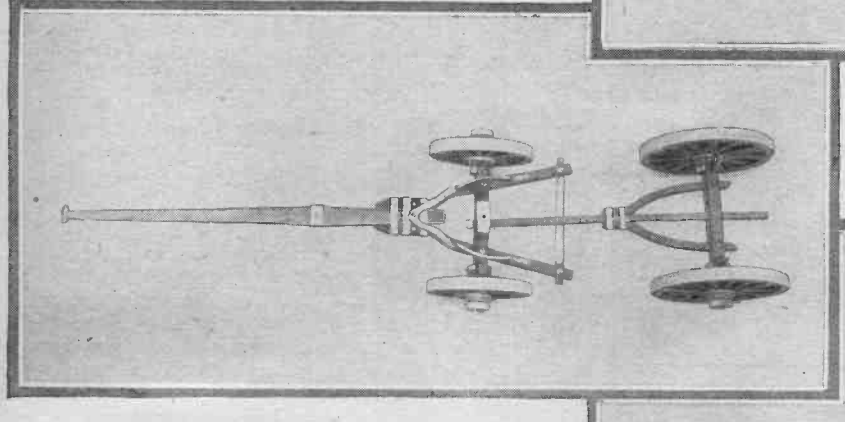


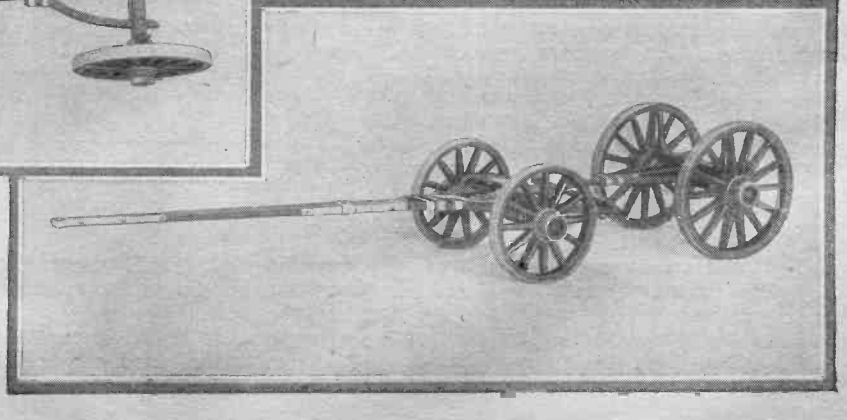
Here is a side view of the trophy cup winner in this month's model contest. Note how the canvas top is laced in place.

Here we have a three-quarter rear view of the prairie schooner which will give one a fair idea of the construction of the under carriage from this point. Note metal-tired wheels. The back of this wagon is removable.



A three-quarter front view of the model. In this view as well as the one diagonally to the left, one can see the wooden ribs over which the top is stretched. For further details, refer to the diagram on the next page.





The photograph above and the one at the right shows the construction of the carriage. The builder has faithfully reproduced the metal banding at all those points where wear is likely to occur and those which require reinforcement in the full size construction. The entire top of the model can be removed so that one can easily examine the carriage.

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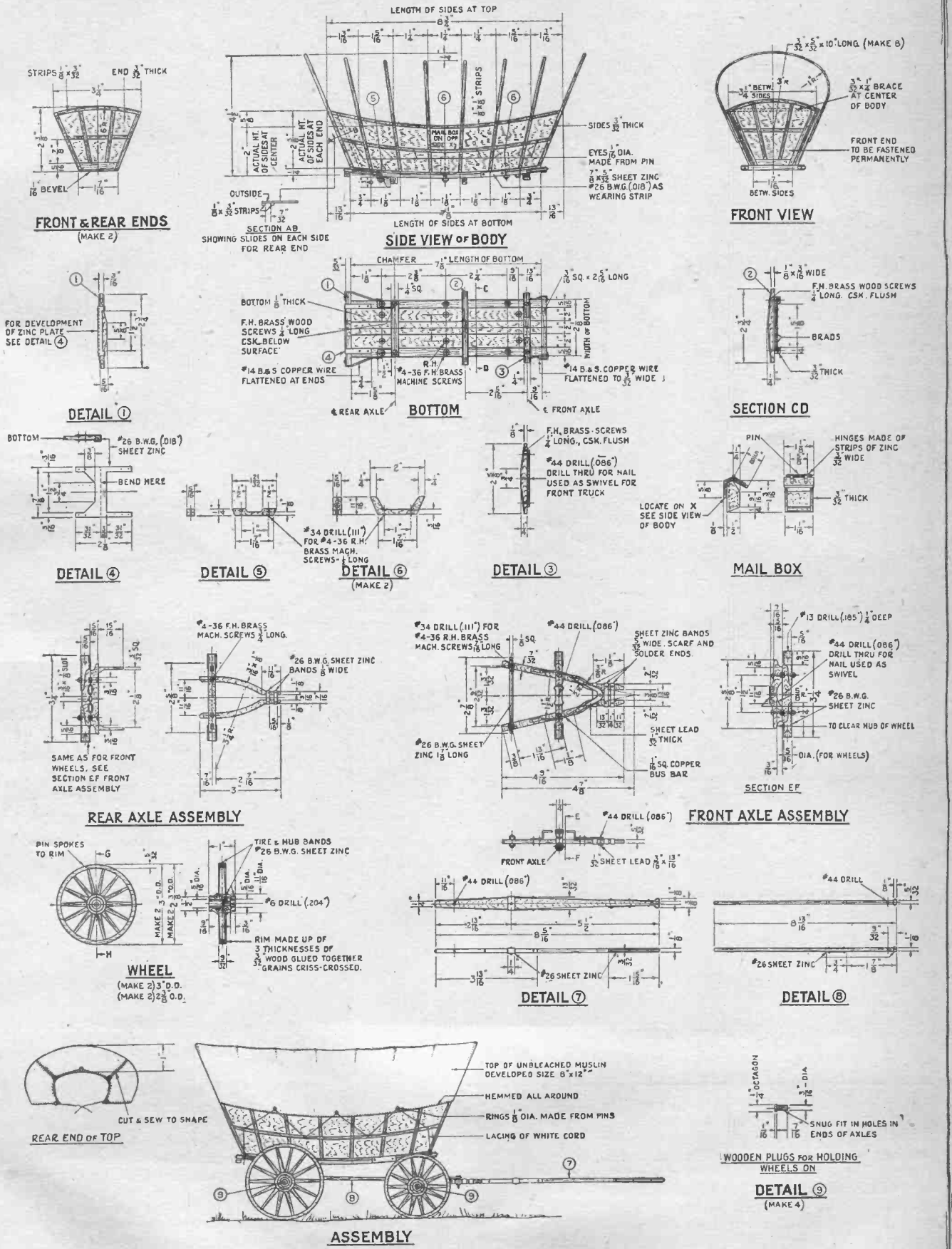
Construction Details of Prairie Schooner



Made almost entirely of wood, the prairie schooner here illustrated is an interesting addition to the model enthusiasts' collection. The assembly and all the details for duplicating a model similar to the one which won the Trophy Cup for the present month is clearly given in the diagram above. For contest details see page 1100, where the rules governing this department are given.

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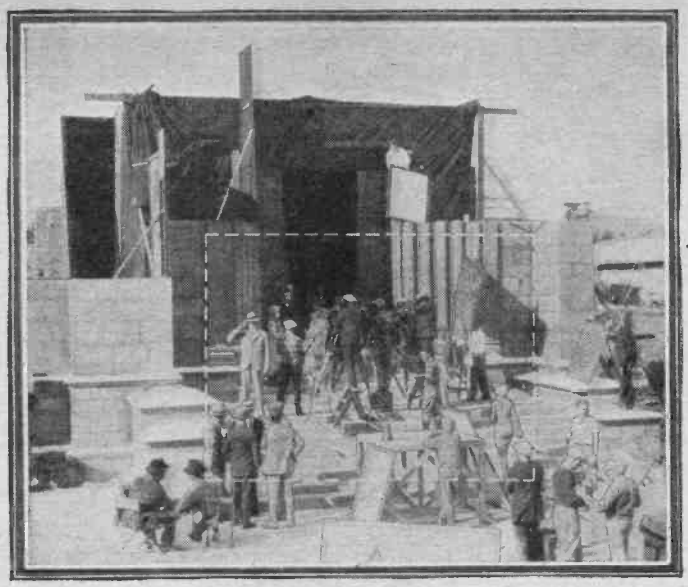
Details of a Complete Amateur Moving Picture Studio are Given Together with Hints on the Filming of Photoplays



The photograph at the left shows the reflecting screens in use. The dotted lines show the portion of picture taken in by the camera.

HOME MOVIES

By

DON BENNETT

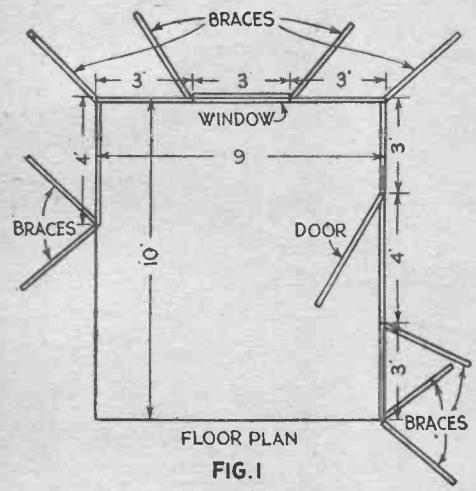


FIG. 1

The floor plan of the studio appears in the above drawing. This measures 9 ft. x 10 ft. Note the placement of braces.

All residents of Rockland interested in forming a

MOTION PICTURE CLUB

are invited to attend a meeting to be held in the

HIGH SCHOOL

Thursday Evening at 9 P. M.

George Jones will speak

THIS notice, typewritten and tacked to telephone poles at strategic points around Rockland had resulted in the gathering of slightly more than a score of Rockland's cine amateurs in the auditorium of the High School.

In the center of the platform were seated a few of the more enthusiastic amateurs and seated beside Jones, behind the speakers' table, was his star customer, Blake. Mr. Blake arose to start the meeting.

"Gentlemen," he said, "it has been my pleasure recently to become a devotee of this most fascinating hobby, *home movie making*. Like you, I have called on our friend Jones many times for advice and help. Likewise, my films have shown a constant improvement because of his guidance. The idea came to several of us to start a *Movie Club* in Rockland for the exchange of information and ideas. We might even band together to beat Hollywood at its own game, that is, to produce a film with Rockland talent and Rockland staff.

"Mr. Jones has very kindly consented to tell us tonight what is necessary for the production of regular story or dramatic films, and, if after his talk you are in favor of producing some films, we will appoint organization and production committees and get our club under way. Mr. Jones—"

"Mr. Chairman and gentlemen: It has given me much pleasure to see the improvement from week to week in your personal films. When Mr. Jones suggested the formation of the club I thought it would be a wonderful idea to band together for the production of a few one-reelers with local talent. The Dramatic Club should be able to supply a director and the necessary actors and we can certainly find enough cameramen in this group.

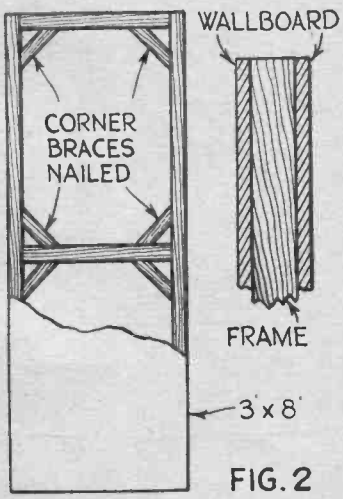


FIG. 2

Above is a sectional view of a "flat" showing the bracing and interior construction.

"A film can be made, of course, with nothing but exterior locations, but there is always something lacking in such a film. It seems too amateurish, too crude. What we should do here in Rockland is to build a miniature studio, one that will be inexpensive and yet will fill our needs. Some scenes we can get in members' homes, but that entails the installation of artificial lighting equipment and might prove bothersome.

"For a hundred dollars or so we can build sets and all the equipment that will be needed. This is figured with volunteer labor in mind. Some of us who are handy with tools can construct the *flats*, our amateur decorators can finish them off and we can gather enough furniture from the various homes to furnish the sets."

"I have prepared a few drawings that will show you how simply the studio can be built, and if you will all move in close to the platform I will explain them. This (Fig. 1) is a floor plan of the studio. You will notice that it only has two complete sides and a part of the third side. That will give the cameras plenty of room to move around and still include enough

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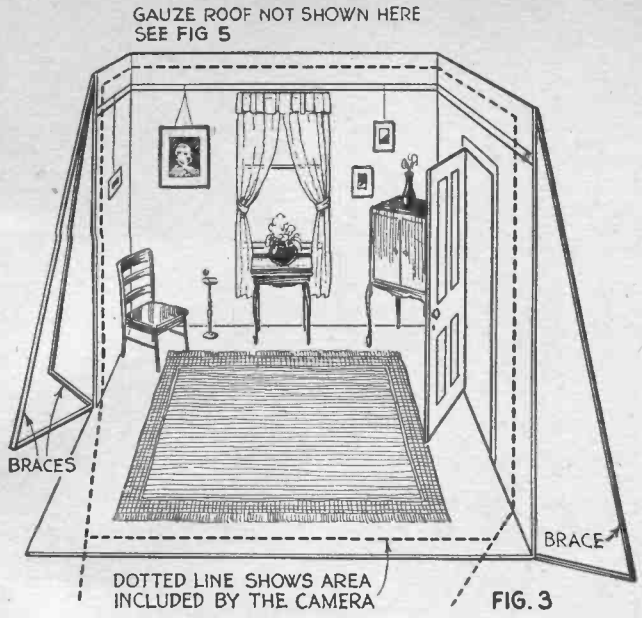

FIG. 3

Above is an interior view of an amateur set, the dotted lines showing the area included by the motion-picture camera.

to make the scene appear to be laid in a full-sized room. The long wall is ten feet long and eight feet high, the short wall nine feet long and the same height. The small extension that forms the third wall is four feet long and eight feet high.

"The walls are made up of *flats,* which are simply wooden frames covered with wall-board and decorated. In regular studio practice only one side is used, and the other side is open to allow for clamps that hold the flats together. For economy's sake, we will nail our flats top and bottom to a batten (Fig. 2) and thus be able to decorate both sides so that they can be easily and quickly turned around, while we are in the midst of a production.

"After the flats have been fastened together they are covered with cheap wallpaper and trim. The wallpaper extends to

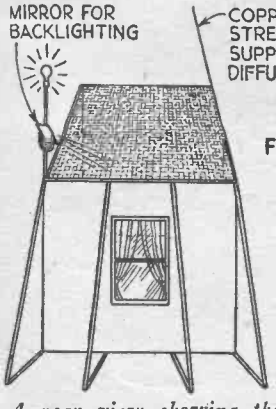

FIG. 5

A rear view showing the bracing, gauze roof and mirror for back lighting.

the regular trim and above that is placed a plain paper of some light tint. Of course we can't use white, because it would cause halation and spoil our films. As we are going to erect this set out-of-doors and use natural daylight, we must find some way to control it. The simplest way is to go back twenty years in the motion picture industry and use some of the ideas employed in those early days. In this sketch (Fig. 5) you will see how gauze placed above the set diffuses the light and prevents dense, sharp shadows. This diffusion cuts down our light somewhat but we can compensate for that by opening the diaphragm of the lens a trifle. We will throw some light into the set by the use of reflectors and mirrors, and in order to get *backlighting* and *top lighting,* we will mount mirrors above the top diffusers that will throw a diffused beam of light through and on the subject. Additional reflectors can be used at the side for the same effect when a little stronger light is needed.

"Now, let us consider the details of the set itself. The story may call for a door and a window. In this case we use a flat that has a complete door jamb built into it or a window frame complete with sash and weights. The door and the window both work and you must remember that they both need additional bracing. As these frames are built flush on the inside, we can only use one side unless we build another flat on the other side of the frame. This will make them quite a lot thicker and heavier, but would probably speed up production considerably.

"The flats measure three feet wide by eight feet high. They are made of one by two inch strips nailed together with corner braces and a center cross-brace. After covering with beaverboard they are assembled on the battens and braced in place. The braces are odd pieces of wood, tacked to the top of the set and to the floor at the bottom, sloping outward at an angle of thirty degrees or more. The flats that contain the doors are four feet wide, allowing a few inches on either side for support. Above the door, the flat runs to the height of the rest of the set, eight feet.

"The window flat is three feet wide, the same as the rest and the flat runs above and below it. If you decide to make the doors and windows two-sided, build up a framework around each one, so that the flats will be flush on either side. Doors should be hung so that the person entering is not hidden from the camera, unless that is the purpose of the story. Doors usually swing inward and with that in mind, braces should be placed so that they do not show in the camera when the door

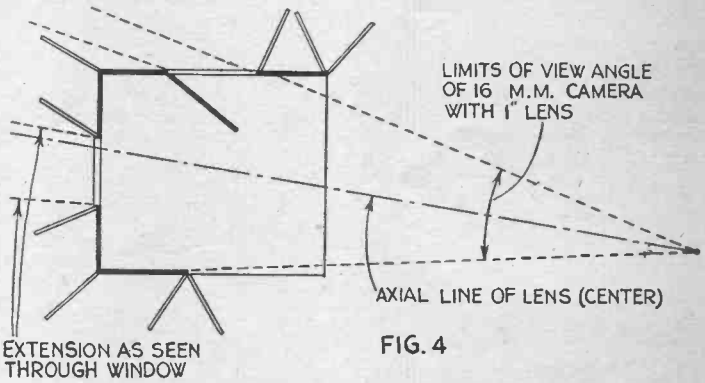

FIG. 4

"Camera angle" of set showing how the braces must be placed, so that they cannot be seen through doors and windows.

is opened. These dotted lines on the sketch (Fig. 4) show the places the camera penetrates to under every condition when it is in 'long-shot position' or the maximum distance from the set.

"In arranging the furniture it is well to bear in mind that because of perspective, small pieces should be placed near the camera while the larger pieces are set in the rear. A rug should be put on the floor of the set, which should be covered with linoleum. Brown linoleum photographs neutral and therefore is ideal for the purpose. If you were taking a ballroom scene and wanted to get the effect of a mirror or highly polished floor, black linoleum of a high polish would give the effect that a polished floor or mirrors would not.

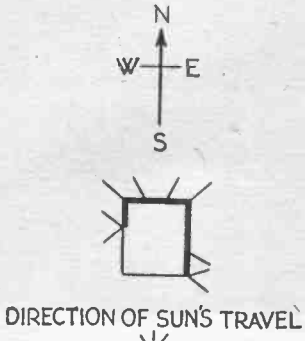

FIG. 6

The geographical layout of a set for exterior use is shown here.

"The walls should be decorated with pictures or hangings that are in keeping with the story. That is one point that must be watched, to follow the script accurately as far as the furnishings and

(*Continued on page* 1112)

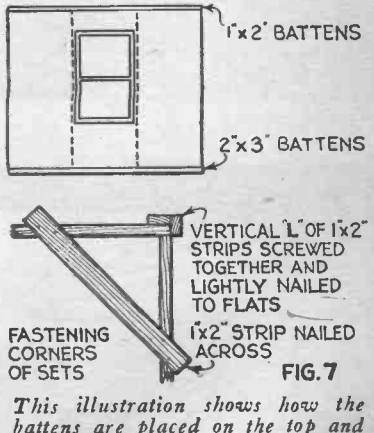

FIG. 7

This illustration shows how the battens are placed on the top and bottom to stiffen the sides. Strips may be tacked along the seams on the outside to prevent warping.

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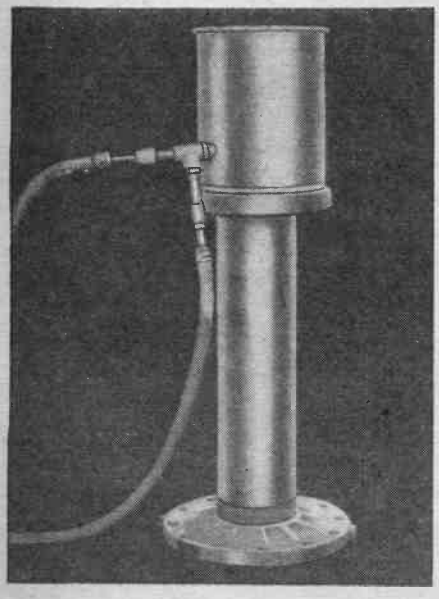
EXPERIMENTAL
CHEMISTRY *and* ELECTRICS

A Home-Made Melting Furnace *for the* Amateur Mechanic

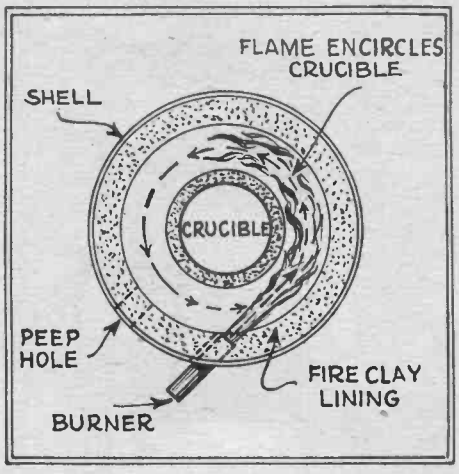
By RAYMOND B. WAILES



The above photograph shows the furnace ready for work. The stand is made from a section of 8-inch pipe with a flange at each end.

A HEAVY iron can, some fire clay and pipe fittings are the main things in making this handy high temperature melting furnace. Operating with illuminating gas and compressed air, temperatures up to 2800 degrees Fahrenheit can be obtained, although it will be found that with some low melting fire clays, the lining of the furnace will melt out with this source of heat. Given enough supply of gas and air, practically all the temperatures required by the mechanic and laboratory worker can be had from the furnace. Unless a high temperature fire clay is secured, the furnace cannot be expected to produce extremely high temperatures.

The furnace proper is made from an iron can such as used to contain red or white lead. A hole large enough to admit the burner which is made from ¾ in. pipe, is made in the side of the can, three inches from the bottom. A sight hole about an inch in diameter is made half way up the side of the can. The refractory lining is made from a high temperature cement, or fireclay, mixed with water and poured while stiff into the furnace shell, a form being placed inside of the furnace so that a wall thickness of three inches is obtained. When sufficiently hard, the form is removed and the burner and sight holes are bored through the wall. A three-inch bottom of fire clay is used.



Above is a sectional view of the furnace. The construction is made clear in this illustration.

The burner is made from three-quarter inch gas pipe fittings as shown here. The inner pipe B is quarter inch pipe and is screwed into the reducing socket from the inside. The air pipe is also of quarter inch stock and screws into the reducing socket from the outside. The gas supply should be half inch.

The burner flame plays about the crucible contained within the furnace in a rotary manner, for the burner is placed tangentally to the furnace. In this manner, no local heating of the crucible occurs and hot and cold spots within the furnace are practically eliminated. A cover for the furnace can be had from two standard fire bricks, but when the furnace is in operation, these should not fit so tight upon the mouth of the furnace that the combustion gases are retarded.

The mixture of air and gas should be such that with the burner out of the furnace, no yellow flame is seen, and yet not too much air. This type of flame can be secured by shutting off the air so as to produce a smoky yellow flame and then slowly admitting the air through the central tube of the burner until all of the yellow flame just disappears. The burner can then be placed into the furnace.

Before the furnace is used, it should be dried out in a warm room and the first heating up of the furnace should be done with a very small flame, allowing half a day continous heating before the furnace is brought up to full heat.

It will be found that the furnace will not work well when it is first started up, due to the cold walls, but after some heat has been soaked up into them combustion will be more complete and the temperature can be closely controlled by the operator.

The peep hole should be loosely plugged up with a piece of fire clay brick cut to the shape of a bung. A pair of blacksmith's tongs will be found necessary to remove the cover and take out the crucible when the heating operation has been completed.

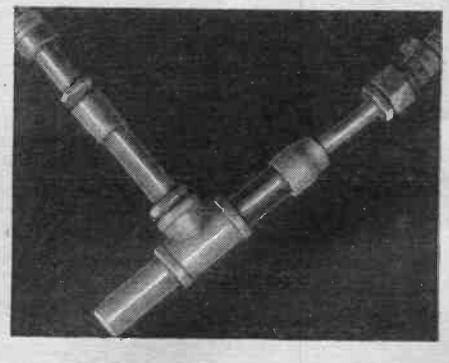
A fireclay or Hessian sand crucible should be used. They can be purchased very cheaply from dealers in laboratory and smelting supplies.

The heat of the furnace is dependent upon the pressure of the gas, the efficiency-thickness and thermal conductivity of the refractory wall used, radiation effect and dryness of the compressed air used.

With care in following the constructional details given here, the amateur should have no trouble in making a melting furnace which will develop temperatures up to 2,800 degrees F., when operated with ordinary illuminating gas and compressed air. The actual outlay in money is not large as the burner is made from pipe fittings, and the furnace shell is an iron container which can usually be obtained from paint stores or the local painter. Cans such as used for containing white lead or red lead are admirably suited for the furnace. The crucible and fire clay are inexpensive. It is well to use a high temperature fire clay if the furnace is to produce high temperatures. Low melting clays will melt out.

Many experiments can be tried with this furnace which otherwise could not be performed.

(*Continued on page* 1091)



The burner of the furnace is made from pipe fittings as shown in the above photograph. The inner pipe is made from ¼ inch fittings.

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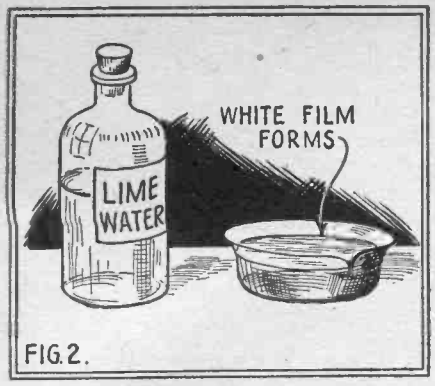
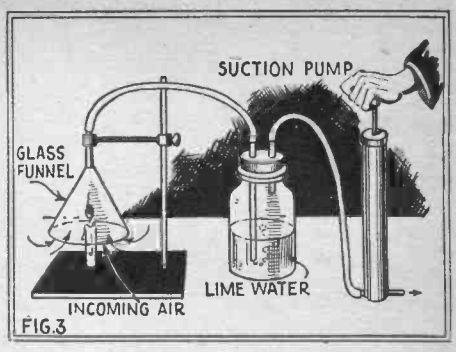
The Air We Breathe

By WILLIAM LEMKIN, Ph. D.

Simple Tests Reveal the Composition of the Atmosphere Which Surrounds Us

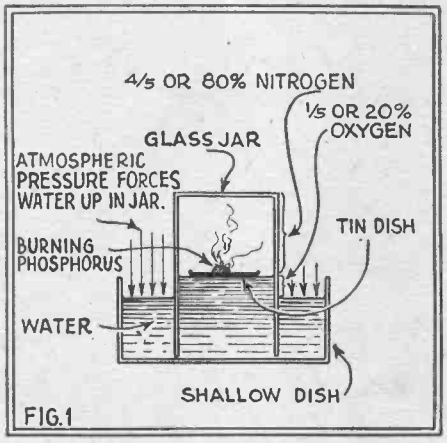


The white coating of calcium carbonate which forms on the surface of lime water is an indicator for carbon dioxide.



The above illustration shows how to demonstrate that carbon dioxide is formed when a candle burns in air.

HAVE you ever stopped to realize that we all live at the bottom of a great invisible ocean—an ocean of air? This vast sea which is known as the atmosphere extends from the earth's surface up to a height of from one hundred to five hundred miles or more; becoming thinner and more attenuated the higher we go. Although we cannot ordinarily see this mighty ocean we are frequently aware of its varying currents as they sweep and flow about us. Usually its waves and eddies are gentle in their motion, giving us our common breezes. At other times its wind-currents are stirred to a furious pace, becoming even more violent and destructive than the storm billows of the ocean. These disturbances are our familiar tornadoes, cyclones, hurricanes and typhoons.



The above experiment shows the composition of the air. As the oxygen is used up water rises in the jar. A candle can be used in place of the phosphorus.

Air occupies all space about the earth not filled by solids, liquids and other gases. It fills all the crevices between the particles of matter in wood, and other porous substances, etc. It fills every room in your house. It is contained in the ground sometimes to a depth of twenty feet, being forced into the earth both by its own weight and by the pressure of strong winds. Indeed, air may be regarded as an all-pervading substance.

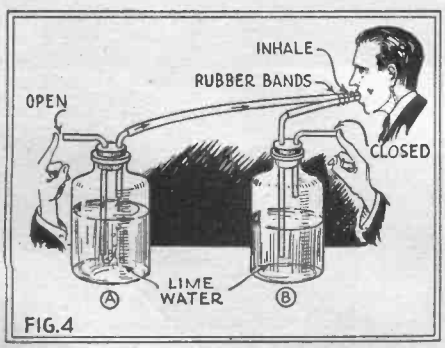
Our Ocean of Air

THIS huge air ocean is valuable to us in numerous ways. It carries our sound waves, supports our airships and flying machines, furnishes us power to operate mechanical devices. But most important of all, it makes life itself possible. Without air all forms of animal and vegetable life would speedily die, leaving the earth a great barren waste, similar to our own moon and other celestial bodies that possess no atmosphere.

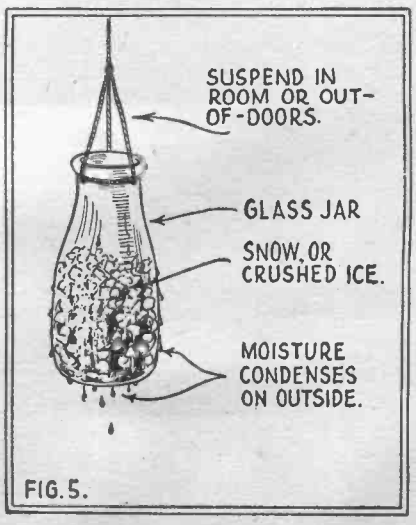
Probably no subject, as important to life as the air we breathe, is so little understood by the average layman. Moreover, there is no subject the ignorance of which gives rise to so many evils. It is important that people in general should obtain a knowledge of the relation of pure air to health and efficiency. It is only by having a fundamental knowledge of the properties and functions of the atmosphere that the average person will be able to understand and apply the facts to the betterment of his health and well-being.

The fact that we are enveloped on all sides by this gigantic sea of air, its abundance and ease of handling, coupled with its extreme importance to mankind in a host of diversified ways, makes the experimental study of its chemical properties and physical peculiarities a relatively simple and highly profitable one for the amateur scientist. The more attractive does it appear, when you realize that to delve into this fertile and instructive field requires the use of the most commonplace chemicals and apparatus usually found in the laboratory of the home experimenter.

If we look back in the history of the development of science, we find that it is only about one hundred and fifty years ago that we began to obtain a really accurate idea about the nature of air. The early philosophers in the time of Aristotle (about 350 B.C.) believed that there were four elements—earth, air, fire and water. This concept, that air was a simple element, persisted for many centuries, with but slight modification. With the work of Priestley, Scheele and Lavoisier in the latter part of the 18th century, chemists began to realize that the air, far from being a pure element, is a mixture of a number of gases, chief of which in its functions is the life-giving oxygen. The nitrogen is an inert diluent. The work of a group of later investigators determined the exact composition of the atmosphere and the relative importance and usefulness of the various constituents. Even at this very day we are not by any means thoroughly familiar with all of the mysteries embodied in the study of the air. Scientists are still engaged in (*Continued on page* 1107)



Above is a test to show the relation of carbon dioxide to our respiratory process. It proves that exhaled air contains considerably more of this gas than the air which is inhaled.



The drawing at the left can be used as a simple proof that air contains water vapor. A glass jar containing snow or crushed ice is suspended out-of-doors or even in the room. After awhile the moisture in the air will have condensed upon the outside of the jar. The water vapor or moisture present in our atmosphere is one of the most important of the component gases. The hotter the air the more moisture it can hold without precipitation. Humidity is an expression of the water vapor in air.

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The Constructor

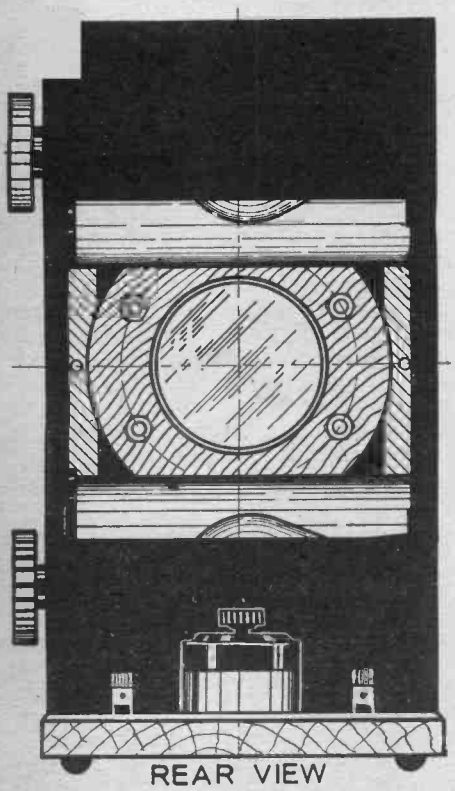
A Home-Made Reflectoscope

By R. J. ROBBINS

THE instrument about to be described will be found very interesting to build and may be made quite useful for either entertainment or instruction purposes. Radio clubs in particular should find this projector well adapted for use in class work for illustrating pictures, circuit-diagrams, formulas, etc. Inasmuch as specially prepared slides are unnecessary for this type of projector, its advantages over the conventional stereopticon would seem manifold.

The first lanterns of this type, the writer believes, were constructed with but one lamp, which was located to one side of the focussing tube. In the writer's early experiments an arc was used. The resulting illumination was therefore very weak and only a small percentage of light finally reached the screen through reflection from the picture. The body of the first machine was made from wood, which also proved unsatisfactory on account of the heat developed by the arc.

How to Build an Instrument Which May Be Used for the Projection of Pictures or Diagrams, Making It Both Entertaining and Instructive. The Placement of the Lamps and Reflectors Has Been Arranged so That an Intense Beam of Light Is Directed Upon the Surface to Be Projected. This Instrument Has Been Designed for Practical Use and Is Not Merely a Toy



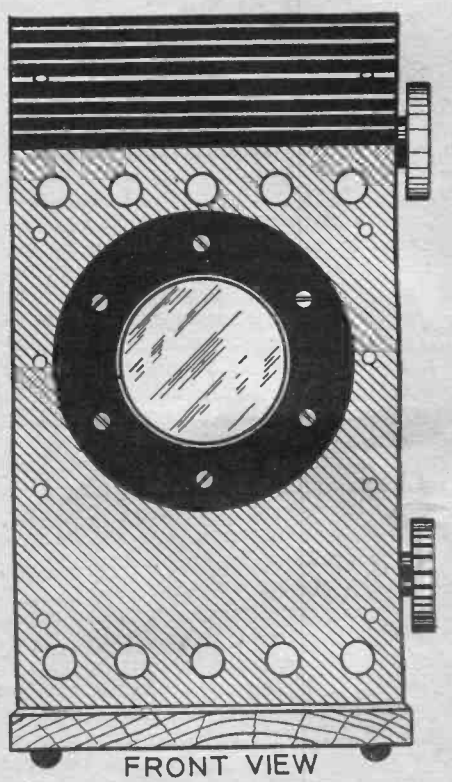
The above illustration shows a rear view of the completed instrument. The body is best made of sheet or galvanized iron.

The accompanying drawings show the layout of the projector finally developed. It will be seen to be composed of a heavy baseboard on which is mounted the lamphouse and control-switch. The sockets for the two high-power incandescent lamps are fastened to the inner side of the projector above and below the focussing tube as shown and are placed exactly concentric with the rotating reflectors.

The placement of lamps and reflectors has been so arranged that no direct light can escape through the lens but very intense beams may be directed upon the surface to be projected.

The baseboard is first cut from a piece of clear-grained oak which has been planed to a thickness of ¾-inch. It is next cut to a size of 15 inches by 7 inches, after which the upper edges are given a slight bevel with a plane for the sake of appearance. It may later be given a coat of stain and finished with shellac. Four rubber tacks of the ½-inch size, serve as points of support and are driven into the under side about ¾-inch from each corner as shown.

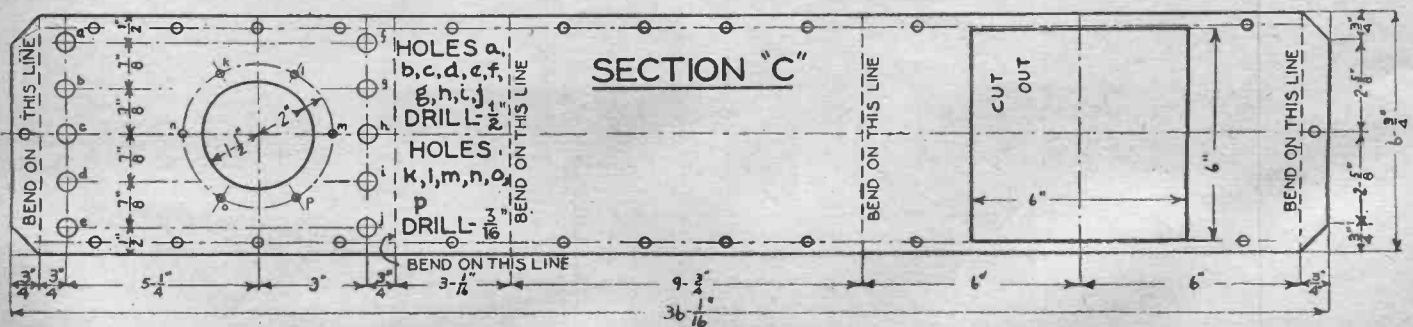
The snap switch is one of the small type and is mounted on a line drawn centrally and at a point located 1½ inches from one end of the baseboard. This completes the work on this part of the projector.



The completed instrument when viewed from the front will apear as shown above. The focussing tube is about 3 in. in diameter.

Body of the Projector

WE will next proceed with the construction of the body. This is preferably made of black sheet iron though it will be possible to use galvanized iron or any other metal for that matter if the constructor wishes to go to the trouble later on of painting the interior a dead black. This will be necessary as otherwise too much light will reach the lens due to excessive reflection from the bright metal surfaces. Inasmuch as the successful operation of this type of projector depends upon the reflection of light from the surface of the picture or print placed in the exposure aperture, we cannot afford to have any



Section "C" is shown above in detail. The dotted lines show where the metal should be bent at right angles. A right angle bend is first made at the end nearest the hole for the focussing tube, then at the other points indicated. The two rows of ½-in. holes provide ventilation. This section forms the front, top and rear of the projector. This reflectoscope is useful for many purposes.

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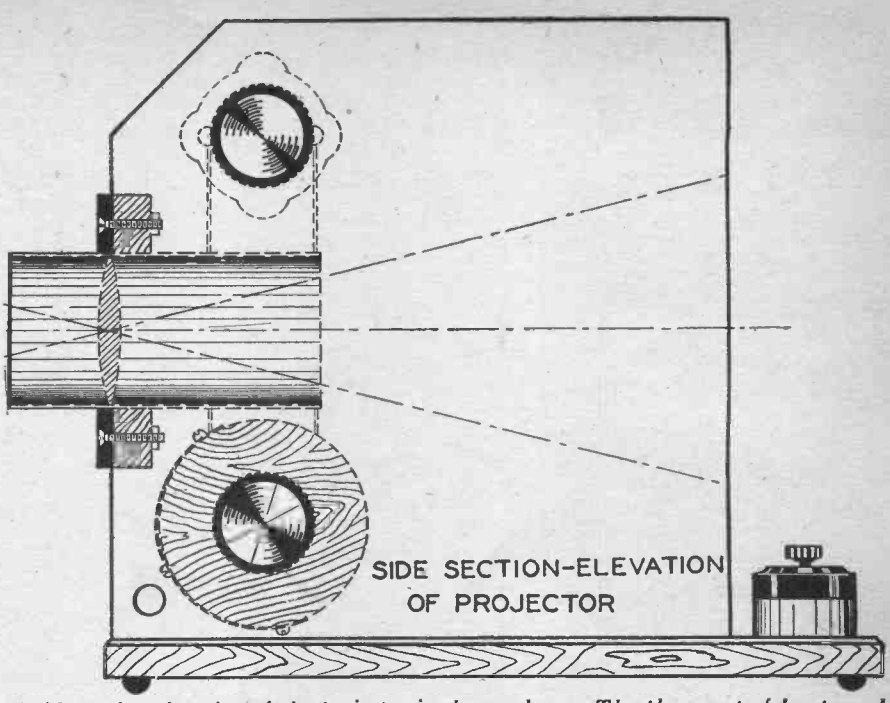
undue reflection finding its way to the lens from other sources.

It would have been entirely possible to have laid out the body of the machine as a single piece, cut it out and bend it together, but the wastage of stock would have been excessive so the writer built his in three sections. These have been designated in the plan views as sections "A," "B," and "C." The first two, covered by a single drawing, gives all information necessary for constructing the side pieces while the latter is seen to be a long strip which may be bent into shape in five places to form the front, top and rear of the projector. Before cutting this piece into shape, perhaps it would be well to cut out the two openings shown for the focussing tube and rear exposure aperture as otherwise the metal may become slightly distorted in cutting if this operation is delayed until after section "C" is cut away from the large sheet. It will be noted that irregularly shaped protuberances have been shown at sides, top and bottom of the sections "A" and "B"; also at ends of section "C." These are to be bent at right angles after holes have been drilled for the assembly bolts, bending being made along dotted lines. In the case of section "C," a right-angle bend is first made at the end nearest the hole for the focussing tube and in a direction calculated to point toward the inside of projector. Bends should be made as indicated and should leave the two end tabs pointing at each other while the section "C" has assumed a rough letter-U shape.



A side-section elevation of the projector is shown above. The placement of lamps and reflectors has been so arranged that no direct light can escape though the lens, but an intense beam may be directed upon the surface to be projected.

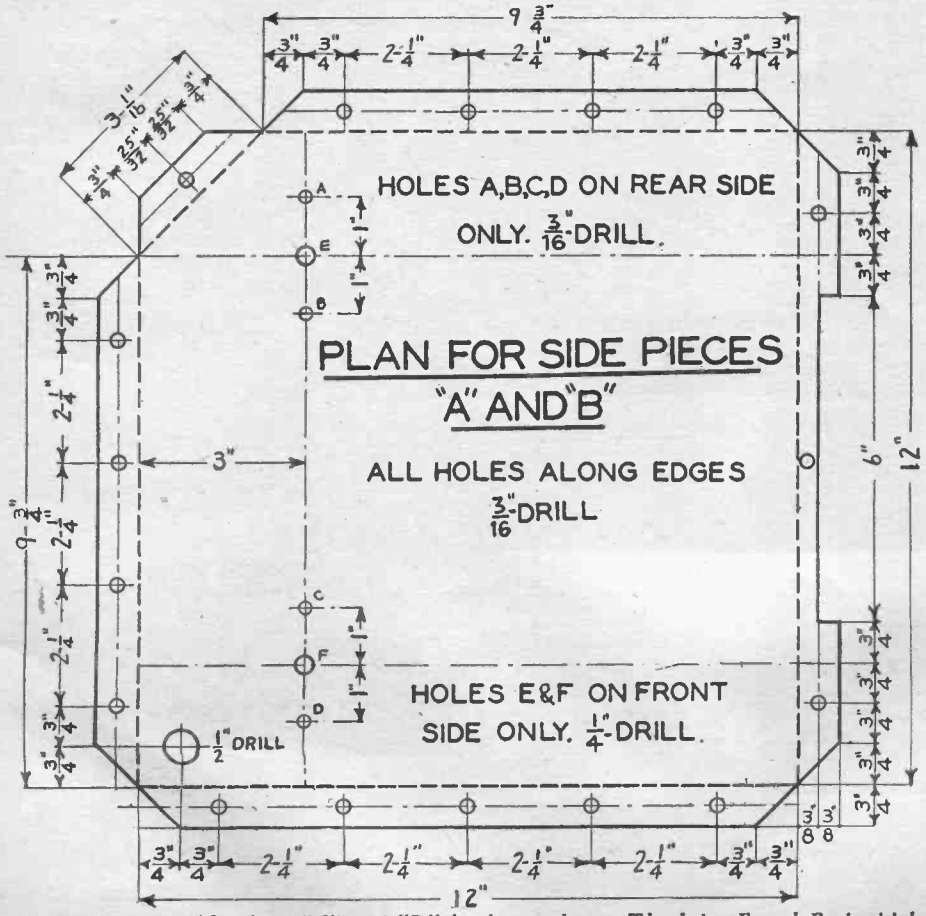
The two rows of ½-inch holes shown are for ventilation and serve to dissipate some of the heat from the two bulbs which furnish the light for the projector. They are preferably drilled before section "C" is bent into shape as are also the six 3/16-inch holes laid out around the lens opening and the ⅛-inch holes shown along the edges. These latter have not been dimensioned as they must be placed so as to line up with corresponding ones in sections "A" and "B," which may be used as templates. In assembling the body, small 6-32 R.H. machine-screws or rivets of corresponding size may be used. In the latter case, however, the machine cannot be dissembled for repairs.

The two ¼-inch holes shown on side pieces are for short pieces of ¼-inch rod which serve as shafting for the revolving mirrors. The latter are shown in detail in the illustration. Each will be seen to consist of a piece of highly polished tin bent into the shape of a half-cylinder of the diameter indicated (four inches) and of a length nearly sufficient to touch both sides of the projector. The end facing the knob by means of which the mirror is adjusted, is fastened by means of small screws to the edge of a wooden disc four inches in diameter and ½-inch thick. This disc is, in turn, secured to the shaft by means of two thin ¼-inch hex nuts. To accommodate these the shaft is threaded for a distance of ¾-inch and a slight counterbore is made in the outer face of the disc as shown.

The opposite end of the concave reflector thus formed is allowed to swing free and has no means of support except the initial bend placed in it while being formed. This bending must, therefore, be a very careful job.

The two sockets for the lamps are of the porcelain type and are mounted directly opposite the wooden discs which support the mirrors and are exactly concentric with them. In each case it will be necessary to drill small holes in the side piece to pass mounting-screws for these sockets.

Assuming that all of the foregoing has been accomplished, we next commence work on the vital part of the apparatus, the lens or focussing tube.



The plan for the side piece, "A" and "B," is shown above. The holes E and F should be drilled on the front side only, while holes A, B, C, D, are on the rear side only. Dotted lines show where the pieces should be bent. Rivets or screws are used for assembly.

The Focussing-Tube

THIS will consist of a piece of tubing roughly three inches internal diameter, according to the size of lens available. This should be an ordinary reading glass of about three inches diameter

(*Continued on page* 1111)

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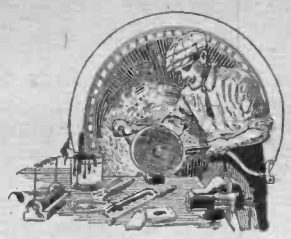
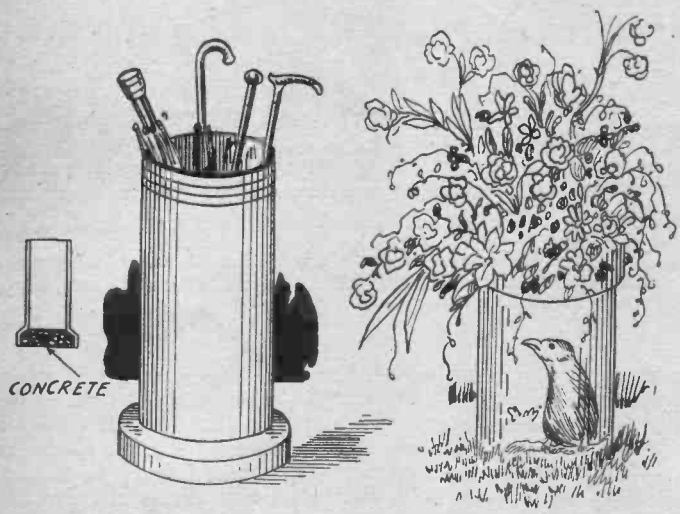
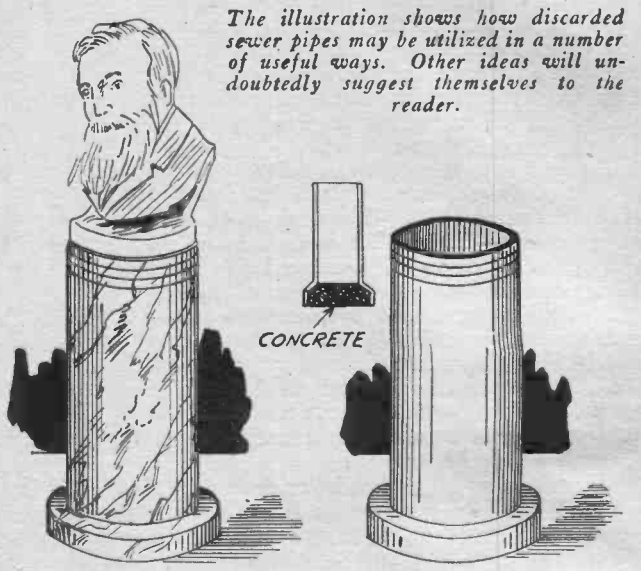
HOW TO MAKE IT



Practical Uses For Tile Sewer Pipe

The illustration shows how discarded sewer pipes may be utilized in a number of useful ways. Other ideas will undoubtedly suggest themselves to the reader.

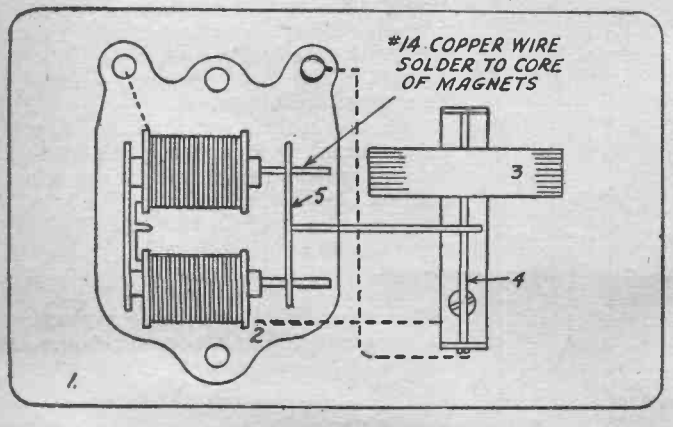


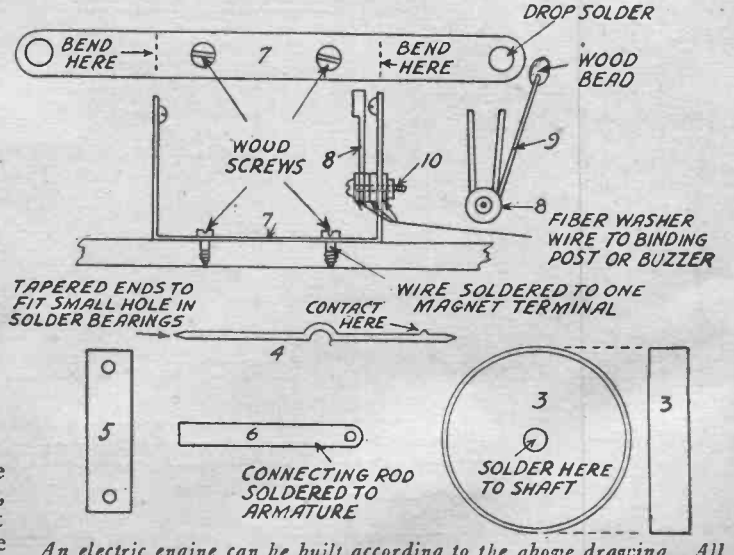


THE ordinary sewer pipes are obtainable in different diameters and can usually be purchased from dealers in building materials. They may be changed with little effort into various useful or ornamental objects, as shown in the accompanying drawing. A decorated sewer pipe provided with a concrete base makes an attractive umbrella stand. A pipe buried in the ground with the collar protruding and filled with earth, makes an excellent and very pretty flower pot for the garden. A sewer pipe weighted at the bottom with concrete and given a marble finish makes a good pedestal. The entire pipe may be filled with concrete if desired, thus adding to its stability. A sewer pipe can also be made to serve a useful purpose. The bottom, as previously stated, is filled with concrete and the pipe then used for preparing household provisions for the winter. Sewer pipes will undoubtedly find many other uses in the house, while in the garden any number can be used to advantage and add to the ornamental effect if suitably decorated. If the garden is large, a number of pipe pedestals can be used for supporting statuary and the sun dial.—*P. C. Van Petegem.*

ELECTRIC ENGINE

AN inexpensive electric engine is shown in the illustration below. The base is shown at 1; 2 is an old buzzer; 3 is the flywheel; 4, shaft of No. 14 copper wire; 5, armature of tin; 6, connecting rod, which should be soldered to the armature as shown; 7, shaft bearing; 8, brush assembly; 9, handle for brush assembly; 10, small bolt insulated from shaft bearing; 11, wire as per drawing; the motor will operate forward or reverse upon the pressure of the brush on the small offset near the right hand end of the shaft. Tin can be used for the connecting rod and brushes. The flywheel is a tin can cover. The connecting rod is soldered to the armature as shown.—*Harry E. Stedman.*





An electric engine can be built according to the above drawing. All numbers are referred to in the text. A buzzer and a few odds and ends are all that are necessary.

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ARTICLE NUMBER 9 IN A SERIES

An early American sewing table is shown at the left.

WOOD TURNING

All four knobs are turned in one piece as shown below.

By

H. L. WEATHERBY

An Antique Sewing Table

THE popularity of antiques is growing by leaps and bounds, and the average workman in his home work shop can reproduce these genuine antiques of our grandfathers' time in every detail, and the fact that they are hand made adds greatly to their intrinsic value. The workman with a lathe in his shop has a great advantage over one who does not possess such an article of equipment, when it comes to copying antiques; for so much of our early American furniture was made up in part of turnings which made it very attractive.

The Sewing Table

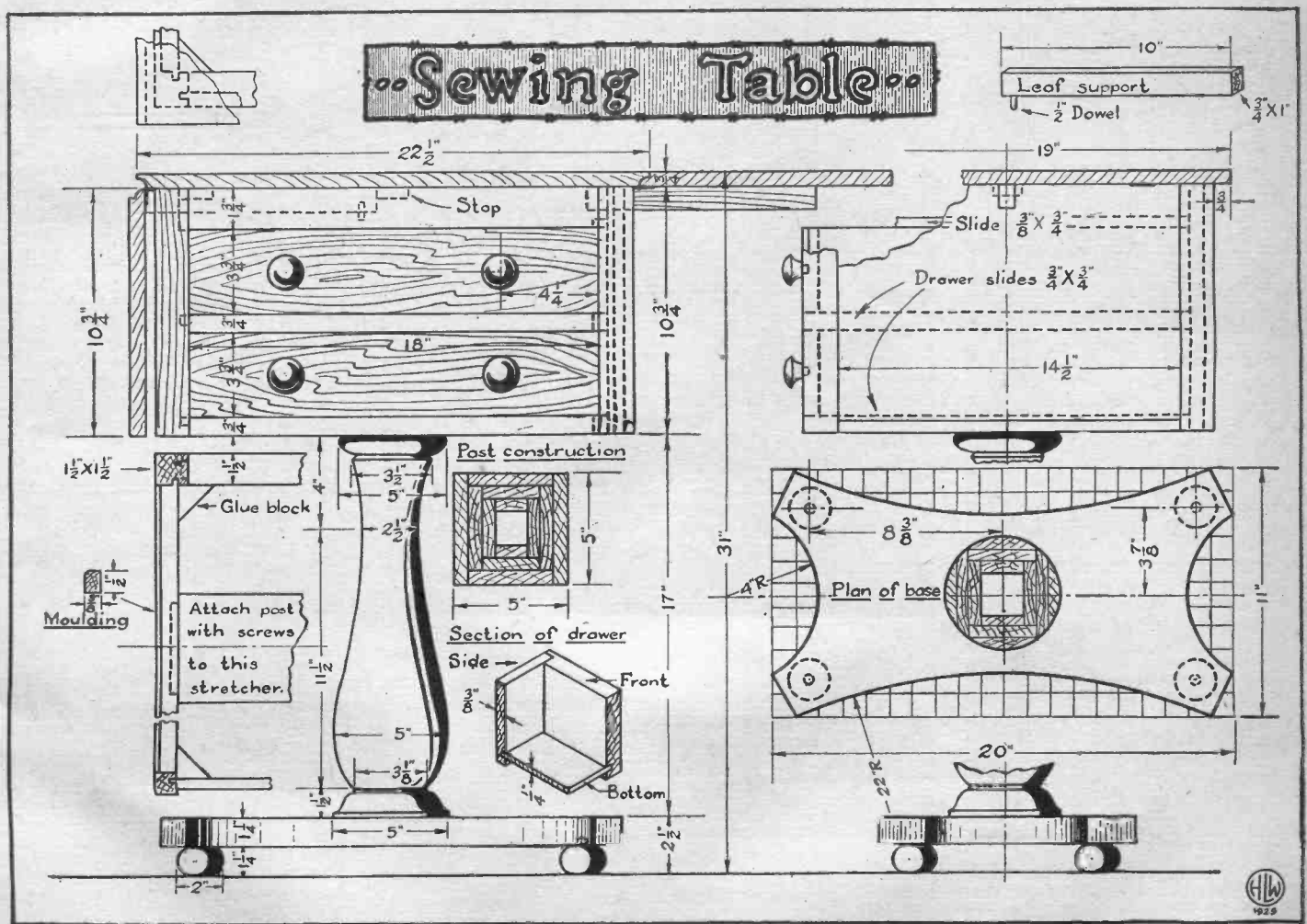
THE sewing table illustrated for this month is a copy of a venerable old sewing table, hand-made a hundred years or more ago. Although it may not in every detail represent any particular period or style of furniture, the original is a treasured keepsake, its lines are good, and in addition, which is most important, it justifies itself by being a very useful article of furniture.

Genuine mahogany is recommended for its construction in order to keep it true to the period which it represents. However, black walnut or cherry may be used; or birch or poplar, either of which may be finished in mahogany.

Secure material according to the following list for the Sewing Table. All dimensions are finish sizes and the material must be secured a trifle larger in all directions in order to dress to sizes given.

For the top: Wood to glue up ¾" x 19½" x 4'-0". This will make the top and the two drop leaves.

Cabinet sides: (*Continued on page* 1115)



The old style sewing table can be duplicated by the amateur wood worker who owns a lathe. Genuine mahogany is recommended for its construction, in order to keep it true to the period it represents.

Full details for the construction of the table will be found above. All dimensions are of finish size and the material must be secured a trifle larger in all directions, in order to dress to sizes given.

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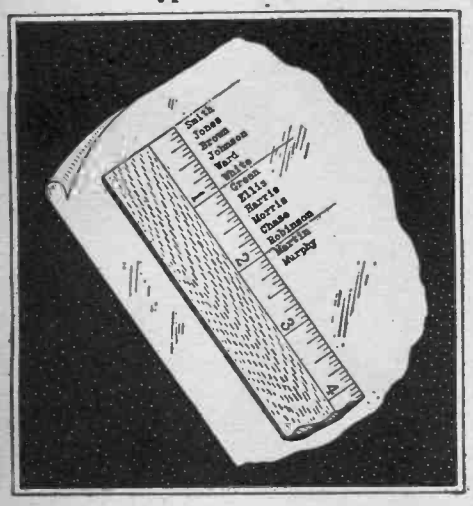
WRINKLES, RECIPES

Type Measure

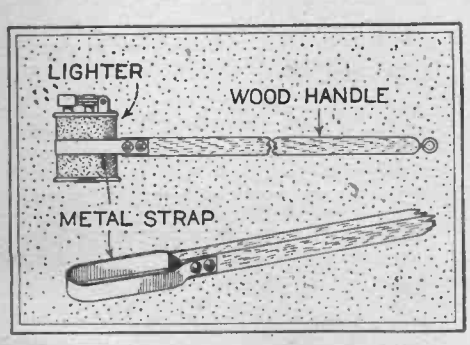


Long lists of typewritten names can be added quickly by measuring the number of inches of names with a ruler and multiplying by six (most typewriters write six lines to the inch). By using a pica rule, it is possible to measure the lines without multiplying.—D. M. Brown.

Corkscrew Substitute

By pushing a nail through a bottle cork, so that the head is at the bottom, as shown, a good handle is provided and the cork never need be pushed into the bottle, which often happens, particularly when the bottle has a wide mouth or a flat cork is used.—B. Hoopes.

Gas Stove Lighter



An old cigar lighter provided with a wooden handle makes an excellent gas stove lighter. The wick is lit in the usual manner, and if the familiar pop or explosion occurs in the valve air intake, the user will be out of danger.—L. B. Robbins.

Barometer Paper

A novel little instrument by which it is possible to judge of the humidity of the air with some accuracy can be made for a few cents. It is easy to make and can be used for a variety of purposes which will suggest themselves to the reader.

First, a solution consisting of the following is to be prepared:

Cobalt chloride	1 ounce
Sodium chloride	½ ounce
Calcium chloride	75 grains
Gum arabic	¾ ounce
Water	4 ounces

Dissolve the chemicals in the water and saturate white blotting paper with the liquid. The paper may then be cut in strips and mounted on a board of wood or other material, having the paper in the same position as the mecury tube in the regular barometer. The blotting paper may also be cut into regular size blotters and an advertisement printed on it, for use as an advertising souvenir. This will make a large quantity.

The changes in weather will be indicated by the following changes in color:

Blue	Dry—Fair weather
Lilac	Moist—Change
Red—	Wet—Storm

—Contributed by Menno N. Harder.

A Good Hand Soap

A hand soap that will remove any kind of paint, dirt or grease from the hands can be made by mixing sand soap with auto oil until the mixture is soft. This is superior to the ordinary sand soap.—*Contributed by W. R. Turner.*

Magnifying Glass

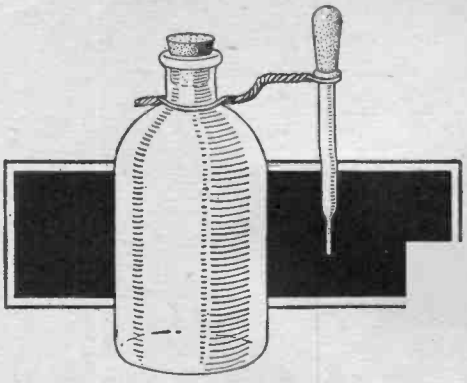
An old automobile bulb, or any other round incandescent lamp, may be made into a serviceable magnifying glass by immersing the bulb in clear water and, *while so immersed,* pinching off the tip of the bulb with a pair of pliers. When the tip is broken, the water will immediately rush into lamp, filling the vacuum, and will not leak out again due to external atmospheric pressure. Objects or small print viewed through the water-filled bulb will be highly magnified.—*Contributed by C. K. Theobald.*

Renewing Worn Out Bolt Threads

Nearly everyone is familiar with the method of renewing the threads on a bolt, or screw by wrapping them with a piece of thin wire, and are probably aware of the difficulty one encounters in obtaining fine wire, and the trouble one has in keeping the wire in place while the nut, or tap is being replaced.

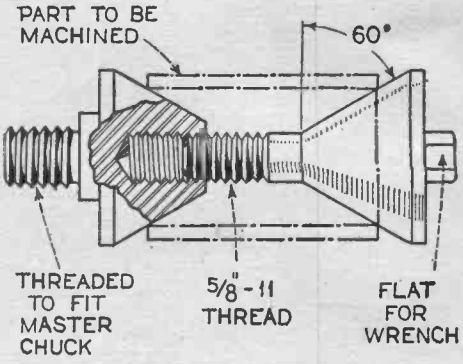
A better method of making such a repair is that of using tin, or lead foil instead of fine wire. The foil can easily be obtained from a cigarette package, and can be used more effectively, especially on threaded bakelite objects such as pipe stems, and similar objects.—*Contributed by Glen F. Stillwell.*

Medicine Dropper Holder



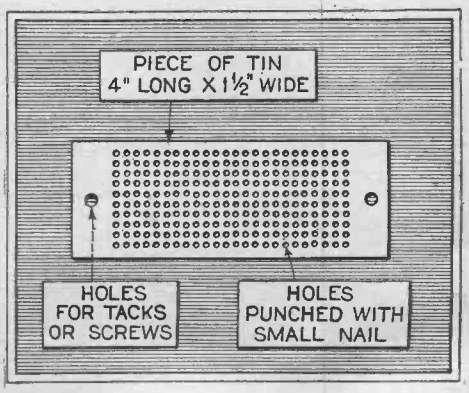
Holders on small medicine bottles will be found handy for keeping the dropper where it belongs. A length of light wire doubled and twisted as shown, with an eye left at one end, is fastened around the neck of the bottle. Laboratory workers, chemists and druggists will find this a useful kink.—B. Hoopes.

Chuck



The above illustration gives the details of a chuck, which will be found valuable in machining sleeves and collars whose inside diameters are not of standard size. If it is accurately made, the work done will be found to be as true as if a special mandrel were employed.—James Marsh.

Match Scratcher



An indestructible match scratcher can be made from a piece of tin, cut to the dimensions shown above. Small holes are punched in the tin with a nail and should be evenly spaced. By scratching a match across the jagged edges of the holes, it will light instantly.—Wm. D. Holmes.

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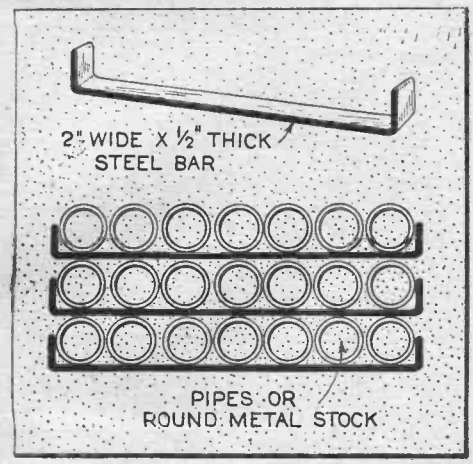
and FORMULAS

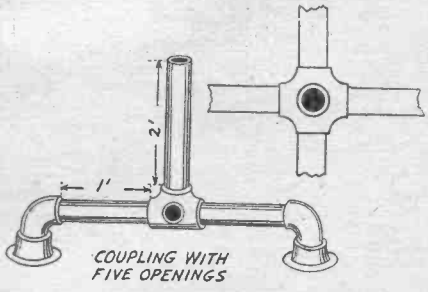
Edited by S. GERNSBACK

Stacking Pipe



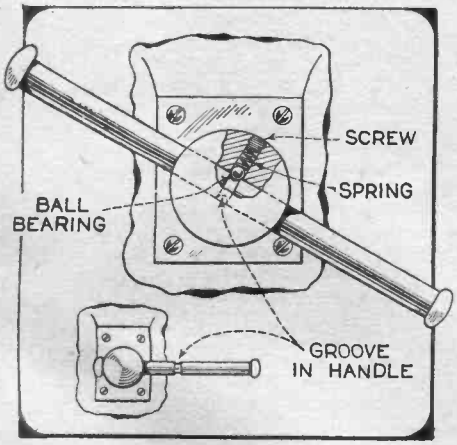
A handy method for stacking pipe or round stock is illustrated above. The stacking bars are made of steel or iron bent at the ends, and of a length to suit the requirements. Two bars are used, one at each end of the pipe, but if the pipe is of small diameter and quite long, it is best to employ a bar at the middle.—H. R. Wallin.

Umbrella or Aerial Support



Large beach umbrellas can be placed almost anywhere without driving the handle into the ground, by using a stand made from pipe and couplings, as illustrated here. It is a good aerial mast support also.—C. F. Feldstead.

Improved Vise Handle



By fixing the handle of a vise in the manner shown, it may be turned more quickly by virtue of the ball bearing held in place with a spring. A screw supplies the necessary pressure.—J. N. Sell.

Handling Wet Photos in the Tray

Large prints, when wet, have a tendency to stick to the bottom of the tray and delay in picking them out may cause over-development. If a large tray is being used a piece of corrugated glass in the bottom will overcome this difficulty. This can be obtained by carefully knocking the wooden frame off a glass washboard. The large corrugations make it an easy matter to slip the finger nails under the prints to remove them. Small trays can be fitted with the rubber matting such as is used on the running board of automobiles. An occasional washing with water will clear off the old developer.—*Contributed by Howard P. Rowe.*

Chewing Gum Seals Leaking Canoe

A piece of chewing gum figured dramatically in a recent incident by saving another person and myself from a dangerous situation.

Last week while we were in a canoe we discovered a good-sized leak at one end. It was useless to attempt to reach the shore because we were too far out. If we were to save ourselves from being swamped, the leak must be closed at least temporarily and it had to be accomplished from the inside of the canoe. We were in our bathing suits and chanced to have nothing along that might be used to plug the opening.

Then luckily I thought of the chewing gum and found that we had some. I chewed up a piece and stuck a wad of it down over the leak. It held perfectly all the way back to shore.—*Contributed by C. Nye.*

(*The same material is excellent for temporary repairs in the gasoline supply system of motors.—Editor.*)

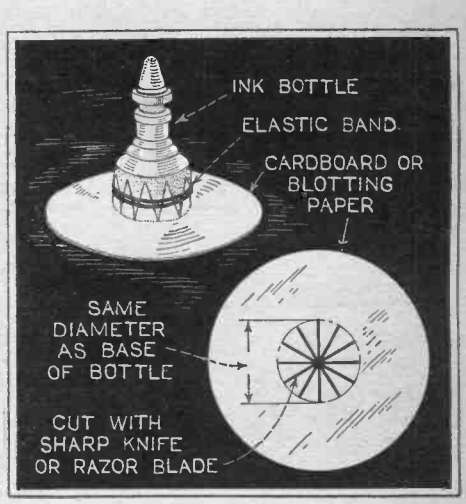
Cleaning Automobile Generators

To clean an automobile generator, sandpaper with No. 00 sandpaper, then take a Pyrene fire extinguisher and squirt the liquid on the brush holder. This will clean out the dirt and brush residue and evaporate quickly. This liquid is carbon tetrachloride and is non-inflammable.—*Karl G. Smith.*

Cheap Wood Stain

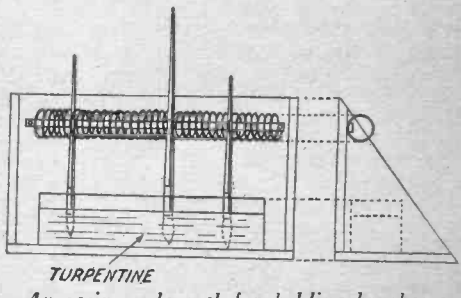
An excellent wood stain or dye can be made by thinning common roofing cement with turpentine until the proper color is obtained. Various shades from light to dark oak and walnut are obtainable by varying the amount of turpentine used. It is applied with a brush and rubbed off with a rag in the usual manner. An old experienced painter uses this on the finest work.—*D. S. Jenkins.*

Ink Bottle Holder



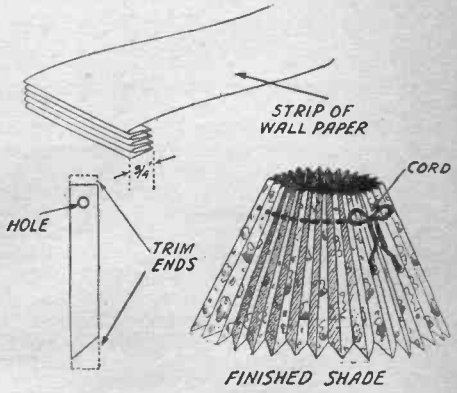
The above illustration shows a useful article for the draughtsman. This is an India ink bottle holder made from a blotter or a piece of cardboard, cut as shown, and fastened to the bottle with a rubber band. It is easily made and a new one can be put on in a few seconds. Blots of ink on the drawing are also eliminated.—L. Keiser, Jr.

Brush Rack



An easiy made rack for holding brushes can be constructed from a spring supported on each end with the spring loops spread about ⅛ in. apart. A shallow container of turpentine can be placed on the rack for oil brushes and will always keep them soft and pliable.—Thomas E. Miller.

Lamp Shade



Decorative lampshades can be made from a strip of paper plaited and folded as shown. The ends of the plaited strip are glued together and a colored cord strung through holes previously punched in the plaits. The shade is placed on a wire frame.—H. Jackson.

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READERS FORUM—

SCIENCE AND INVENTION desires to hear from its readers. It solicits comments of general scientific interest, and will appreciate opinions on science subjects. The arguments pro and con will be aired on this page. This magazine also relishes criticisms, and will present them, whether caustic or not. So if you have anything to say, this is the place to say it. Please limit your letters to 200 words or less, and address your letters to Editor—The Readers Forum, c/o Science and Invention Magazine, 230 Fifth Avenue, New York City.

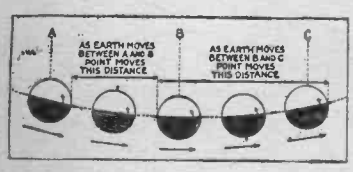
Relativity

Editor, SCIENCE AND INVENTION:

In the December issue of SCIENCE AND INVENTION appears a front page editorial on Speed, which puzzled me entirely.

The statement, especially that "The earth rotates or moves forward 2,000 miles per hour less in daytime than at night" needs some explaining to my mind and reason. How do you figure it out? Please give us light on this point.

D. A. MOSHER,
Corinth, N. Y.



(The statement was not quoted exactly as given. The sentence reads: "This gives the surprising fact that in the daytime we go 2,000 miles an hour slower than at night," not that the earth moves forward 2,000 miles per hour less in the daytime.

The difficulty lies in the fact that you do not seem to grasp the idea that the earth rotates about the sun in a counter-clockwise direction once every year. At the same time that it makes this elliptical journey, it rotates about its axis once every day. Looking down on the orbit from the north and also on the rotating earth, imagine for a moment a point along the equator. Now, as the earth moves forward in its orbit, this point rotates backward at the same time because of the rotation of the earth so that from the moment of early dawn to twilight, one must subtract the rotational speed of the earth from that of the forward orbital speed. As this spot on the earth comes into darkness, it will move forward because of the daily rotation of the earth and the speed of this point must be added to that of the orbital speed. The effect may be likened to a person walking through a moving train. When he moves forward on the moving train, his speed relative to that of the ground is faster than the motion of the train alone When he moves toward the observation platform of the train, his speed must be subtracted from the speed of the train to give one his speed relative to the earth.

It is obvious from the above that the speed will be maximum at midnight and minimum at noon. Only at the instant that the point of observation lines up with the orbit, is the speed of this point identical with that of the orbital velocity of the earth. Of course, all of these motions are again subjected to changes when one considers that the earth does not spin perfectly true on its axis and that our entire planetary system is constantly moving through space at a terrific rate of speed, and we cannot definitely establish any point in space which may have a totally fixed position.

If you like these problems on relativity, cogitate upon an individual walking in a dirigible which is traveling from the North Pole to the Equator, in as direct a line as possible, and figure all the relative factors which must be taken into consideration when that individual's flight is being viewed from space. Then do the same with two spirals beginning also at the North Pole and rotating once to the right and once to the left, terminating at the South Pole.—EDITOR.)

IN THE MARCH "AMAZING STORIES"

INTO THE GREEN PRISM, by A. Hyatt Verrill. (A serial in 2 parts.) Part I. The idea of taking a projected image and fixing it so that the image becomes a reality, is, at first blush, nothing less than astonishing. Imagine, for instance, a reflection in a mirror suddenly coming to life in its three dimensions. Yet it is not as foolish as it seems at first. Why, is very well told in this new story by the well known author, who collects material for his stories first hand in comparatively unexplored lands. You will find the story intensely interesting.

THE WORM, by David H. Keller, M.D. In this story, the doctor shows his versatility as an author of scientifiction. Although he cannot entirely escape using the science of psychology in his stories, this one is predominantly different than all his other works—and no less interesting.

THE AIRLORDS OF HAN, by Philip Francis Nowlan. When "Armageddon—2419" was published, we received a surprising number of requests for a sequel. Mr. Nowlan has finally given us one, and it is not only worthy of its predecessor; it actually surpasses it. We know you will follow, with bated breath, the work of the scientists of both factions—the Hans and the Americans—while they prepare more and more effective means for attack and defense.

THE FACE OF ISIS, by Cyril G. Wates. Most of our readers will remember Mr. Wates as the first prize winner in our cover illustration contest of December, 1926. His story, "The Visitation," was unanimously acclaimed worthy of the prize. In "The Face of Isis," the author bases his plot on the discovery of an ancient Egyptian casket and on the science of archeology. The contention is that the Aztec culture was an offshoot of the ancient Egyptian civilization. It seems quite plausible. And others.

Psychic Force

Editor, SCIENCE AND INVENTION:

Zell's Popular Encyclopedia, published in Philadelphia, 1878, Second Volume, page 2016, under title "Psychic Force," publishes experiments by Sir William Crookes in which he claims "the existence of a force associated in some manner not yet explained, with the human organization, by which force increased weight is capable of being imparted to solid bodies without physical contact."

"One of the scientific friends of Dr. Crookes, who witnessed these experiments, was the celebrated savant and astronomer, Dr. W. Huggins, who, in a published letter, certifies to the correctness of Dr. Crookes' report, but expresses no opinion as to the causes of the phenomena."

I have been much interested in some of your exposés of spiritualistic frauds, but I have never seen any reference to this subject other than in "Zells." It is stated that it is not necessary to have access to known psychics.

Whether or not such a force exists would seem to be capable of definite proof. As the experiments were conducted in Crookes' dining room, it may be that the floor was not solid.

At any rate, whether Crookes was deceived or not, it seems worth while to know whether or not such a force exists, although it may be of no more practical importance to us than electricity was to the ancient Greeks.

It would seem that statements regarding psychical phenomena made by one of the most brilliant scientists of the nineteenth century are worthy of candid investigation.

JAMES H. MCFARLAN,
Linden, Mich.

(One cannot definitely state that the conclusions of experiments which were performed by Sir William Crookes were based on fraudulent phenomena. Nevertheless it has been quite definitely established that the mediums Florence Cook and D. Dunglas Home frequently resorted to trickery. One cannot take the definite stand that Home always fooled Sir William, but in several of his writings, Crookes took this definite stand, "I do not say that these things are possible; I say that they exist," and at the close of his life he said, "I have nothing to withdraw of all I have borne witness to." He seemed to believe everything was authentic.

Eusapia Paladina (another medium of perhaps even greater reputation than D. D. Home) was studied hundreds of times by the leading scientific men of Europe. There is no question about the integrity or ability of these men of science and letter, for example, Schiaparelli, Porro, Aksakoff, G. Finzi, A. and F. Myers, O. Lodge, E. Fielding, Lombroso, A. de Rochas, Ochorowicz, J. Maxwell, A. de Schrenck-Notzing, C. Flammarion, Bottazzi, Morselli, Foa, Sabatier, A. de Watteville, A. de Gramont, Carrington, and many others verified Eusapia's manifestations. And then Eusapia came to America to demonstrate to the scientific world her ability—and was exposed. It would be wrong to say that all of these men were duped. However, Eusapia, dictating her own terms, could not produce one single manifestation without calling upon simple trickery, and to cap the climax, she was actually photographed resorting to the use of childish stunts.

Should we not think that these exposés would make one question the honesty of the medium's previous performances before "shut-eye" scientists? And this holds for a great many mediums of international fame such as Slade, Stainton Moses, Mrs. Goligher, Katie King, Stanislaus Laszlo, Pierre Keeler, The Crewe Circle, William H. Mumler, Dr. Stansbury, The Fox Sisters, The Davenport Brothers, Buguet. All of these were caught in fraud. For further information concerning them, see Houdini's Spirit Exposes and Dunninger's Psychical Investigations.—EDITOR.)

Mental Power

Editor, SCIENCE AND INVENTION:

Being a reader of SCIENCE AND INVENTION, I take this opportunity of asking you a few questions which are very important to me. A young lady came to me for advice and stated the following:

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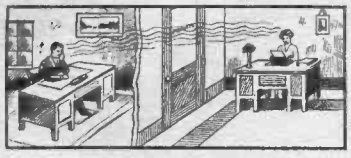
THE EDITOR'S MAILBAG

1. I am employed as a stenographer by an association in this city.
2. The manager told me about five years ago that he had studied hypnotism for several years, and asked me to be one of his subjects.
3. Being of the R. C. faith, I refused his request.
4. Since that time he did not like me very well and was always fault-finding.
5. My personal attitude is now, that I hate him more and more, and he hates me.
6. I do not like to give up my position for him, for he himself is employed by a yearly contract; he told me that he could make it unpleasant for me.
7. He sits in his private office and concentrates on me.
8. I feel the pain which starts in my neck and goes down along the spine and around my heart; this makes me very uneasy and nervous.



9. I notice also that this pain goes away as soon as somebody enters his office or when he answers the phone.
10. It also makes me tired and it seems to me that he wants to take my health for his own use.
11. Are there any laws that protect a person* against this method?
12. What would be the best attitude for her to overcome this?
13. Is it possible that the mind (brains) can work like a broadcasting and receiving station for our thought?
14. Is it a scientific fact that the mind of one person can be affected by the mind of another person who is in another room?

If I take it for granted that the above mentioned statements are facts, I would like to know more about this subject. I read something about mesmerism, but it did not appeal to me as a scientific method.

A READER,
San Francisco, Calif.

(We will answer the items which require an answer in the order in which they are put.

3. There is no necessity of refusing the request of a hypnotist, or an individual who wants to learn hypnotism, when he asks you to be a subject. Only those of strong wills, only those who have the ability to concentrate make easy subjects; an imbecile or an idiot can rarely be hypnotized.

4. Is it not possible that this is largely the product of the young lady's imagination?

5. The young lady dislikes this man more and more; it is very obvious that under the circumstances she will be reticent when it comes to doing work for her employer. She assumes the attitude that she does not have to do anything to please him, and consequently makes no attempt to do so. It is perfectly natural then that he should find fault. If it is necessary that the boss tells his associate or secretary to do certain things day in and day out. Because the lady in question cannot subdue her own personal feelings, it is far better that she be either dismissed from the employ of that organization or that she leave of her own free will and get a different situation with more compatible surroundings.

6. Anyone can make things unpleasant for another party. Evidently the lady is doing so for the man and he probably returns the compliment.

7. In the first place, it is impossible to prove a statement of this nature. Secondly, what if he did? Concentrating on an individual means nothing. It can neither produce a good or harmful effect upon the person thought of.

8. and 9. Evidently an imaginary pain; otherwise it would not go away as quickly and as easily as it does.

10. How could anyone appropriate someone else's health for their own use? The young lady in question should have visited a psychiatrist long ago. This particular case is typical of countless others about which we hear daily.

11. Inasmuch as the method does not exist, no laws are necessary for protecting a person against it.

12. First, change her position; secondly, do some work that is going to absorb her interest every single minute of the day; thirdly, explain the situation, telling the physician everything, in particular visit a good neurologist. Overwork, neurasthenia, or some trivial matter may be responsible for such thoughts.

13. Absolutely nothing. Thought transference has never been proven nor established. SCIENCE AND INVENTION *Magazine has a $5,000.00 award posted for a demonstration of this effect.*

14. Emphatically, no.

Do Humans Think?

Editor, SCIENCE AND INVENTION:

The article headed "Do Animals Think," which was published in your August number, has just been brought to my attention.

Before going into that matter, I wish to state that you erred when you permitted incompetent witnesses to testify in this very important scientific subject. What a scientist wishes to bring out in any matter under discussion are purely scientific facts which can only be brought out after an investigation has been made solely to bring out only favorable and tangible evidence—prejudiced testimony is wholly unsatisfactory, more especially if the witness still wears blinders ever since he entered the nursery.

A competent witness is one who has been with some of the animals that have at different times exhibited unusual mental characteristics.

"Do animals think?" you ask. You unquestionably refer to the lower forms of animal life. But what about this creature they call man? Does he think in 100 per cent of the cases? In 90, 80 or even 10 per cent of the cases. You are in mighty deep water just now. Man is no different than the lower forms of animal life. Just because we have an Edison, a Marconi, a Lindbergh, etc., does not help our vast array of morons, some of whom won't think; others are really mentally unfitted, as yet, to do any real thinking. No different with the lower animals, positively and absolutely no difference: since some have their various brain centers better developed than others, does not mean, nor should it be falsely misconstrued that great mental differences exist between the upper and the lower forms of animal life.

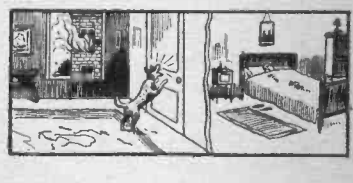
Only the daylight dreamer thinks that man (we, us and associates) has a monopoly on thinking. When you discuss "man," what man do you mean? As that great scholar, Joseph McCabe, says, "the law of the entire universe is death, and you state that one single being in it, man, one amongst myriads of living things on a single globe out of myriads of globes, is a grand exception to the law." But, you will say, and this is the nearest approach to an argument that most people offer, man is so obviously different from everything else in the universe that the claim really has a plausible ground. Man builds cities, writes poems, measures the universe. Does any other creature in the world even remotely approach him in his powers and his nature?

There is certainly one human power which is remarkable and convenient: the power of generalizing. Remember that in reality there is no such thing as "MAN." There are only men. Now which man do you mean? We presume that "YOU" do not build cities, write poems or measure the universe. A few men do these things. But—.

But, you say, there is a perfect gradation of power from me to these intellectual aristocrats of the race. It is only a question of degree. I have the same nature as they. Yes, quite true, but it cuts both ways. The sodden, stupid brute in the gutter has the same nature as you. The laborer, so low in intelligence that he cannot even understand what other men discover, has the same nature. The negro in the forests of the Congo has the same nature. The wild Veddah in the forests of Ceylon has the same nature. Are they so mighty different from the other forms of life?

In fact, not so long ago there were no men who could write poems or measure the universe. Consider the whole race as it was a hundred thousand years ago, and we know it well. Men could not even make homes of the rudest description. They had not begun to scratch the outline of an elephant on a bone or a stone. The utmost that man could do was to chip a piece of flint a little better than his neighbor.

And this is by no means the lowest level of humanity that is known to us. On the contrary, man was then already some millions of years old. There is no savage as low in this world as the entire race was then. From this we go back to a still earlier animal and brutal type of life. And, finally we go back even beyond this type and we see the most primitive semblance of humanity merging into the lower animal type from which, you say, we are so glaringly different.



Evolution is true—we were even lower than those intelligent animals whose mental status you now seem to question, and now some of us write poems, and some build cities—who will say that speech centers will not be developed in a few million years in some of the lower animals you so untruthfully misrepresent when you say that none are capable of thinking. Can it be you who don't think because of your limited knowledge?

A common dog in Tampa, Fla., about a year ago wakened his sleeping master in an adjoining building by barking and throwing his entire weight against his bedroom door at 2 A. M., when he observed the fire in a building in the rear of the lot. Some human beings would forget to do it—did that dog (I saw him) think?

DR. G. H. HALLER, Cincinnati, Ohio.

(Don't arguments of this nature sort of knock the wind out of anyone's sails, yet with all, the Doctor speaks very wisely. We do not believe that we made the statement that animals do not think. The opinion of some scientists was that they do think and most of them believed that they think in a limited sort of way. The entire argument revolves around what one means by the word "think." If we apply our own intelligence tests to animals, the answer must be "no." Perhaps animals have an intelligence test of their own. Perhaps the attack of the army ants is all planned and prepared for beforehand. Perhaps they even communicate with each other. It will be a long time before we are able to tell anything about this.—EDITOR.)

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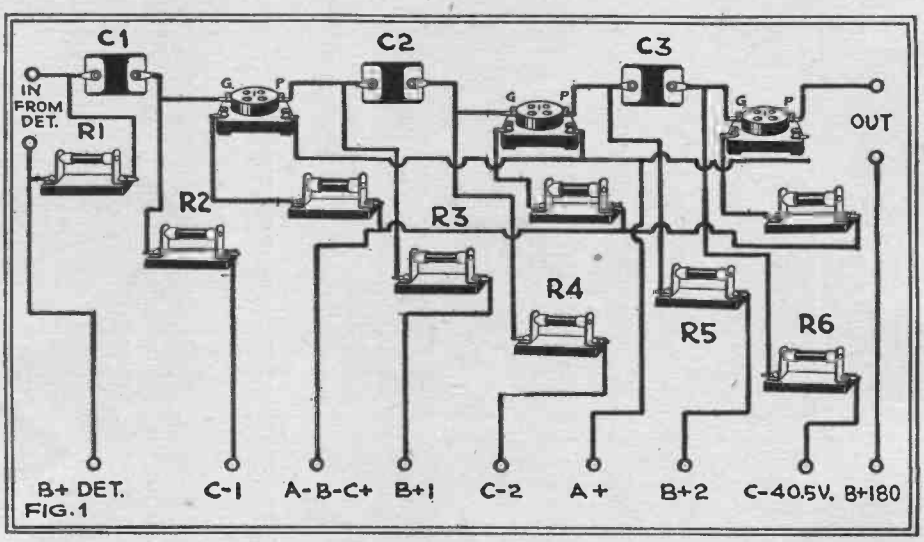
Amplifiers for Picture Receivers



At the left is a picture diagram of a resistance coupled amplifier recommended for use in the reception of television images. R2, R3, R4, R5 and R6, are the grid and plate resistors and C1, C2 and C3, are coupling condensers. A 171 tube is used in the last stage.

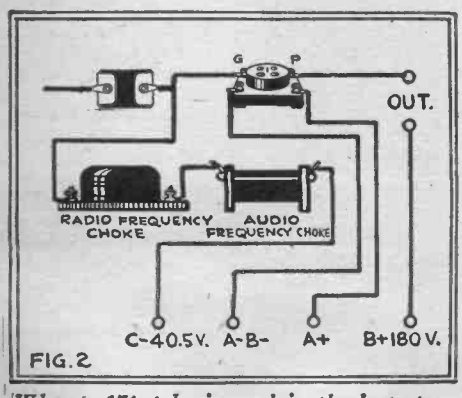
THE good television amplifier is one having a high frequency range and which gives therefore, good picture reproduction. This article deals with various types of amplifiers suitable for use with television receivers.

Resistance Coupling

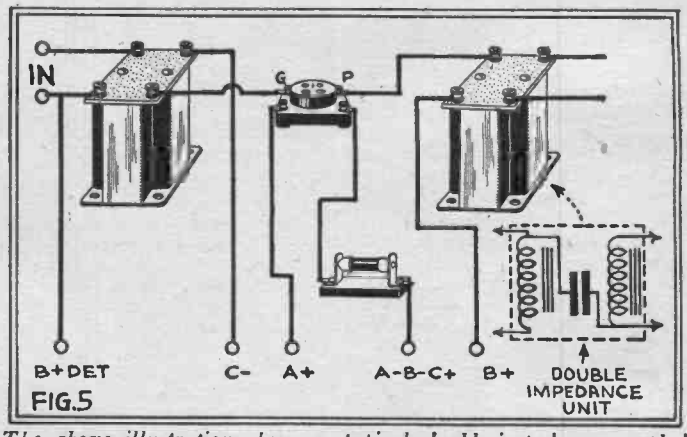
THE use of a resistance coupled amplifier in connection with the television receiver has been advocated by engineers as being the best form of radio picture receiving equipment now available. A picture diagram of a resistance coupled amplifier is shown in fig. 1. The plate voltages for the detector and first two audio tubes are applied through resistors R1, R3 and R5 respectively. The plate potential is prevented from being applied to the grid of the succeeding tube by means of the blocking condensers, C1, C2 and C3. The grid resistors R2, R4 and R6 allow the grid charges to leak to the filament and complete the grid to filament circuit through the "C" battery. The choice of resistances, condensers and tubes, plays an important part in the proper functioning of this amplifier.

Proper Values to Choose

THE plate resistors should have as high a resistance as possible, and yet, the value should never be less than the plate resistance of the tube in whose plate circuit the resistor is used. When using 240 type tubes the resistor should be rated at least at 250,000 ohms. As the plate resistance of this tube is about 150,000 ohms, it is necessary to use a resistance of the order named, in order to obtain satisfactory amplification The amplification which is obtained from this sort of an audio system depends upon the amplification factor of the tubes employed. With 201-A type tubes the plate resistor becomes about 100,000 ohms, as the plate impedance of a 201-A tube is 15,000 ohms at the lowest.



When a 171 tube is used in the last stage, a radio frequency and an audio frequency choke may be connected in series and substituted for R6 in Fig. 1.



The above illustration shows a typical double-impedance coupled audio stage. An inductance is used in both the grid and the plate circuit, with the blocking condenser connected between them as shown.

The capacity of the blocking or coupling condenser must be such that too much distortion is not introduced. The value of this condenser may be as high as .5 mf. An improvement in quality is noticeable when using condensers of a high capacity, although if such an amplifier were to be used with a radio receiver, it might be better to use a condenser of lower capacity in this position, in order to obtain a higher power output from the amplifier.

The value of the grid leaks R2, R4 and R6 will depend upon the tubes used and the power to be handled. Generally it will be found satisfactory to use a 1 megohm leak in the first stage, a ½ megohm in the second, and a ¼ megohm leak or lower in the power stage. A 171 type power tube is used in the last stage as the available neon lamps, at the present time, are designed to work with a 171 or 171-A type tube, taking about 180 volts. The values of the voltages designated as C-1, C-2 B+1 and B+2 will depend upon the type of tubes used. It is evident that a great portion of the plate voltage will be lost in the drop across the resistor, but the frequency characteristics

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Good Audio Units for Television Sets

of this amplifier are so excellent that one should be willing to sacrifice something for good picture reproduction.

In Fig. 2 is shown a method used by one of the larger manufacturers in their television amplifier, for applying the grid bias to the power tube. In place of a resistor, a radio frequency choke of about 500 millihenries and an audio frequency grid impedance are connected in series, as illustrated in the circuit diagram.

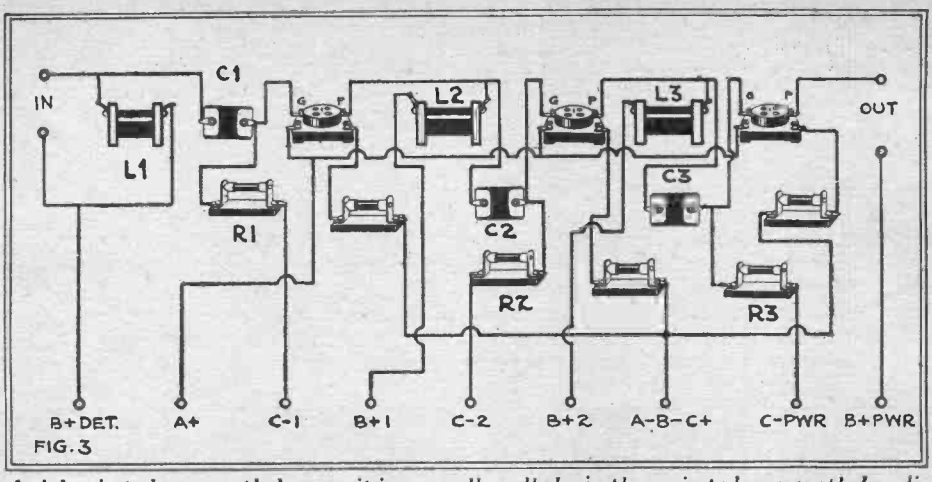

FIG. 3

A sinlge impedance coupled, or as it is generally called, simply an impedance coupled audio amplifier is shown in the above picture diagram. This is similar to the resistance coupled amplifier, except that the plate resistors have been replaced with iron core inductances.

Impedance Coupled Amplifiers

AN audio amplifier similar to the resistance coupled system shown in Fig. 1 is illustrated in Fig. 3. Audio frequency choke coils L1, L2 and L3 have replaced the plate resistors. Both of these amplifiers have the same principle of operation. However, the impedance coupled is more economical, as the large voltage drop across the plate resistors is eliminated by the use of choke coils. If the impedance of the audio choke at the lowest frequency which it is to amplify is about three times as great as the output impedance of the tube, the distortion will not be serious. Coils having an inductance of 100 henries or more are satisfactory.

The "C" bias is applied through resistors as in the case of the resistance coupled amplifier and a large straight portion of the grid-voltage plate current curve will be usable and on the negative side. Higher values of signal energy can be handled with this arrangement. The resistors not marked in this diagram are simply filament ballasts which keep the voltage within the recommended value.

A system using two impedances known as double-impedance coupling is shown in Fig. 5. In this case, both the grid and plate resistors in the circuit in Fig. 1 have been replaced by iron core choke coils. Both the grid and plate coils are generally wound on different cores and are not magnetically coupled. The replacement of the grid resistor by an impedance is used where there is danger of grid current flowing momentarily when an occasional loud signal is received, particularly in the last stage.

Transformer Coupling

FOR beginning, the present audio amplifier in the receiver may be used and a good transformer coupled amplifier will give fairly good results, providing that it has the necessary gain per stage. Recently, a new type of transformer has appeared on the market. This consists of an auto-transformer, a resistance and condenser, as shown in Fig. 4. The frequency reponse range of the amplifier is well increased by using this type of transformer. The direct current of the amplifier tube flows through the resistance, and the A.C. signal through the resistance, condenser and the primary portion of the auto-transformer. Good amplification down to 32 cycles is obtained. It will therefore be seen that an amplifier using this reception of television signals, if one does not wish to construct a resistance coupled or impedance coupled audio system, is desirable.

"Motorboating"

ONE of the bug-bears of the resistance and impedance coupled types of amplifiers is what is known as "motorboating," called so because the puttering sound resembles the noise made by a motorboat engine. It is recommended that "B" batteries be used with the amplifier for the reception of television signals, but even then when the batteries become worn down, the internal resistance of the plate supply increases and resistance feedbacks occur. The use of choke coils in series with each plate lead and a resistance in series with the "C" bias lead when properly by-passed will help matters a great deal. A two or three henry choke coil is satisfactory for the plate supply lead of each stage. The use of an impedance leak in place of a resistor in the last stage can also be tried. Alternating between stages of resistance and impedance coupling is generally effective in all cases. If a socket power unit is used, it will be found that one having a low output resistance and a good filter will provide a constant voltage and motorboating will usually be absent.

With the older types of audio transformers low frequency amplification was poor and a condition of oscillation manifested itself usually as a high pitched note. However, with the transformers available today low note amplification is good and if oscillation is present, the tone emitted is of a low pitched character and is known as "motorboating." A cure can be effected by reducing the impedance of the "B" supply or preventing the impedance from being common to the plate currents which are in phase. The connection of a 100,000 ohm resistor across the secondary of the first audio frequency transformer will effectively stop motorboating in some cases where transformer coupled audio amplification is employed.

It is, of course, possible to eliminate resistance feedbacks by using separate A, B, and C batteries. Such a means, however, is usually too expensive to be employed by the amateur. A large capacity condenser placed across the "B" battery terminal will permit a flow of plate electrons from the plate through the coupling medium through the condenser and back to the filament without passing through the "B" battery. It is well to properly by-pass each tube in the amplifier. The capacity of this condenser should be in the nature of 1 mfd. The coupling through "C" batteries is eliminated by placing a by-pass condenser of 1 mfd. between the negative filament terminal of each tube and the filament terminal on the audio frequency transformer which precedes the tube.

General Consideration

IN resistance coupling, the plate current decreases with the strength of the signal and the stronger the signal on the grid the less will be the plate current flowing. A three stage resistance coupled amplifier will use a little more than three-fourths of the plate current used by two stages of transformer coupling. Too high a resistance in the grid circuits of a resistance coupled amplifier will cause distortion and blocking. Howling can sometimes be eliminated by changing the values of the grid leaks.

The amplifiers described here will give good picture reproduction as they have a wide frequency range. It is well to keep the scanning unit removed from the amplifier and receiver as vibration will be detrimental to the received television image and will manifest itself as a black line.

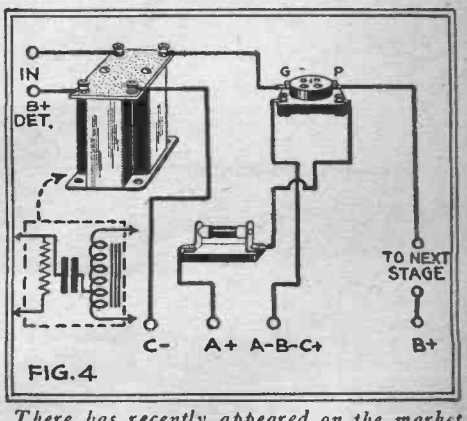

FIG. 4

There has recently appeared on the market a transformer which has admirable characteristics, obtained by using an auto-transformer with a resistance and a condenser.

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RADIO DEPARTMENT

Radios 20,000 Miles to Talk Ten Miles

By NORMAN J. STONE

A MESSAGE by radio was recently transmitted from Times Square, New York City, to Bellaire, Queens, with the Byrd expedition, now some 10,000 miles away, acting as an intermediary. Mr. F. E. Meinholtz was listening to a press dispatch sent by one of the expedition's operators aboard the "City of New York" in the Antarctic. Suddenly a break occurred in the story and he was startled to hear the following message: "Meinholtz, the Times wants you to hang up your telephone receiver, so it can call you on the phone." A Times operator sent the message to the "Eleanor Bolling" and it was relayed to the "City of New York" by radiophone. The former ship is not equipped with a code radio transmitter. When R. A. Hilferty, the Times operator, found that he could not call Mr. Meinholtz on the phone, he injected the request into his message going south. The operator there inserted the message into the press dispatch.

(*Continued on page* 1092)

The above illustration shows how the operator at Times Square called Bellaire, Queens, by way of the Antarctic. The Byrd expedition, now about 10,000 miles away, acted the part of central. The message from Times Square was sent in code to the "Eleanor Bolling" and was relayed by radiophone to the "City of New York."

From the "City of New York" a code message was sent to Bellaire, Queens, on Long Island. Mr. F. E. Meinholtz, the manager of the N.Y. Times radio station, was sitting in his home in Queens, listening to a press dispatch from the Far South when he was startled to hear a personal message from the New York Times.

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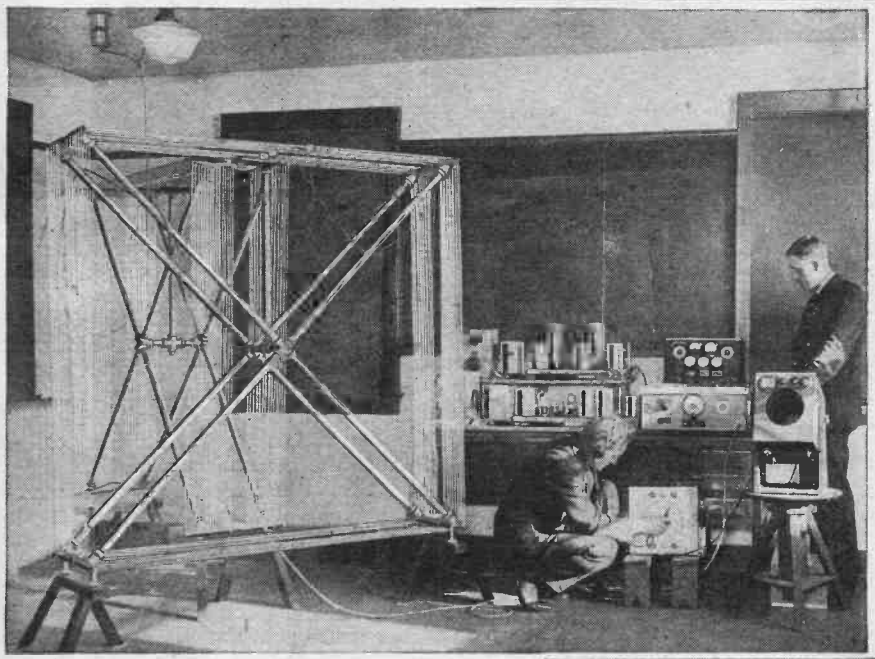
"Message" from Mars

DR. MANSFIELD ROBINSON, of London, England, asseverates that he has established communication with the inhabitants of Mars. He is shown in the photograph with Prof. Low and newspaper reporters listening in for a reply to the message which he sent to this planet through the British Post Office radio station, at Rugby, England. The doctor was certain that he did receive an answer but which he could not decipher. We wonder how the Martians understood his message. Evidently, they are some sort of super-men much further advanced in the scale of evolution than we.

The photograph at the right shows Dr. Mansfield Robinson and associates who are listening in for a message from the planet Mars.



Static Recorder

THE Naval Air Station, at Washington, D. C., has recently installed an automatic static recording mechanism which will assist in the prediction of storms. By means of the large loop antenna shown, the direction from which the strongest static signal is received can be determined. A graphic record of the intensity of this interference is made by the device. If the intensity and direction of the static can be ascertained, then the path of the storm will be indicated by the static discharges. As the storm approaches, static becomes more noticeable and it is simply necessary to read the graph to predict the direction which the storm will take. The recorder is a valuable aid to aviation.

At the left is Lieut. Eldridge with phones adjusting the automatic static recording device at the Naval Air Station, Washington.

Radio "Props"

IN the broadcasting of a radio drama, much attention is paid to what may be termed, local color, which will give a realistic effect to the performance. Small details, such as, a rap on the door or footsteps, add greatly to the radio play and determine whether or not it shall be a success or a failure. When "Napoleon's Retreat from Moscow" was sent over the air, metal cans were used to simulate the roar of cannons and a number of men draped in chains represented the marching soldiers and prisoners. A musical accompaniment was used to add atmosphere to the broadcasting event. The "props" and chain gang may be seen in the photograph before the microphone of radio station WOR, in Newark.

When "Napoleon's Retreat from Moscow" was dramatized over the radio, local color was achieved with the equipment shown at the right.

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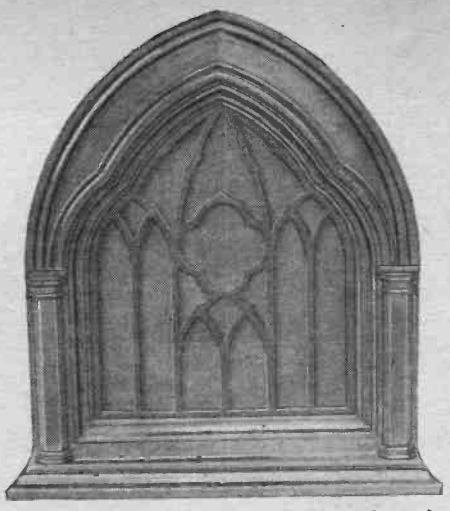
A Review of the Moving Coil Type Reproducers

Dynamic Speakers of Latest Design

By PAUL L. WELKER



Single Turn Voice Coil Used in One Popular Type of Speaker

Fig. 1. A front view of the mantle style dynamic housed in a Gothic cabinet appears above. A triple arch grill backed up with gold silk cloth covers the front of the speaker.

THE construction and operating principles of the moving coil type speakers are undoubtedly well known to some of our readers. However, a brief discussion will undoubtedly not be amiss.

Construction

THE general construction of all types is easily made clear by referring to the drawing, Fig. 5. A light-weight cone of paper is supported about its periphery with a ring of chamois or leather. The apex is usually held by a thin flexible bakelite spider, such as that seen in Fig. 6. This type of mounting permits the cone to move like a piston or in a horizontal direction. The moving coil is a winding attached to the apex of the cone and held in the field of a strong electromagnet. The two leads from the moving coil connect to a transformer which couples the speaker to the receiver output. The secondary of this transformer matches the low impedance of the moving coil. When the moving coil is energized, the cone pulsates as a reaction is set up between the moving coil and the magnetic field. This type of speaker is from 35 per cent to 50 per cent efficient. No levers are used to transmit the impulses to the cone or to return it to a neutral position. By virtue of this, resonant effects from the above-mentioned mechanism are eliminated.

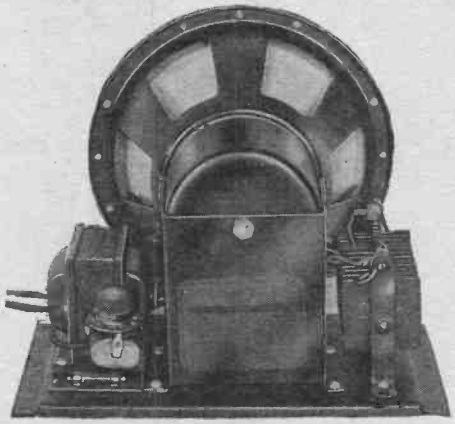


Fig. 2. A rear view of a dynamic A.C. chassis is shown above. The condition equalizer is an outstanding feature and is shown at the rear of the base to the left. The dry rectifier is at the right.

The electro-magnet or pot, as it is known to the amateur, consists of an iron core or pole about which the field coil is wound, being protected by a heavy iron cup which is bolted to one end of the core. The pole also projects into the moving coil but does not touch it at any place. A cover plate placed over the front completes the magnetic circuit. This front plate or ring covers the front to within several thousandths of an inch. It will thus be seen that the moving coil is situated within a ring-shaped air gap. When the field winding is energized, a magnetic field is set up about the moving coil. This magnetic field is constant and the impulses acting on the moving coil are dependent upon the current in the coil and not upon the position of the coil in the field. One of the drawbacks to the magnetic type of speaker which uses an armature is the saturation of this piece of metal which is entirely done away with by using the moving coil. The inductance of the moving coil is very low and therefore the speaker offers what may be termed almost a pure resistance load on the output tube. Further, there can be no danger of the coil hitting the pole pieces as it moves across the air gap.

Field Coil Types

THE field coil can be excited either with A.C. or D.C. Six to twelve volts A.C. is supplied by a transformer or D.C. by a battery, or a dry rectifier. About one-half ampere of current is taken by the six-volt models. Another common method of exciting the field of those speakers using 90 to 200 volts at 40 to 80 mills for the field coil, is to use the field winding in place of one of the choke coils in the filter system of the "B" battery eliminator. Models are also available for use with 32 volt farm lighting systems. Fig. 3 shows another type of dynamic speaker which employs a 280-type rectifier for supplying the necessary direct current to the field.

Hum Neutralizing Coil

A HUM neutralizing coil is used on some models of speakers designed for use with rectified A.C. supply. Fig. 2 shows a dynamic equipped with such a coil which is wound around the center pole and connected in series with the moving coil. It is wound opposite in direction to the moving coil, and is so constructed that it will pick up in opposite phase the same amount of hum caused by the field in the moving coil. Thus, the the hum picked up by the moving coil and hum in the neutralizing coil balances out and reduces the hum to a minimum.

Condition Equalizer

THIS same speaker is equipped with what is known as a condition equalizer, visible at the rear, to the left of the chassis. A control of the tone quality is made possible by a switch which allows a choice of two shunt capacities of .025 mf. and .05 mf. to be connected across the primary of the input transformer. These effect the response to higher frequencies.

A 280 Rectifier Used for Field Supply with This Dynamic

Fig. 3. The speaker shown above obtains the field coil supply from a 280 type rectifier which supplies direct current. The transformer and rectifier tube may be seen at the left.

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A Discussion of the Fine Points of Available Dynamics

WHAT'S NEW IN DYNAMICS?

THIS season has seen the birth of many new reproducers. Among those which have created the greatest interest are the moving coil type or as they are more popularly termed dynamic speakers. A description of some of the latest types, as well as, the outstanding points in their construction are presented her. This discussion will enable the reader to choose the reproducer best suited for his requirements, and give him an understanding of the operating principles.

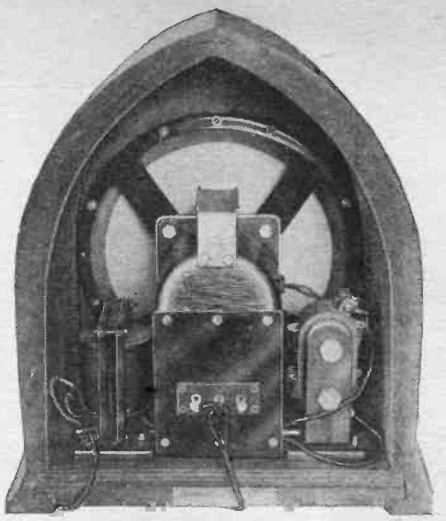

Fig. 4. A rear view of the dynamic speaker which employs a single turn voice coil is shown above. This is an A.C. model of the 6 volt type.

Condition Equalizer on Speaker Aids in Good Reproduction

The larger the condenser used at this point, the greater will be the reduction in response. The speaker can be made to respond to the necessary portion of a high and low frequency range under varying conditions found in different receiving sets and amplifiers. A permanent adjustment can be found where a good balance will be obtained. When using a phonograph pick-up, the equalizer tends to reduce needle scratch.

Single Turn Speech Coil

FIGS. 1, 4 and 7 show one of the latest dynamic speakers housed in a cabinet with a baffle which employs a single coil in place of the usual moving coil which latter consists of 150 or more turns of fine wire. The secondary of the input transformer is a single turn of bar copper. To this the suspension lead-ins are bolted and the suspension and leads are integral with the voice coil. The one turn secondary has unlimited current carrying capacity. This reproducer can be had with either a seven or a nine-inch cone.

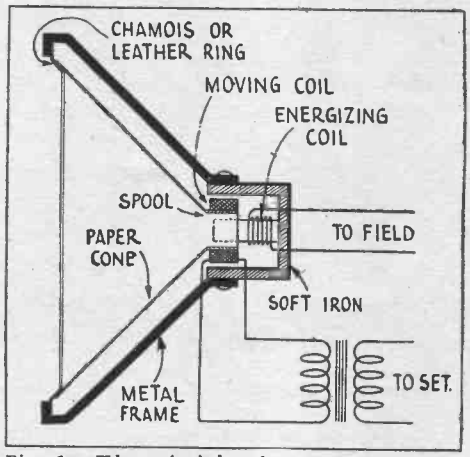

Fig. 5. The principle of construction of all dynamic speakers is illustrated in the above drawing. The speaker using a single turn voice coil is somewhat different.

Baffle Board

IN order to use a moving coil type speaker to the best advantage, it should be mounted in a cabinet or on a baffle board. The baffle board itself should be at least 7/8-inch thick, as thinner boards would tend to resonate at the middle frequencies. The cone in this type of speaker moves with a piston-like motion and the waves from front and back would tend to interfere, particularly at the lower frequencies. However, if the shortest path from the back to front approaches the length of the lower frequency waves, this interference will be eliminated. The distance from the front edge of the cone around the cabinet or baffle should be at least one-quarter wavelength of the lowest note to be reproduced.

The baffle board delays the meeting of the two sound waves; those coming from the front and those from the rear of the cone. A baffle having an effective length of 36 inches will be found satisfactory for general requirements. A cabinet baffle can be used where a large flat baffle would be inconvenient. A deep cabinet, however, is liable to produce resonant or barrel effects, due to the large air column which acts as a resonator at certain frequencies. The back of any cabinet used as a baffle should not be enclosed. A speaker installed in the wall will have a baffle of infinite measurement and will therefore reproduce the lowest note fed to it from the amplifier. Enclosing the speaker in a small box will produce disturbing resonances. The frequency response range of dynamic speakers is good and extends up to 5,000 cycles with a peak usually at about 1,500 or 2,000 cycles. This is due in part to the vibration of the cone and also to the horn effect noticeable at the higher frequencies. Ribbed cones tend to minimize this vibration. The defect in the response curve, if it may be called such, is also corrected by speakers using equalizing filters.

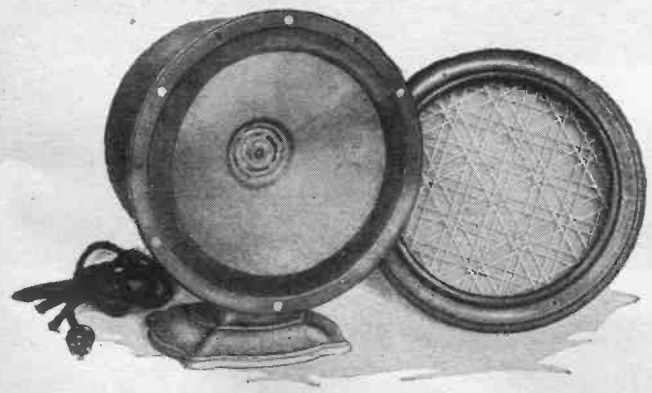

Fig. 6. One of the latest types is enclosed in a metal case fitted with a suitable stand and is shown above. The front grill has been removed, in order to show the cone. The cord is provided with a four prong base for connections to the set and voltage supply.

This is the first part of an article dealing with the design of moving coil type speakers. The second part will appear in the April issue of this magazine. The names and addresses of the manufacturers will be supplied to those interested in better reproduction.

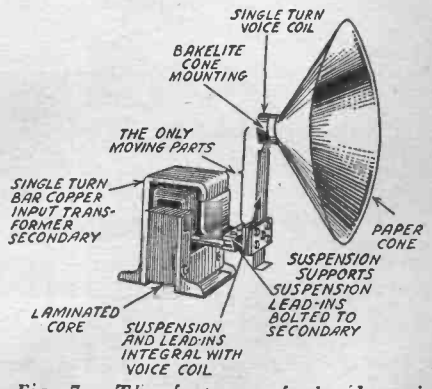

Fig. 7. The features of the dynamic speaker using a single turn moving coil or voice coil are shown above. A single bar of copper constitutes the input transformer secondary.

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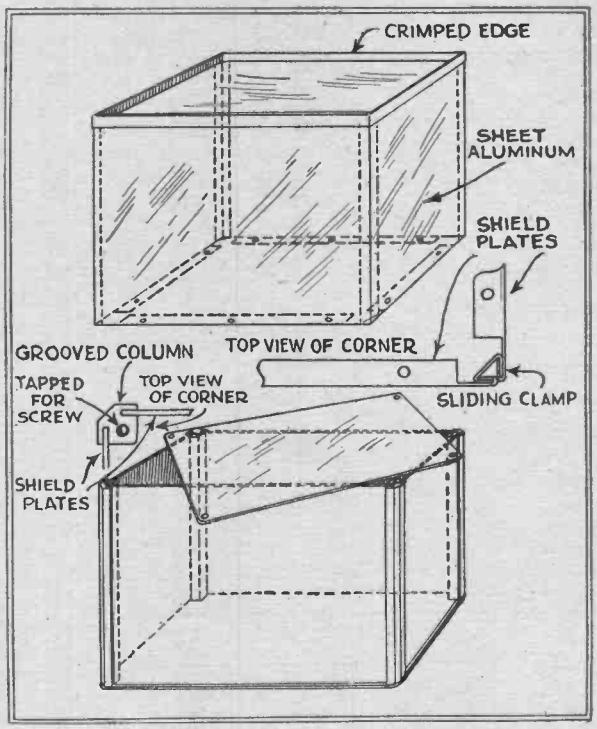
New Radio Devices

Aluminum Shields

TWO types of aluminum stage shields have been made available by a New York manufacturer. One is made of sheet aluminum and is 7 in. long, 6 in. wide, and 6 in. high. It is supplied in knockdown form and can be quickly assembled. The four side plates are bent at the edges to receive a sliding clamp, one of which is used at each corner and holds the shield together rigidly. The bottom of each shield plate is bent inwardly at right angles and has several holes in order to facilitate mounting. The top of the can is equipped with a crimped edge which fits tightly over the shield box. The other shield is made of rolled aluminum, thicker than the metal used in the construction of that just described. It measures 8¼ in. long by 4 5/16 in. wide and is 5¼ in. high. The construction is also somewhat different, as grooved columns are used for receiving the shield plates and the top is held in place by machine screws. A bottom plate is also provided with this shield.



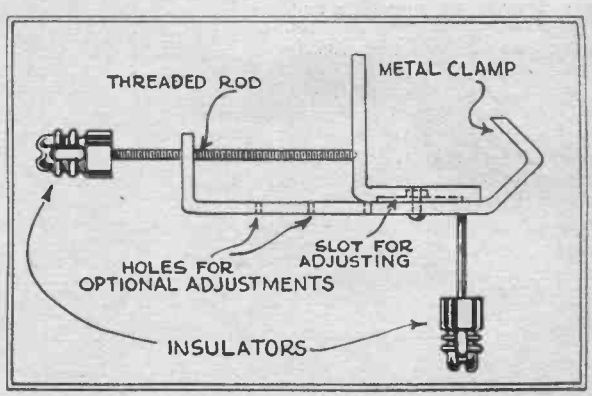
Two types of new aluminum shield cans are illustrated above. One is of thin and the other of thicker aluminum.

Aerial Clamp

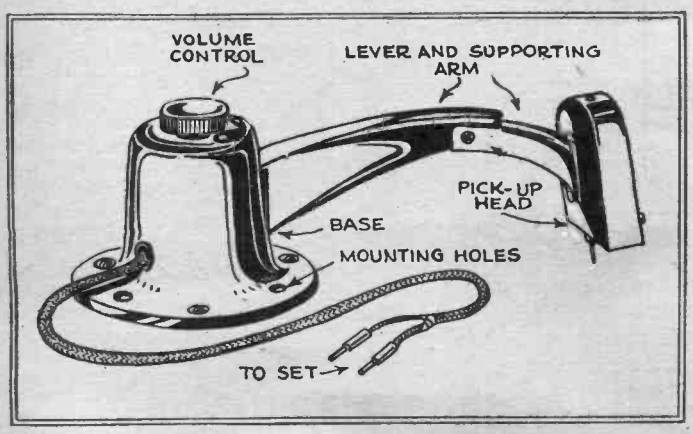
AN excellent clamp for supporting the aerial or lead-in wires is now being made by an Indiana manufacturing company. It is of heavy galvanized metal with a sliding jaw provided with a slot for adjusting to the desired width. A threaded rod with an insulator at one end, screws into this portion of the clamp as shown. Another similar rod with an insulator is placed at the bottom, several holes being provided for optional adjustments. The jaws of the clamp can be opened to a maxmum distance of 10½ inches, and the clamp may be fastened almost anywhere. It can be quickly fastened to the windowsill or eave corner. If the strain of the aerial is toward the object to which the clamp is attached, the insulator on the longer rod should be used. But, if the strain is away from the clamp support, the shorter rod provided at the bottom of the channel should be used for supporting the aerial. The sliding portion of the clamp can be reversed when making adjustments of less than six inches.

Phonograph Pick-Up

A WISCONSIN company has recently put on the market a phonograph pick-up. A large mounting base is provided on the top of which is a knob for controlling the volume, a variable resistor being placed in the base. The vertical base holds the arm to the turn-table mounting. The tone arm is pivoted to this base so as to be free to transcribe an arc over the surface of the record. Pivots have been arranged so that friction is at a minimum and the arm swings freely. At the end of this arm is a smaller pivoted arm which carries the pick-up head. The pick-up unit itself is of the magnetic type. The lever and supporting arm are allowed free vertical movement by virtue of the construction. The arrangement of two arms prevents the needle from pressing excessively upon the record, and thus, shortening its life. A long length of cord is provided for connection to the radio receiver and adapters for both four and five prong sockets are furnished by the manufacturer.



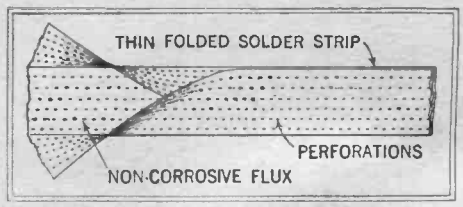
The aerial clamp is illustrated above. A slot and a number of holes are provided for optional adjustments.



The phonograph pick-up with a volume control incorporated in the base is shown above. This instrument is finished in gold.

Tape Solder

STRIP or tape solder of the self-fluxing type can now be obtained from a St. Louis company. A suitable length of the tape is wound around the connection and a match flame, torch or iron, applied. Quick repairs can be made with this convenient form of solder and poor connections are eliminated.



The tape solder is formed by a thin folded solder strip in the center of which is a non-corrosive flux. Perforations allow even distribution of flux.

(Names of manufacturers furnished upon request)

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RADIO ORACLE

Tuned Impedance R.F.

(700) Russel Gordon, Boston, Mass., writes:

Q. 1. What is the operating principle of the tuned impedance-coupled radio frequency amplifier?

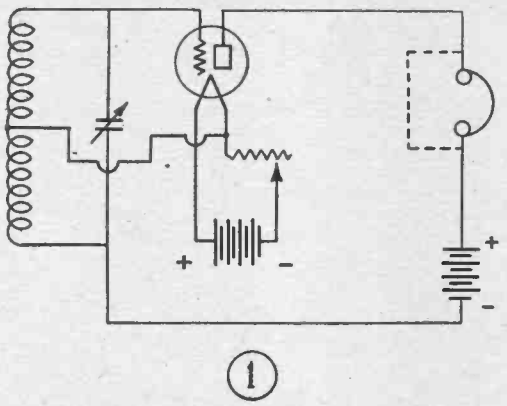
A. 1. This sort of an R.F. stage is similar in operation to an impedance coupled A.F. amplifier. In both cases, a voltage drop is obtained across an impedance or a resistance in the plate circuit of one tube and through a fixed condenser, the changes in voltage across the impedance or resistance are applied to the grid of the following tube. The coupling device consists of a coil and a condenser in parallel placed between the plate of the tube and the "B" battery. By varying the capacity of the condenser, the circuit may be tuned to resonance with the signal to be received. When the coil and the condenser are tuned to resonance, they have the greatest impedance possible at the received frequency. The plate current meets a great coil- and condenser-impedance at this frequency and there is a drop of voltage across this impedance. From the connection of the impedance leading to the plate of the tube, a lead runs to a blocking condenser, the other side of which is connected to the grid of the succeeding tube. The changes in voltage across the impedance are carried through this condenser and applied to the grid. A grid leak is also connected across the grid terminal and the A positive. The principal objection to this sort of amplifier is the difficulty found in preventing self-oscillation. The tuned impedance circuit cannot be neutralized. Oscillation may be controlled by a potentiometer in the grid return or by any suitable method, such as, placing a high resistance in series between the impedance and the "B" supply. In tuned impedance coupling there is no step-up of voltage as there is with transformer coupling where there may be an increase in voltage from the primary to the secondary. Since the entire amplification obtained is from the tube alone, it is advantageous to employ high-Mu tubes.

Wavemeter and Resonance Indicator

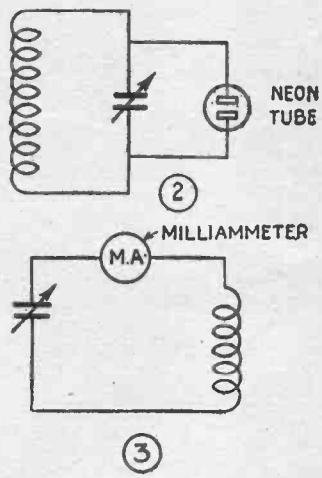
(701) G. P. Sullivan, Johnsonburg, Pa., writes:

Q. 1. Please publish a diagram of an oscillating wavemeter and a resonance indicator of simple design.

A. 1. Illustrated on this page you will find a diagram of an oscillating wavemeter in Fig. 1. This uses the well known Hartley circuit and the inductance of the coil and capacity of the condenser will depend upon the wavelength which the oscillator is to cover. The inductance, however, for covering the broadcast band should be the same as is used in the receiver with the same capacity condenser. The oscillator can be calibrated to wavelengths by means of standard signals. A procedure of calibration known as the zero-beat method, briefly, is as follows: First tune the receiver to the standard signal and then place the wavemeter about three feet from the set and turn the dial slowly. When the oscillator is tuned almost to the wavelength of the incoming signal, a whistle will be heard. This is a beat note whose frequency is the difference between the frequency of the incoming signals and the oscillations of the wavemeter. The beat note changes to a lower pitch as the dial is turned and finally ceases altogether. If the dial is turned still further, the beat note will come in again and rise in pitch. Tests may be made for a number of different wavelengths and a graph plotted using the ordinates for the frequencies or wavelengths and the abscissas for the dial readings. When the phones are not used they are short-circuited as indicated by the dotted lines. Diagram No. 2 shows how a neon tube may be used to indicate resonance. When a circuit consisting of a condenser and a coil is tuned to resonance, the voltage across the terminals of the condenser is at maximum. Therefore, a voltage indicating device such as the small neon tube can be used across the condenser. When the wavemeter is tuned to the frequency of the oscillations it is receiving, the current flowing between the coil and the condenser is at a maximum. The wavemeter is then in resonance at the frequency of the incoming signals a simple resonance indicator, in this case, is a hot wire milliammeter connected in series with the coil and condenser as shown in Fig. 3.



A diagram of an oscillating wavemeter using the Hartley principle is shown above in Fig. 1.



Above in Fig. 2 is shown how a neon tube may be used to indicate resonance and Fig. 3 illustrates another resonance indicator in the form of a milliammeter.

Minimizing R.F. Coupling

(702) Robert Sutton, Brooklyn, New York, asks:

Q. 1. In present day receivers using two or three stages of radio frequency amplification, three positions of the coils appear. What is the advantage of placing coils at an angle to each other, or separating them some distance apart with their axes parallel or at right angles to each other?

A. 1. Coils of the solenoid type will be coupled together by their magnetic fields unless they are separated by quite an interval. With their axes directly in line, the degree of coupling depends upon the coil separation. Placing the coils so that the separation remains at a fixed value, and so that their axes or lines of center are at an angle to each other will reduce the coupling. When the axes are exactly at 90 degrees or at right angles to each other, this coupling is at a minimum. Feedback between coils can be effectively reduced in this manner. If two coils are placed parallel to each other, the magnetic field of one will pass through the other. If the magnetic lines of force cut one side of the turns of wire on a coil and do not cut the opposite sides of the same turns with equal strength, a voltage difference will be set up across the turns.

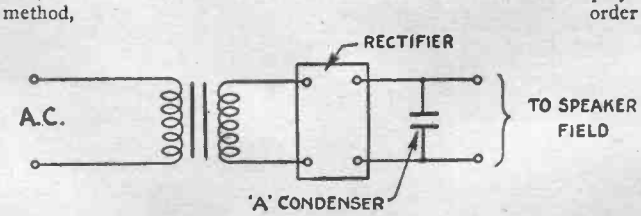
If the axes of the coils are parallel changing the angle they make to a straight line drawn through them, causes the magnetic lines of force sent out by one coil to cut through both sides of the turns of the other. This angular placement may be increased until a point is reached where the lines of force will cut evenly through both sides of the coil. In this position there will be minimum magnetic coupling between the coils. When the coils are placed parallel and close to each other, their efficiency and that of the associated circuit must be reduced so that the feedback will not cause oscillation.

Eliminating Speaker Hum

(703) A. J. Hughes, Newark, N. J., asks:

Q. 1. I recently bought an A.C. dynamic speaker of the 6-volt type and ever since it has been in use an annoying hum has been experienced. Can you tell me how this can be eliminated?

A. 1. In the majority of cases it has been found that the hum can be cured by shunting high capacity condensers across the field coils of the dynamic speakers. In some cases a 4 to 8 microfarad condenser will work satisfactorily or a high capacity electrolytic condenser will prove effective. In the majority of instances, however, it will be necessary to employ a high capacity "A" condenser in the order of 1000 to 2000 mfds. If the hum is not eliminated sufficiently, it might be well to try a current carrying choke in series with the rectifier and field coils with an "A" condenser on each side of the choke. The diagram found on this page shows the method which proves most effective in the majority of cases. This is simply the connection of an "A" condenser across the rectifier output. These condensers can only be used with speakers taking up to 10 v. A.C.



The hum experienced with some types of A.C. dynamic speakers can be eliminated or reduced in many cases by connecting an "A" condenser across the field winding as shown.

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Scientific Humor

THE FILLING STATION

GEORGE: "Do you know what Sandy does with his empty eggshells?"

MIKE: "No, what?"

GEORGE: "He sends them to WRNY and has em relayed."—*John Novick.*

RUST REMOVER PLEASE

FIRST SCIENTIST: "Are you ever absent-minded?"

SECOND: "Well, the other day I held an egg in my hand and boiled my watch three minutes."—*Leslie F. Carpenter.*

WHEN MA FITS LINOLEUM PA HAS FITS

"Darn, this razor won't cut anything."

"Why, John dear, you don't mean to say that your beard is tougher than the kitchen linoleum, do you?"

—*Earle Bennett.*

FORCE OF HABIT

DOCTOR: "You held a mirror over her face to find out if she was breathing?"

NURSE: "Yes, and she reached for her powder puff."—*Leslie F. Carpenter.*

TRY INSURANCE "COLLECTORS"

PROF.: "I would like to know the names of a few good reducing agents."

CO-ED: "So would I."—*B. Karmiol.*

TICKLING SERIOUS SCIENCE

CURIOUS CHILD: "What is this Scientific Humor?"

DAD: "You are too young to understand. It consists of sneezing powders, laughing gas—."—*H. Palomer Vibal.*

THREE STAR GROUPS

First Prize—$3.00

PROFESSOR OF ASTRONOMY: "How many classes of heavenly bodies are there?"

FRESHMAN (An ardent admirer of the fair sex): "Three, Professor—blondes, brunettes and redheads."—*Smith O'Brien.*

BUILDING AN UPLIFT SOCIETY

HE: "I am working for the support of literature."

SHE: "What are you doing?"

HE: "Making bookcases!"

—*Miss Mary Sanday.*

ALL jokes published here are paid for at a rate of $1.00 each; $3.00 is paid for the best joke submitted each month.

Jokes must have a scientific strain and should be original.

Write each joke on a separate sheet of paper and add your name and address to each.

Unavailable material cannot be returned.

MIXING DRINKS

"What is the best way to make a peach cordial," a young man writes in to ask.

"Might try giving her a pearl necklace."

—*Smith O'Brien.*

WELL LINED

JOE: "I see where a man drank a bottle of shellac."

ED: "Well, he had a nice finish."

—*Wilbur Alexander.*

SOPHISTICATION

SUNDAY SCHOOL TEACHER (after a carefully prepared speech on the birth of Christ): "Johnny, why do bells on Christmas ring?"

JOHNNY (stifling a yawn): "Because someone is pullin' the rope."

—*Stanley Stanbery.*

A GOOD HOOK-UP

CUSTOMER: "Do you carry "B" eliminators?"

CLERK: "No, but we have some mighty fine roach powder and some fly swatters"

—*S. G. Frandsen.*

THE LIMIT

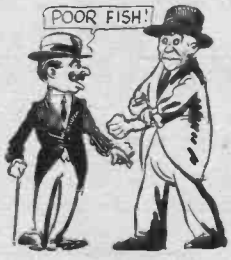
There was once a widow who had seven sons. One day at the dinner table they were trying to think of a name for their cattle ranch. Finally one said, "Let's name it focus." "Why?" asked his mother. "Well," he said, "a focus is a place where the sun's rays meet (sons raise meat)."—*Archie Kimmel.*

NO TRUMP

"Should evening dresses be worn to card parties?"

"No, in playing cards it is only necessary to show your hand."—*Charles Gerard.*

FROM FISH FIRST



FIRST SMARTY: "Why is it, according to an evolutionist, that Welshmen do not belong to the human race?"

SECOND DITTO: "Easy—The human race is supposed to come from apes, not Wales (whales)."

—*David J. Gibson.*

NOT LIKE WATERING HORSES

FARMER: "Did you milk the cow?"

CITY FELLER: "Yes, I did; but the ole fool wouldn't drink it."—*Stanley Stanbery.*

SCIENTY SIMON SCIENTIST

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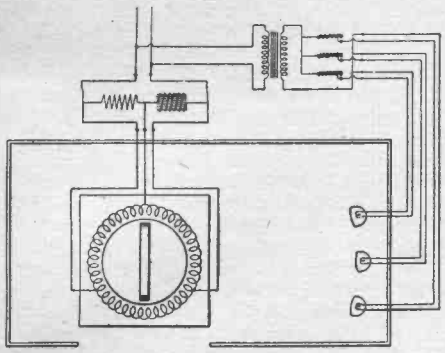
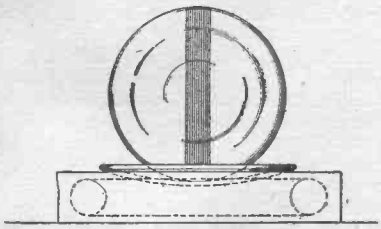
LATEST PATENTS

Advertising Device

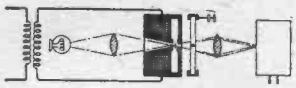




No. 1,666,721, issued to Richard M. Sherrill. The invention shown above produces a rotary magnetic field in which a metallic ring is allowed to rotate giving the appearance of a solid ball. The conventional Gramme ring with a tapped field winding is used. A single phase alternating current is supplied to the ring through a phase splitting device. The Gramme ring is concealed in a case below a glass bowl for the spinning object.

Transmission of Pictures by Electricity

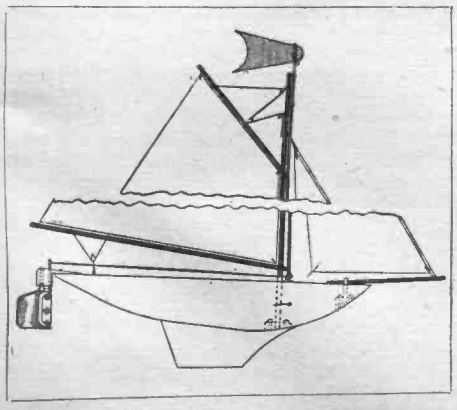
No. 1,688,081, issued to Herbert E. Ives. A diagrammatic view of the system appears here. A double refracting image forming



element is used and a means is provided for controlling the separation of the emergent rays falling upon a recording element. A piece of Iceland spar is used for doubling the image. The resulting picture is free from grained effects.

Wind-Controlled Steering Gear

No. 1,681,415, issued to Harold A. Lee. This invention provides a means for keeping a vessel on its course by making the rudder subject to changes in wind direction and controlling it with a wind vane. A special rudder gearing is used together with a control rudder which make the main rudder easily operated by the wind.

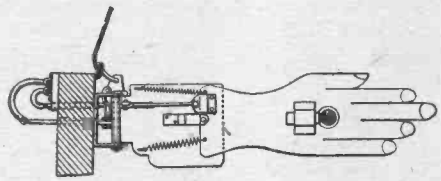


Notice to Readers:

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

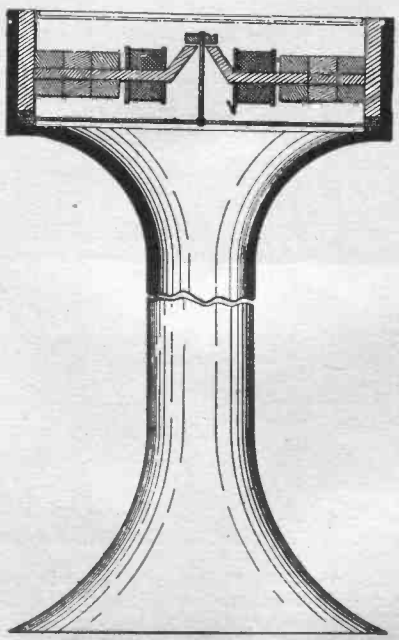
Signaling Apparatus

No. 1,686,691, issued to Frank A. E. Goodroad. In this device a hand or vane is provided which may be operated by the driver without removing his hands from the wheel. A foot lever controls the operation of the signaling device, which is returned to its natural position by a spring. A small lamp can also be attached to the signaling hand and is particularly useful when driving at night.

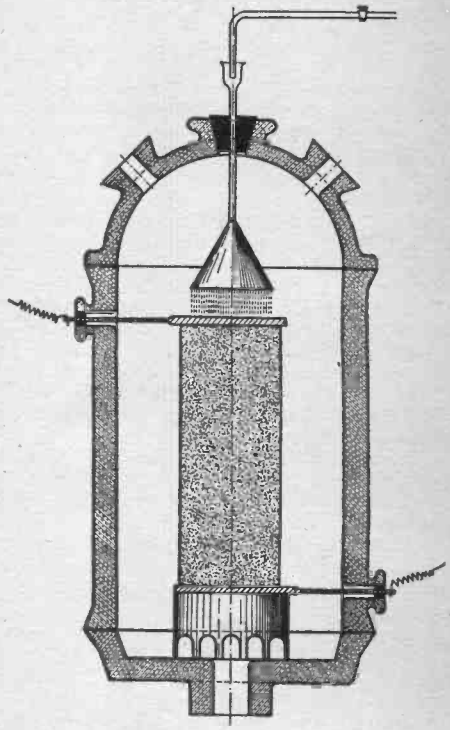


Loud Speaker Unit

No. 1,685,086, issued to Miller Reese Hutchison. The unit shown here comprises an electro-magnetic unit and diaphragm mounted so that the diaphragm is adjacent to an air column, which is a tube having a flare and filled with a fluid which can be made to resonate at a predetermined natural frequency in consonance with the tuned diaphragm, so as to produce greatly amplified effects at certain frequencies.



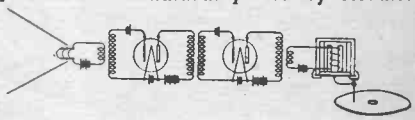
Heating Liquids Electrically



No. 1,688,679, issued to Gustav Baum. This process effects the heating of liquids for distillation and the like by utilizing the liquid itself as a resistance between two electrodes. An insulating structure divides the liquid into streams, thus increasing its resistance.

Sound Recording

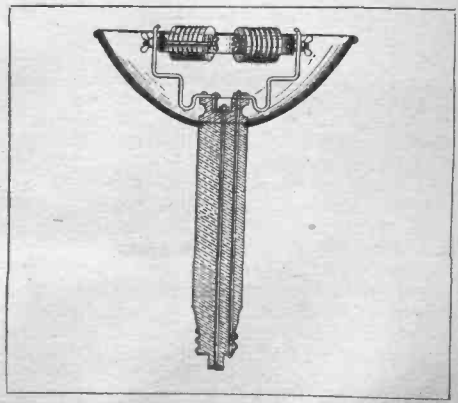
No. 1,661,793, issued to Lloyd Espenschied. This is a phonograph system for translating sound waves without distortion. The microphone is of the non-distorting diaphragm type and has a natural period of vibration



higher than the frequencies to be recorded. A special design is used in the amplifier, making it practically distortionless.

Infra-Red Ray Generator

No. 1,688,124, issued to Hector P. MacLagan. The therapeutic apparatus shown below has a heating element for an infra-red ray generator. The resistance wire is wound in a grooved insulating support, said grooves being covered so as to eliminate rays of shorter wavelength.



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THE ORACLE

A Question of Gravity

(2299) G. W. Tuck, Pontiac, Mich., asks:

Q. 1. If two balls of equal size and shape, one weighing one pound and the other two pounds were dropped from an airplane one mile high, would the two pound or heavier ball strike the ground before the lighter ball, or would they both strike the ground at the same time?

A. 1. If two balls of equal size and shape, one weighing two pounds and the other one pound, were dropped from an airplane at the same time, they would both strike the ground at the same time. Their wind resistance would be the same because they are identical in size and shape. The falling of a body to the earth is attributed to the earth's attraction for it. The weight of any body is due to a force which gives the measure of that attraction. It has been observed that in a vacuum all bodies fall at the same rate of speed (this does not mean, however, that they are all equally attracted to the earth). All bodies are subjected to the attraction of the same body (the earth) at the same distance from its center. In accordance with Newton's second law of motion, the acceleration of a body is proportional to the force and inversely proportional to the mass.

$$a = k \frac{F}{M}$$

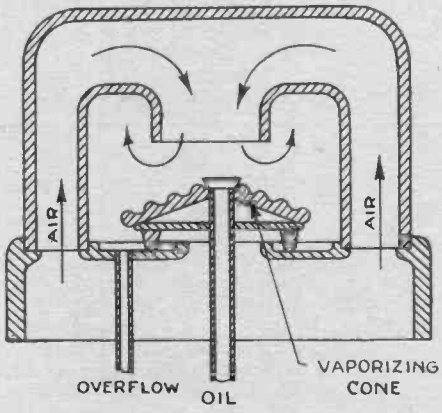
With various masses M, the acceleration, a, could not be the same unless the force F varied in the same proportion that M varied, that is, unless $\frac{F}{M}$ is constant; so that if the accelerations are alike as shown by experiment, then the ratio of F to M for all bodies is the same and therefore, the attraction of the earth for bodies, (their weight) is proportional to their mass. This force or weight is a basis for the comparison of masses. By suspending hollow spheres on strings of the same length and filling these spheres with various substances, it will be observed that all pendulums so formed will swing in the same period. Such an experiment helps to confirm the second law of motion. If we then consider that the attraction of the earth for any body at a given space is proportional to the mass of that body, then these principles would demonstrate that a heavy body and a light one fall at the same rate leaving out of account the air resistance. The force F due to gravity varies as the mass of the body. For all bodies, the ratio of the force of gravity to the mass, or $\frac{F}{M}$ is constant. This ratio by Newton's second law of motion, is the acceleration due to gravity. Gravity is expressed as the ratio at which the velocity of a freely falling body increases. It is not a force, therefore, but is numerically equal to the number of units of force which gravity exerts upon a unit mass.

Oil Burner Vaporizer

(2300) C. B. Clifton, El Paso, Texas, writes:

Q. 1. Will you publish an illustration showing how natural draft vaporizers in oil burning furnaces are constructed?

A. 1. You will find illustrated on this page a cross-sectional view of a typical natural draft vaporizer. It is of simple construction and there are, therefore, many varieties of this type used at the present time. The burner is constructed out of a few castings. It is placed on the center of the grate and any portion of the grate not covered by it is filled in with sand and refractory cement. This prevents the air from entering the combustion chamber through any other inlet than the regular air passages. Thus, the air for combustion is controlled and preheated before mixing with the fuel vapors. The oil enters the burner through the vertical feed pipe and spreads out in a thin film flowing over the surface of the vaporizing cone. This cone is heated before the burner is started and remains hot while the burner is being used. The oil is vaporized in this way and the fumes are mixed with the hot air and are burned. If



Above is a sectional view of a gravity feed burner used in some types of oil burning furnaces. The oil flows over a corrugated cone shaped apron and is vaporized.

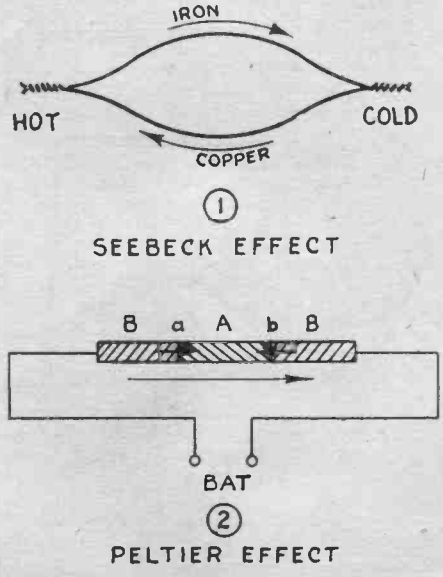
the flame is extinguished in any way, the oil flows over the edge of the cone into the reservoir below, which is connected by means of a pipe to the float of a safety shut-off valve. A small weight of oil will operate the valve and shut off the oil supply to the burner.

Peltier Effect

(2301) J. A. Higginson, Detroit, Mich., writes:

Q. 1. Please furnish me with an explanation and an illustration of the Peltier effect with two dissimilar metals.

A. 1. The Peltier effect takes places in an electric circuit composed of two dissimilar metals. When a current is sent through the circuit, one junction gets warmer and the other colder. If the circuit is of copper and iron, then the junction at which the current flows from the copper to the iron will get cooler, while the junction at which the current flows from the iron to the copper will get warmer. This phenomenon depends upon the metals and the temperatures at the junctions. If a bismuth-antimony junction is heated, the current flows across the former to the latter as shown by small arrows in Fig. 2. Peltier discovered that if a current from a battery is sent through a compound bar from bismuth B to antimony A, the junction will be cooled. If sent the other way, the junction would be heated. The long arrow shows the direction of the current and the small arrows, at a and b, indicate the direction of the voltage at the junctions. At a, the thermal E.M.F. is in the direction in which the current is flowing. Hence, at this junction work is done on the current and the heat of the metals is converted into the energy of the watts. At b, the thermal E.M.F. opposes the current, work therefore, is done on the junction and it is heated. The thermal effect at a junction of dissimilar substances differs greatly from the thermal effect due to pure resistance. The Peltier effect is reversible, the current heating or cooling the junction according to the direction, while the quantity of heat absorbed or evolved varies with the current. The heat due to resistance is independent of the current direction and is proportional to the square of its strength. The converse of the Peltier effect discovered by Seebeck and named the Seebeck effect, appears when a circuit, such as that shown in Fig. 1, made of two dissimilar metals, such as, iron and copper, has its junctions kept at different temperatures. The current will flow in such a manner that the Peltier effect will tend to equalize the temperature of the two junctions. The magnitude of the above effect depend upon the kind of metals, the difference in temperature of the junctions, and on the temperature of the colder junction.



The Seebeck effect is illustrated with a copper and iron couple in Fig. 1, and the Peltier effect with antimony and bismuth is shown in Fig. 2.

Spun Glass

(2302) Alfred Royce, Greenwood, South Carolina, writes:

Q. 1. What are some of the applications of spun glass and how is it prepared?

A. 1. Strands of glass are prepared by drawing out the molten glass in the form of very fine threads with a sort of spinning wheel. Colored glasses may be used to obtain colored threads. Owing to its brittle nature, spun glass receives only limited application but is made into various ornamental objects. Sometimes colored glass threads are used for the weft in silk materials in order to produce novel effects. The glass gives the fabric stiffness and a greater lustre. Glass wool which is a variety of spun glass finds application to some extent as a filtering medium in the chemical laboratory. Glass wool is curly, due to the fact that it is made by drawing out the glass thread from two pieces of glass of different degrees of hardness. By their unequal contraction in cooling, the double thread acquires a set curl. Today the principal use of spun glass is in the making of insulation and for separators in storage batteries.

In the manufacture of spun glass, solid glass rods ¼-inch in diameter are made of pure soda glass, one end of the rod is heated and drawn to a thread and the thread attached to a wheel. The end of the rod is slowly revolved in a constant flame and the wheel turned by an electric motor. The hank of thread is removed from the wheel and resembles silk if sufficiently fine.

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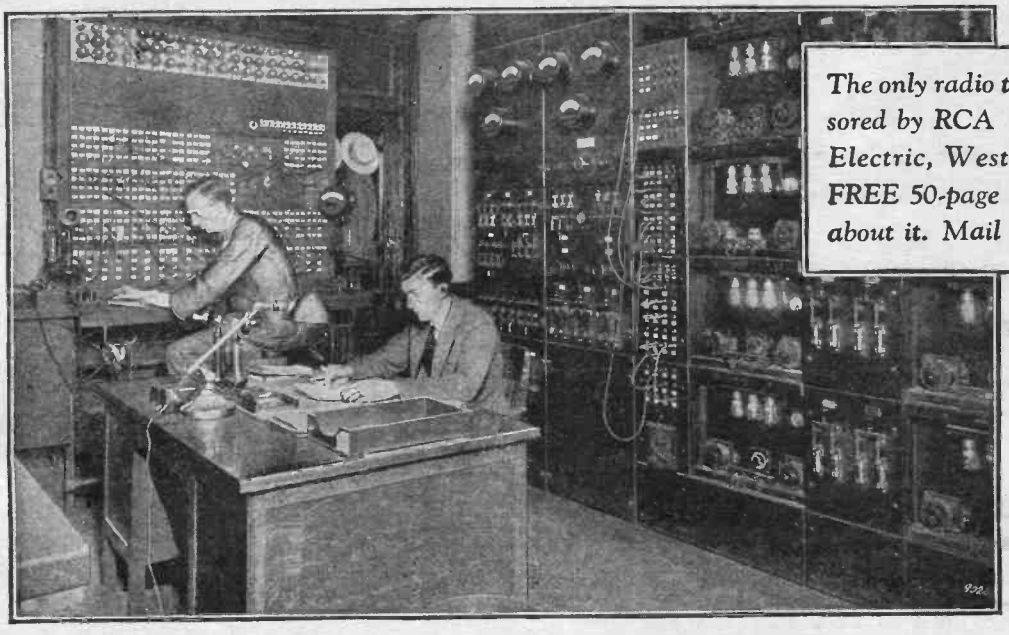
"I Found the Short Cut to Success in Radio

through this amazing home laboratory method!"



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By Frank Halloran

I GOT hungry to get into Radio when I learned about the big money it was bringing my next door neighbor.

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"Charlie," I asked him one day, "how did you become a radio expert?"

"A cinch," he smiled. "I took it up in my spare time at home."

"What?" I asked in surprise, "you actually took a radio course by mail?"

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Taking Charlie's advice was the luckiest thing I've ever done. It's bringing me more money in a week than I've often earned in a month!

I never dreamed that learning radio at home was so easy and so fascinating. From the very first lesson to the last I was thrilled! Each subject was explained in simple word and picture form . . . . and written in such an interesting style that I was carried along like a novel!

I didn't know the first thing about radio when I started, yet before many months were over I was able to solve many of the problems which now help me command big money. The lessons took me step by step through trouble-finding and repairing . . . . through ship and shore and broadcasting apparatus operation and construction . . . . through photoradiograms, television and beam transmission . . . . through radio salesmanship, store operation and executive work.

Success—In Spare Time!

I didn't have to give up my regular job. I learned at home during my spare time. And I actually learned by doing! With the course, I received an outlay of the finest standard apparatus with which I was able to build radio circuits and sets of almost every description . . . . yet this expensive apparatus cost me absolutely nothing extra!

Even before I had completed the course I was able to earn good money doing odd radio jobs. And it wasn't long after that I was able to give up my regular work and branch out for myself as a full-fledged expert in work that is fun and extremely profitable!

Today, my income is more than doubled . . . . and I've only just started! I'm certainly happy that I found this short cut to success!"

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Frank Halloran's wonderful success is just another typical example of the success which the Radio Institute is bringing to hundreds of men everywhere through its wonderful Home-laboratory training . . . the only official radio training based on the inside knowledge of radio developed in the great experimental laboratories of RCA, General Electric and Westinghouse!

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Whether a salary of $65 to $100 a week—or spare-time playing at $5, $10, $15 or more a night—interests you or not—think of the fun in store for you. In one to three months we can train you at home to play this marvelous, melodious instrument with a fine, easy skill that will make you the envy of all other eyes. You're passing up the *best times* of your life if you pass up an opportunity like this to learn at slight cost and with no inconvenience at all the world's most popular instrument. Decide NOW to learn more about The Play-Way—the quickest, surest, short-cut to social and professional success.

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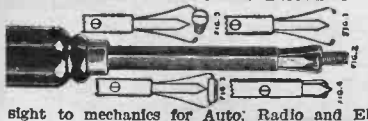

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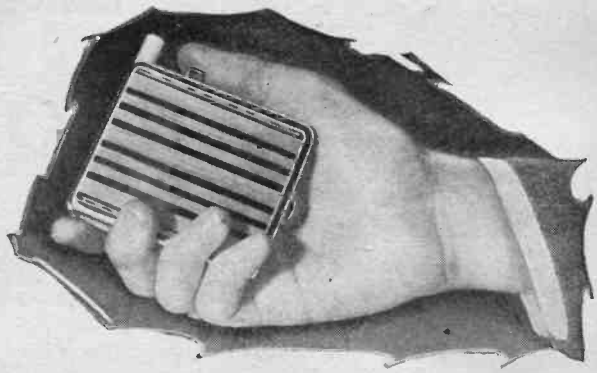
Ejector Cigarette Case

At the right we have an illustration of an ejector cigarette case which pushes one cigarette out of the case at a time when the lever is depressed. To open this cigarette case, one inserts his finger under the lip and slides the cover. The compartment revealed houses ten cigarettes which a spring pushes to the ejector side of the case. The lever at the top terminates at the bottom in a small flat angle, and when the lever is depressed, the angle itself rises, pushing the cigarette out as the illustration shows.



A cigarette case which ejects its cigarettes in rapid succession whenever the lever is pressed.

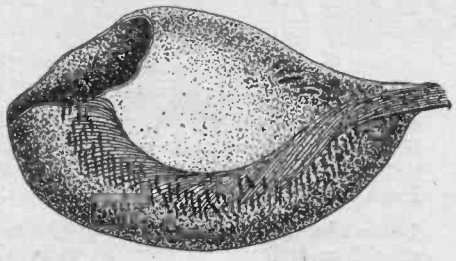
Name of manufacturer on request.

The Magnetic Lobster

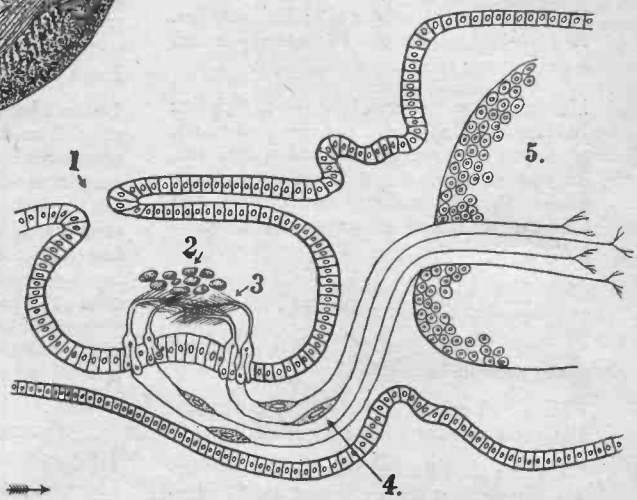
By Dr. Ernest Bade

(*Continued from page* 1036)

and the crayfish was very well satisfied with such heavy objects for his balancing organs. Never had his sense of balance been so definite and certain as under this weight of iron filings. Then came the scientist with a magnet, placed it close to the head where the iron filings were—the great moment had arrived—and the crayfish turned on his back, lying horizontally to this new force, the crayfish had become magnetic. Not that one could lift the crayfish and pull it in any direction with the magnet, but due to the pressure of the filings being attracted by the magnet, the sense of balance was disturbed and the creature turned around. It required the weight of its balancing material to press in a certain direction upon its nerves and this told the creature that it was in its normal position. It made no difference whether it stood on its head or its tail, the position of the iron filings were paramount while the filings themselves could be held in any position desired by the magnet.



The sack in which the heavy balancing material is found is shown above. This particular form belongs to a certain type of crayfish. The hairs within the bag are stimulated and this causes the animal to assume its correct position in the water or on land.



A section through the ear of the crayfish showing the balancing organs appears above. The heavy material used in the balancing organ is introduced through the opening 1, the stiff hairs which receive the stimulus from the weighted material are at 3. The nerves which transmit the stimulus are found at 4 and the brain is shown at 5.

IN MARCH RADIO NEWS

THE "RADIO NEWS 1929 HI-Q"—Screen-Grid Model—A Blueprint Article
THE "DRY-CELL FOUR"—A Blueprint Article
THE "CANDY-BOX SPECIAL"—A Short-Wave Set
THE SCREEN-GRID TUBE AS AN AUTOMATIC VOLUME REGULATOR
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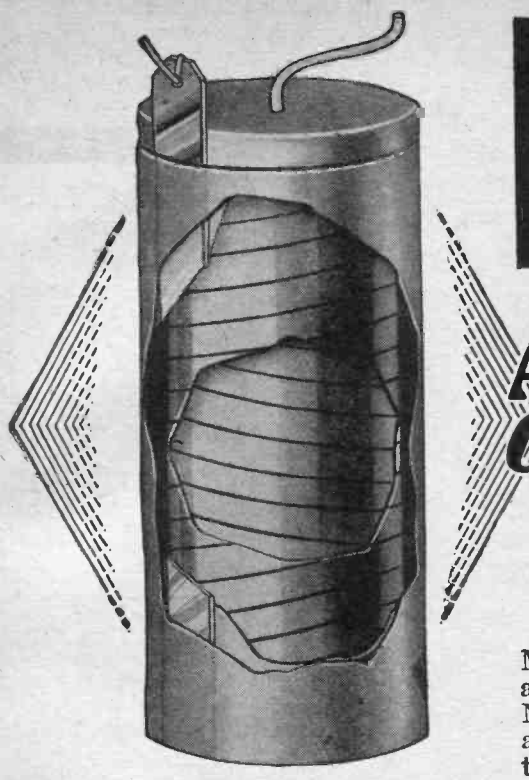

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Many set owners have come to realize the importance of using a dependable antenna, also the value of perfect grounding in getting good reception. Now science has gone a step further; it says that the LOCATION of the antenna is an equally important factor in getting best results. Because the radio wave goes right into the earth—where obviously there is less atmospheric disturbance and interference—it is claimed the logical place for the antenna should be the EARTH, not the air. This important conclusion allowed Radio Engineers to work out the EARTHANTENNA.

Reduces Static—

Gets Clearer, Sweeter Tone

Have you ever listened to reception that almost took your breath away with its faultless reproduction, its pure melodious tone? And then gone home and compared its haunting beauty to YOUR receiver's often unsatisfactory, static-ridden performance? Probably nine out of ten set owners who formerly thought they were getting "pretty good" reception have had this experience.

They accepted the shrieks, whistles, knocking and howls due to atmospheric conditions—the weak, faulty results of sagging, broken, or soot-laden aerial wires—the interference of other aerials or power line noises—the fading often caused by corrosion or imperfect contact in an unscientific ground—all as necessary evils.

Progressive radio refused to stop there. The new scientific, successful EARTHANTENNA is designed to give you clearer, better, more dependable reception—and it posts no more than the old inefficient aerial—in fact less than many.

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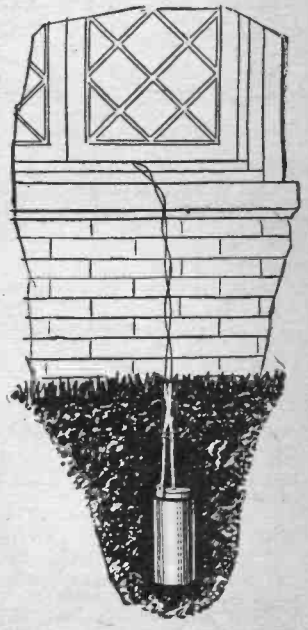

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By Joseph H. Kraus

(*Continued from page* 1037)

the lead in the market, being a favorite among the fairer sex.

The selection of tobacco and the preparation and blending has much to do with this constantly growing popularity of the cigarettes. Of course, one must also take into consideration the fact that automatic machinery today not only makes the cigarette, but packs it in tin foil, then in boxes or packages, and even goes so far as to place these packages in cartons, which are in turn again wrapped by machines.

The blending of tobacco has become an exact science. Tobacco from at least five successive crops is used and the harvests of these various years are blended together to eliminate any possible variations in the quality of the tobacco, due to natural variations and changes in weather conditions. In order to keep only one cigarette factory going, the crops of tobacco harvested from 148 acres are required. This one factory would buy from the government $96,000.00 worth of revenue stamps to place on the packages of cigarettes manufactured. This factory, only one of many, would produce enough cigarettes in one day to fill three freight cars.

Ordinarily, the tobacco, after it has been grown and harvested, is cured for three or four days to check fermentation. It is then slightly moistened to prevent breakage during shipment, and when it arrives at the factory, it is re-dried, separated in hogsheads and allowed to age for about three years. Each hogshead contains about a thousand pounds of tobacco, which is the approximate amount one would get from an acre of land. Each hogshead makes about 235,800 cigarettes and a single manufacturing plant will use as much as 140 hogsheads a year.

By-Products from Tobacco

WHEN ready to be treated further, the hogsheads are opened and placed in a steam room for about twelve days. An automatic machine strips the leaves from the stems, after which they are heat-treated. The stems also undergo a special treatment and the nicotine is extracted from them. The nicotine is used to make sprays for plants and fruit trees.

From then on, everything is done to eliminate foreign matter from the tobacco. It is inspected repeatedly as it goes through the ovens and the cigarette-making machines. The cigarettes on being packed in cases are marked with the date of manufacture and then sent to the dealer, so that he may know he is getting a fresh case.

In order to popularize a cigarette an extensive advertising campaign is usually waged. It is expected that the money spent for advertising during 1928 will exceed $75,000,000.00.

A Graphic Illustration

THE illustrations accompanying this article are based upon figures made using the round type of cigarette as a standard. This cigarette is two and three-quarter inches long. If all of the cigarettes which are smoked in the United States in a period of but twenty-four hours were placed end to end, they would reach nearly half way around the world at the equator, and those smoked in one year would form a band nineteen and one-half rows leading from the earth to the moon.

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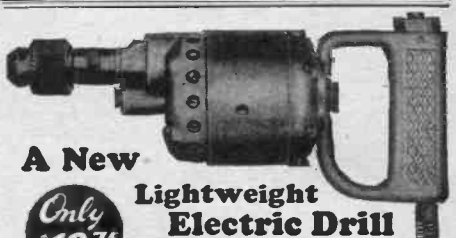

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Hints for the Mechanic

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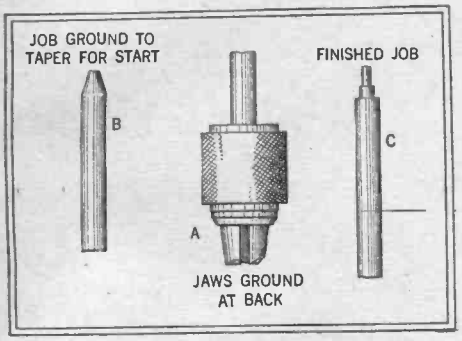
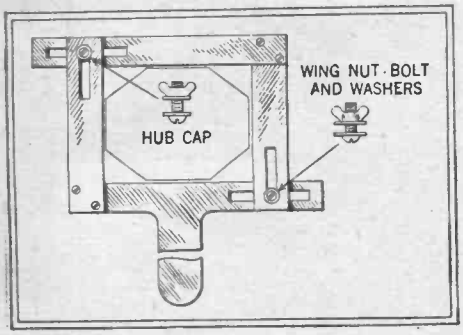
Adjustable Pin Cutter



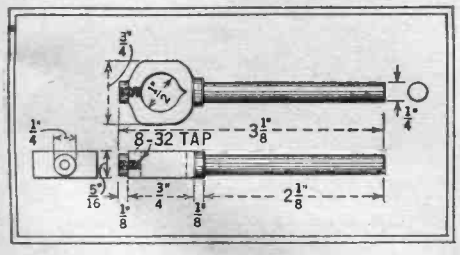
When there is no horizontal lathe available for pin cutting, the jaws of an ordinary vertical or press drill can be ground to a rake which converts it into an adjustable cutter. It is advisable to grind a taper on the end to cut B for the purpose of a good start. A shows the jaws ground at the back and C the finished job. The job can be held in a drill vise or disused lathe chuck.
—R. Brown.

Hub Cap Wrench



Various makes of automobiles have different sized hub caps and a wrench devised to fit most of these is illustrated above. Flat cold rolled steel 3/16 in. x ¾ in. is used throughout with 5/16 S.A.E. cap screws and wing nuts for the clamp bolts. The two solid corners can be bolted or welded together. This wrench will not harm the hub cap.
—Clem. Walker.

Lathe Dog



A lathe dog can be made as shown above from ¾ in. diameter cold rolled steel. It is placed in the lathe and turned as shown. A hole is drilled and elongated to form a 3 point bearing. A tap hole is drilled on centers with No. 29 drill. Tap 8-32 and insert set screw.—C. Russell.

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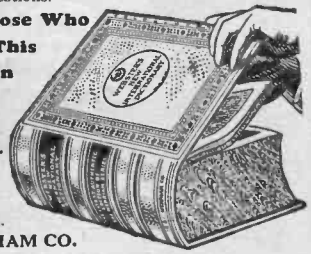

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If You Should Fly Into a Thunderstorm?

By B. Francis Dashiell

(*Continued from page* 1025)

pass through the front squalls, the pilot will soon break out into the clearing weather in the rear.

Flying Into a Storm

IF a plane should fly into the main body of the thunderstorm from the front it will encounter the violent squall winds and powerful uprushing currents. Here atmospheric electricity is being generated. Lightning is all about, and pitch darkness prevails. All sense of direction and position is lost. The lightning menace becomes very great, as well as that of electric induction which may explode or set fire to the machine. It may also dangerously shock the aviator to such an extent that he will lose control of the plane. Altitude will be lost as the descending air currents beneath the first clouds of the storm send the plane crashing earthward at a speed of nearly 100 miles an hour. At another time the plane will be caught in the uprush of air just at the front of the storm and it may ascend at a terrific rate. At times this velocity cannot be overcome by nosing the ship down with its motors roaring. Planes have been tossed from as low as 500 feet above the earth to over 3,000 feet up into the clouds within a few seconds. This violent twisting and strain will destroy even the stoutest planes, and few can expect to emerge safely without the loss or weakening of at least some of the vital parts.

Thunderstorms are caused by the rising of warm air from the surface of the sun-heated earth during the hottest days of the year or season, and usually at the hottest time of the day. The rising air contains much moisture because the heat and the sun have caused a heavy evaporation of water. When the rising air reaches the upper levels of cool and swiftly moving air, usually coming from a westerly direction, the invisible moisture molecules are condensed into fog. This is the reason for clouds. However, due to the great amount of rising and humid air, the clouds that are formed are very large, dense, tall and billowy. They soon become huge thunderheads, and, gathering size and water as they move along, assume terrifying dimensions. Such clouds can be as high as six miles or more above the surface of the earth in severe storms.

The winds of a thunderstorm require serious consideration by those who would go by air. As the storm advances the surface winds blow under and toward the front edge of the clouds. Suddenly the curve upward

(*Continued on page* 1084)

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From "The Pit and the Pendulum."

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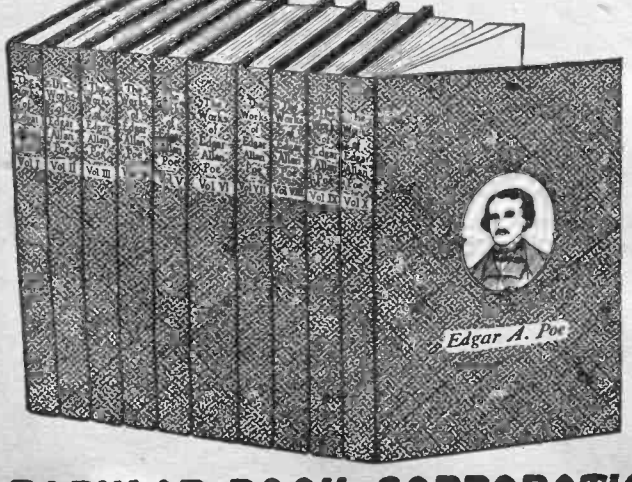

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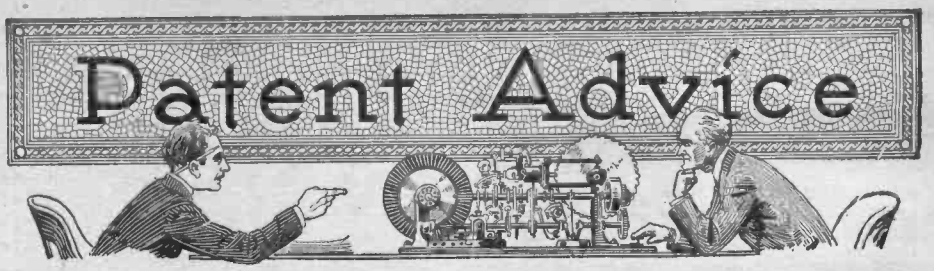

CONDUCTED BY JOSEPH H. KRAUS

In this Department we publish such matter as is of interest to inventors and particularly to those who are in doubt as to certain patent phases. Regular inquiries addressed to "Patent Advice" cannot be answered by mail free of charge. Such inquiries are published here for the benefit of all readers. If the idea is thought to be of importance, we make it a rule not to divulge all details, in order to protect the inventor as far as it is possible to do so.

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

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

Multiple-faced Die

(1155) William Lukacs, Glenfield, N. Y., asks for our opinion on multiple-face die to be used as a gaming device.

A. 1. A multiple face die is not a new idea at all. In almost any store in New York, and particularly in the magical supply houses, you can get dice with 10, 15 and even 30 faces. While a design patent might be procured on a product of this nature, it is scarcely likely that as a result of such a patent, you will be able to secure a market.

The system of photographing sound which you have suggested is identical with that used in the deForest Phonofilm, and we are quite confident that you could not possibly protect this by means of a patent.

Honest Attorneys

(1156) J. S. Salomon, Miranda, Calif., wonders whether patent attorneys are honest and asks our opinion concerning them.

A. 1. It is absolutely safe to trust any registered patent attorney with any drawings or descriptions that you may have.

Patent attorneys nowadays do not steal inventions. They have hundreds of thousands of clients. If they stole all the inventions that were submitted to them, they would go bankrupt in short order. On the other hand, if they deliberately stole an invention that was worthwhile, they would be prevented from further practice of patent law, and this would mean more to them than all of the money which they might get through an invention.

This writer knows two patent attorneys who patented inventions, both of which were sold for one million dollars a piece by their inventors. The first of these is the Spencer Thermostatic disc; the second, the Photomaton. We would recommend that you place your matter into the hands of any registered patent attorney, and you will find a good list of them in any issue of SCIENCE AND INVENTION Magazine.

Window Closer

(1157) Walter E. Madson, Oshkosh, Wis., claims to have designed a simple window closer, the nature of which is not made clear, and wonders whether any similar method has been used heretofore.

A. 1. It is difficult for us to advise whether or not it would be worthwhile to obtain a patent on an automatic window closer, unless you will tell us something about the system. One of the simplest automatic window closers which the writer has ever seen is an ordinary square lump of sugar and an iron weight. The weight is hung onto the window and the sugar itself is used to hold the window in an open position. One single drop of rain softens the sugar enough to permit it to release the window sash. Perhaps your device is more practical than the one we have outlined. On the other hand, it might be entirely too complicated to perform a relatively simple function.

We cannot conscientiously recommend further action unless we know more about your invention.

Automatic Film Winder

(1158) Elmore Wood, Waterville, Me., asks our opinion of an automatic film winding device for still photographic cameras.

A. 1. You could patent an idea for an automatic film winding device in a camera. While there are none of these on the market today, a great many have been patented. Whether or not it will pay you to protect such a suggestion depends entirely on the suggestion itself. We cannot comment more explicitly unless we have further information from you on the subject.

A device can be made to perform a certain function or operation, even though there are a hundred or more similar systems on the market. For instance, an ordinary piece of wood made an admirable brake in the old days when horse-drawn vehicles were popular. Since that time, brakes of all kinds and descriptions, some differing but slightly from their predecessors have been patented, and have made fortunes for their inventors many times over. Nevertheless, they all did one thing; they applied friction to the wheels and in that way brought the vehicle to a stop.

Adhesive Match-pack Strip

(1159) John J. Mackovich, Norwalk, Conn., asks us for our opinion of a system in which a package of matches can be gummed directly to the package of cigarettes by means of a paper band covered with adhesive.

A. 1. The use of adhesive tape or strips does not constitute a claim for an invention, and attaching two articles together in this manner does not make it patentable.

Has Patent

(1160) Miss Amanda Halverson, Delevan, Minn., has submitted a patent of a holder for glass chimneys and wants to know what she can do to exploit the idea further, with a possibility of effecting its sale.

A. 1. We regret very much that we cannot encourage you to spend any money on the invention which you patented in 1918. While the chimney mounting is unique, it is more expensive than the flat springs now in general use. Furthermore, it gives the same service, and the possibility of breakage is greater. Why then should anyone care to employ a flat spring system of this nature into which it might be quite difficult to place the lamp chimney at times?

We doubt that you will be able to sell the invention, particularly because you did not get an offer for the same up to the present time, and ten years have already elapsed. In the last ten years, many farms and outlying districts which use lamps have installed electricity, and the use for chimney holders, oil lamps and the like, is gradually yet steadily decreasing. This proposition is a losing one to any manufacturer who undertakes it.

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Can We Control Sex?

(More Opinions of Experts Who Read the Articles in the Dec., Jan., and Feb. Issues)

We inadvertently failed to mention the fact that Dr. A. L. Benedict who wrote the third of the series of articles on Sex Control was the author of a book called, "Why We Are Men and Women, or Factors Determining Sex" at present being published.

Dr. A. Ward Milne, M.D., of Port Dover, Ontario, Canada, has this to say on the subject of "The Control of Sex":

THE control of sex by the will of man among human beings and also among domestic animals, is a subject that has engaged the minds of scientists throughout all ages, but all efforts to find a solution of this most mysterious problem have proved futile.

The following theory, however, with its new discoveries and deductions in connection with sex determination, if not affording a complete proof of the discovery of sex determination, will at least uncover some new views in this regard, which may be a good foundation on which to build a more substantial theory.

Undoubtedly, sex control is a law of nature, a law that enters into the scheme of reproduction, with a sure elimination of the element of chance.

To prove that sex determination is not a matter of chance, the following facts are submitted.

Figures go to prove that the human population of the world is now and possibly has always been, almost equally divided into males and females.

This statement is difficult to believe, when we look around us and note families where the children are all boys and others again all girls and still others of unequal numbers of boys and girls.

If, however, sex determination was a matter of chance, the human population of the world would from time to time in its history, have shown a greater number of males and at other times a greater number of females.

But historians have never recorded any such condition and the following figures will go far to prove that chance was not a large factor at least in arranging the division of the sexes:

Country	*Year*	*Males*	*Females*
British Isles	1911	21,946,493	23,275,120
France	1911	19,254,000	19,938,000
Germany	1911	32,261,000	33,098,000
Italy	1911	17,021,690	17,649,687
Greece	1911	1,071,020	1,029,994
United States	1910	47,332,277	44,639,989
Canada	1911	3,821,995	3,384,648
Australia, Whites	1911	2,270,511	2,132,151
New Zealand, Whites	1911	527,893	475,068
		145,506,879	145,622,657

Total population, 291,129,536.

Female plurality only 115,778.

If we make allowance for the more hazardous life of man, even this small difference would be swept away.

A statistician of some repute, has estimated that of the 1,670,000,000 human beings on earth, 830,000,000 of these are males and 840,000,000 are females.

A difference of less than one per cent.

Surely no chance in this. Mother nature must have performed this wonder.

How does she do it?

The above figures will aid a little in understanding our theory of sex control and the theory will assist somewhat in their elucidation.

THE THEORY

Our theory is in short, that sex is determined by the *difference* of *vitality* of the parents. That is to say, if one parent has more vitality than the other, the majority of the offspring will be of the same sex as the parent having the less vitality and the opposite in sex to the parent having the most vitality?

With rare exceptions, no two persons would have exactly the same degree of vitality and this *difference* would exist between parents.

What is here meant by vitality is the power to live. Thus those living longest, barring accidents, have most vitality.

Vitality is often inherited, but may be strengthened by proper living, such as dieting, outdoor life, exposure to sunshine, and exercise, and avoidance of extreme temperatures. It may be reduced by exposure to extremes of temperature, intemperance, improper food, and sedentary or immoral habits, but more particularly a shortage of the essential vitamines in the diet.

That the *difference of vitality* of the parents is the ruling factor in sex determination has been supported by many years of investigation by the author both among humans and domestic animals, resulting in the following amazing discoveries:

The offspring from an old man and young wife, will in the majority of cases, consist of more boys than girls.

The offspring from parents, where the wife is several years older than her husband, in the majority of cases, consists of more girls than boys.

That the children of widows, in the majority of cases, will consist of more boys than girls.

That the children of widowers, will in the majority of cases, consist of more girls than boys.

That parents whose life occupation has been farming, and are of approximate age, will have more girls than boys in their family.

That where one parent lives an indoor life and the other an outdoor life the sex of the children of these parents will be more of the sex of the parent living indoors

Youth has the largest store of vitality and will create its opposite in sex.

Thus the offspring of the old man and young wife are boys in larger numbers because the wife has more vitality due to her youth.

We usually die because our store of vitality has become exhausted.

We contract disease from which we die, because our vitality has run too low.

This principle applies in the case of the widow. Her boys are in majority, because she had more vitality than her husband. Proven by the fact that she has outlived him. So also in the case of the widower, his children are in majority girls, for the same reason, he had more vitality than his wife, proven by the fact he has outlived her.

Outdoor life and sunshine strengthen vitality. Those living indoors have less vitality, their offspring will be of the same sex as themselves, in the majority of cases.

Our theory offers the explanation why more boys are born during wartime than in times of peace. The male parent is de-vitalized by exposure, fear and the horrors of war. His wife does not suffer to the same extent and has therefore more vitality conserved.

One of the most apparent proofs, that difference of vitality is the determining factor, is to be found in the family history of the Kings of England.

The Kings had more boys than girls in their families. Why?

Because the Queens had more vitality than the Kings. The Queens were chosen for their youth and beauty and therefore vitality. The Kings were often older and in many cases led effete and dissolute lives, that sapped their vitality.

(*Continued on page* 1098)

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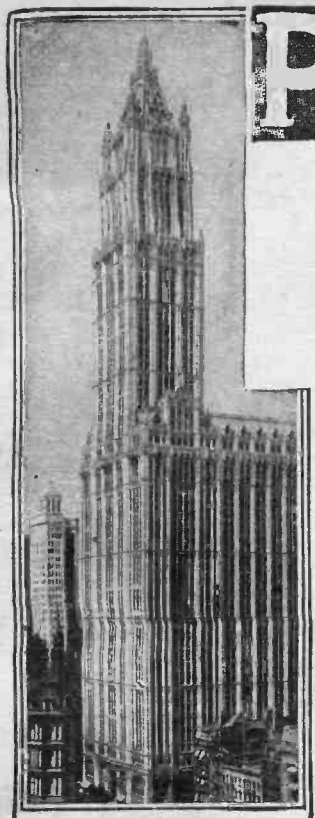

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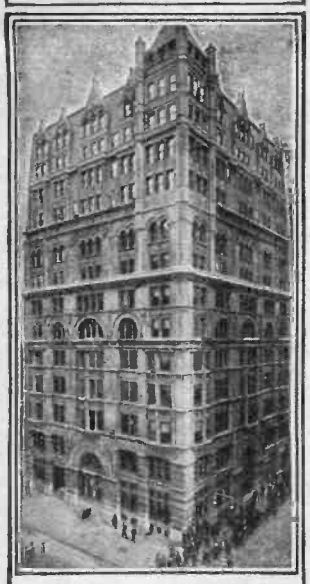

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If You Should Fly Into a Thunderstorm?

(Continued from page 1078)

into the main body of the clouds. Just to the rear of these ascending winds, there are stronger descending winds speeding ahead along the earth but under the forward and rising warmer winds. These winds are the forceful shifting winds which come with the storm after a period of calm. They are destructive and are soon accompanied by heavy rain. Hail will also fall if the forward ascending currents are sufficiently strong to carry the condensed raindrops high enough to encounter the cold and freezing temperatures of the upper air.

Lightning is the result of great electrical activity in the clouds; it originates and vividly occurs in the region of ascending air. Hence rain is being condensed in the cloud and attempts to fall in drops. But as soon as it does, it meets with the violent uprush of air and the drops are broken apart into finer mist or spray; they are lighter in weight and are carried aloft again. Here they coalesce and start to fall toward the earth as drops, but again the uprush of air carries them up as mist. The process of breaking and tossing aloft is repeated time after time, and because of it, much atmospheric electricity is generated. The large drops become positively charged and the fine particles or spray is negative. The latter moist air is carried into and throughout the clouds which assume a general negative charge. The region of vigorous wind and raindrop action and where water is accumulating because it cannot fall to earth becomes heavily charged positively. Lightning, which is simply a giant electric spark between two charged areas, occurs when the positive and negative charges of the two regions become so great that the natural insulation of the air can no longer hold them apart. The greater the vigor of the rising air currents and the amount of water accumulation, the more powerful becomes the electrical activity and the likelihood of severe and dangerous lightning strokes.

Lightning Dangerous

THE flashes dart out from the region of great activity to other portions of the clouds or down to the earth. This part of a thunderstorm is the most dangerous for flying. Between the two forces of the upward and downward air currents, there is the wind shift region where a dangerous squall is always whirling about. The story of the loss of the great airship "Shenandoah" bears mute testimony to the fury of this line squall. Any luckless aviator who may be caught in it is in grave danger. Much prominence was given to the details of the diversion of the newest airship, the "Graf Zeppelin," in order to avert danger of

(Continued on page 1086)

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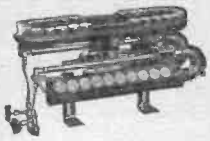

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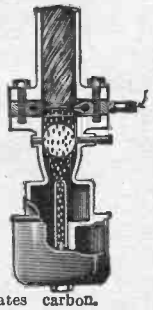

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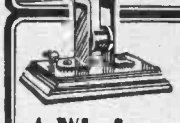

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If You Should Fly Into a Thunderstorm?

(*Continued from page* 1084)

storms over the Atlantic. Thus, through the aid of radio, that great ship was turned from its charted course and probably saved from certain destruction, but not before it suffered serious damage. Such aircraft are still unsuited to any but the most favorable flying conditions.

Plane Shortens Lightning Path

IF a plane should survive the destructive winds of the early part of the storm, it will likely be along the path of some discharge of lightning. When passing through the heavily charged regions the plane will also become electrically charged. Electric sparking will take place between metal portions and might explode the fuel tanks or cause fire. In the case of a balloon or gas-filled ship, the spark danger is a constant and serious danger. The use of the non-explosive gas, helium, averts this danger. Lightning follows the shortest path to the earth, as is evidenced by the zig-zag appearance of a flash as it darts along through regions of air having the best electrical conductivity. It is obvious that a plane must provide a better conductor for a short distance than the air itself, and will, therefore, present a shortened path through the plane for a lightning stroke. ne would never know at what minute the plane is shortening the distance between two charged areas sufficiently to provoke a discharge. The trail of the exhaust gas, because of its high content of particles from burned gas and oil, provides an effective path of conductivity for a lightning discharge along the route of the plane. Such a discharge may occur between clouds, or within the cloud itself, not always between the cloud and the earth beneath.

No aircraft is entirely immune to lightning and induction until it is clear of the region of electrical activity. But at times, even in fair weather, the electric menace is sometimes rather serious. For example, kites, being flown for aerological and meteorological purposes, using a steel wire, have brought down such powerful charges of electricity on clear days that the operators were badly shocked. Many times, in even insignificant thunderstorms or heavy clouds, lightning has struck the kites and flowed down the wires which were immediately melted. Benjamin Franklin, in 1752, flew a kite into a thunderstorm and received electricity down the string, thus proving that electricity existed within the clouds.

Where Storms Are Greatest

AVIATORS in some parts of the country are subject to greater risks of thunderstorms than fliers in other sections. No part of the country is entirely free, but there are two regions of greatest thunderstorm activity—one in the region of Tampa, Florida, and the other over northern New Mexico. The storms of the former are wet with rain, and those of the latter mostly dry without rain. Lightning of great intensity accompanies both kinds of storms. Taking the country as a whole, December has fewer storms and July the most. San Francisco and vicinity is almost exempt from storms. In general, however, the mountainous regions are favorable for the inception of thunderstorms as the slopes of the hill provide a deflection to force upward the warm surface winds. Storms are frequent along the Mexican border and seldom recorded along the Canadian line. They are common to the south and rare to the north.

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Saving the Lives of Crews of Disabled Submarines

By Walter G. Kiplinger

(*Continued from page* 1027)

A Balancing Pressure

HOWEVER, when the pressure is applied from the inside, the reverse is true. A cylinder that will crush at twenty-five pounds external pressure will hold from two to three times that amount of inside pressure, depending almost entirely on the tensile strength of the metal. Dents tend to straighten out and everything is just perfectly charming.

By balancing the bursting pressure limit of the case aginst the crushing pressure, as shown in the accompanying diagram, we can withstand a depth pressure equal to the sum of what the can will stand for each way. We can thus use a container only one-fourth as strong and as heavy as would be otherwise required. As the man occupies the bulk of the inside space, the needed inside pressure can be built up with a hand-pump very quickly and the compression of the air does not reduce buoyancy materially.

It will be noted that when the man reaches the surface he is still under a pressure just under the bursting limit of the pupa case. The stress on the can would be exactly what it started with in the submarine, however, and he has what amounts to his own individual decompression chamber. With an interior controlled one-way valve, he can release the pressure quickly or slowly. Borrowing an idea from one of the patented crew escape-buoys, this outlet valve might even be equipped with a whistle and make still another use of the air!

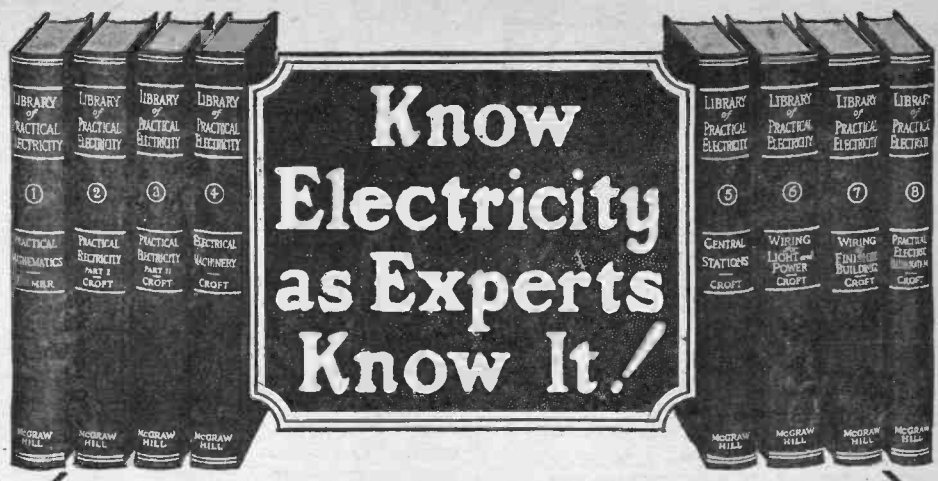
It is too much to hope that space enough can be legitimately found on a submarine for escape-cases for the entire crew, but even one or two might be used in connection with Commander Momsen's "air lung" to take care of the disabled or panic-stricken, or at great depths to get at least one man to the surface to report conditions.

We have not gone very far into the possibilities of built-up cases as none of us are familiar enough with the tactical needs of a submarine. One would think that some of the German machine-gunners' clever nested-equipment might be studied to advantage. Finding space for the cases, as said before, primarily is a problem of packing.

The Navy plans, however, to carry soda lime to the amount of 50 pounds per man on submarines in the future. With a crew of forty, this means a ton. The lime used is that developed by R. E. Wilson. Samples of this ran from .95 to 1.05 in specific gravity, which means the lime will occupy approximately the space of a ton of water or at least 32 cubic feet. The finding of this unoccupied extra cubic yard or more of space is bothering the naval people but is one that must be solved anyhow. Even the apparent trivial matter of whether square or round containers would be least in the way is being discussed. The type of escape-chamber with which we have experimented occupies from six to eight and one-half cubic feet of space, depending on which shell is used and, of course, could contain nearly that amount of soda lime. Unless it becomes necessary to split the 32 cubic feet of the soda lime in small cans tucked away in odd corners of the ship, the soda lime bulk would allow for nearly three of these escape-chambers and many more if they were nested.

One difficulty may be noted in that the soda lime, having a high alkali content, would chemically attack any aluminum alloys. Some protecting inside varnish will have to be developed.

The writer wishes to acknowledge special courtesies of Dr. W. R. Whitney of the General Electric Co., Lt. Commander Paul Searles of the Boston Navy Yard, Professors Jack and Lewis of the Massachusetts Institute of Technology, and Mr. Carey of the Dewey and Almy Chemical Co.



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The Origin of Man

By Dr. Samuel C. Schmucker Ph.D., Sc.D.

(*Continued from page* 1021)

Like the frogs of today, this creature laid its eggs in water and the young had a tadpole stage.

Reptiles

A NEW stage in our ancestry came in the Age of Reptiles (Mesozoic). In these the tadpole stage was so shortened that it was over before the egg was hatched. From this time on all our ancestors have lived during their entire lives as lung breathers! These reptiles were highly successful. Some of them grew to enormous size. The biggest of them (Dinosaurs, Fig. 7) were seventy feet long and must have weighed more than twenty tons. These reptiles, like ours today, were dependent on the outside temperature for their heat, and in cold weather were sluggish.

The sharks had multitudes of teeth in many rows. When our ancestors took to the land they had only a single line remaining. In the reptilian age these grew roots and became pointed and were nearly alike along the whole line of the jaw.

With the waning of the Mesozoic there came small reptiles who showed signs of better things. They had various kinds of teeth for varied food.

Now a change appears. The pump, previously divided at the top becomes divided fully into two parts. One of these, the left, sends the blood over the body. The stream then returns to the right pump which sends it to the lungs. Here it gets its oxygen and comes back to the left side to repeat this continuous double circulation. This furnishes the body with so much larger a proportion of oxygen that better burning is the result, and higher temperatures prevail. The especial feature however is that a nervous mechanism controls the heat like a thermostat and keeps it even.

The Reptiles Change

A VERY cold period now came, which was hard on the reptiles, but allowed our particular branch to use their advantage and become warm-blooded mammals.

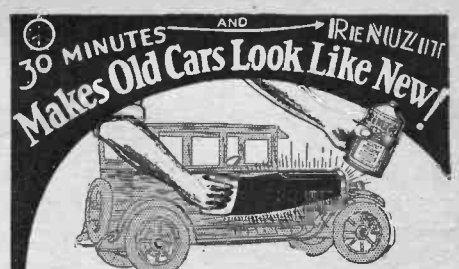
These lost their reptilian scales, except at the ends of their fingers and toes, where they formed claws, which in our case would later become nails. The egg too was kept inside the body until it was hatched, because in these creatures the forming young must be kept warm.

On the basis of their habits, these mammals became divided into several lines. (See Fig. 8). They particularly differed in feet and teeth. Our ancestors kept rather simple feet and teeth, but they developed brains. Instead of running from their enemies they climbed into the trees. This was an important step. It taught them to use their front and hind feet, to hold on by grasping and it kept them *head up*, where they noticed things.

Fortunately for us, our ancestors lived in a region where later the trees gave way to grass, which became populated with herbivorous animals. Our ancestors came down from the trees, losing the clasp of the hind feet. Fortunately they continued head up, standing high where much was to be seen. Our cousins, who remained in the trees, developed into much more successful climbers than we ever were.

But our hands remained, and our bigger brain. These reacted on each other, both developing in the process. (See Fig. 9.)

Passing from fruit to animal food, we were compelled to co-operate against the big game. We learned to make for ourselves artificial claws and teeth and helps to motion which have steadily grown better. For many thousands of years we have been far above all our animal cousins.



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Motor Hints

(*Continued from page* 1046)

permits for the automobile, required to be carried with the car when driving, are frequently mislaid. To solve the problem of carrying these safely and in a place not likely to cause mutilation, one driver uses the method shown in the attached illustration.

By means of pins, the cards are attached to the roller curtains on the car windows.

Similarly, the same owner uses the curtains for maps while touring. The convenience of this arrangement will be apparent to those who have tried to use maps, unfolding them and folding them for pocket stowage.

When using this method, the pins to secure the papers, should be inserted crosswise the curtain, so the curtains will roll, without bulging.

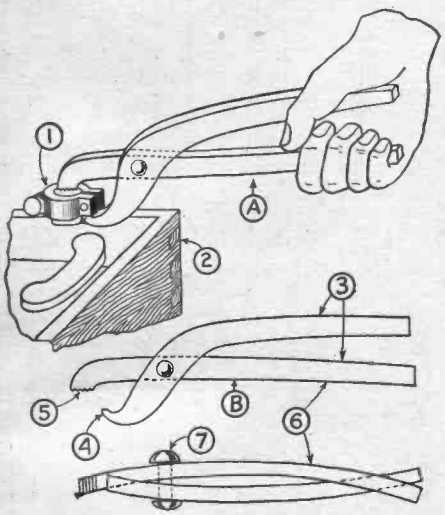
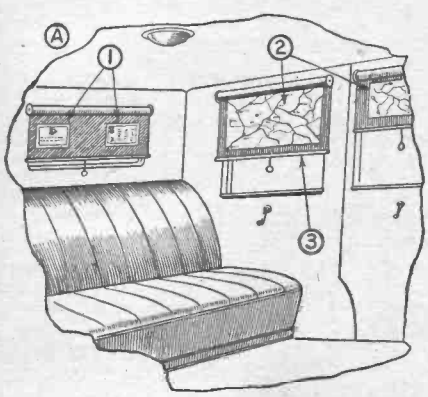
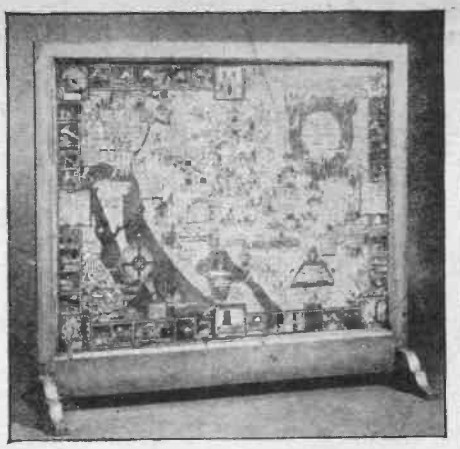


Illustration A above, shows how the plier tool is used. The terminal is shown at 1, 2, is the battery, 3, handles, 4, hook form, 5, serrations, 6, details of tool, 7, bolt or rivet. B illustrates a side view of the tool.

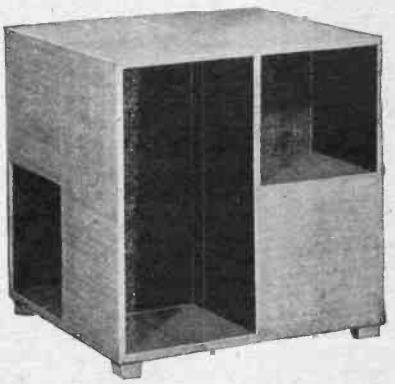


In the above drawing, an inside view of the car is shown at A. Licenses and permits are shown at 1, and maps, at 2. The papers are exposed when the curtain is lowered, as at 3.

DO you believe that woman is superior to man in intelligence, in endurance, in physical strength, from the standpoint of longevity, and from the viewpoint of her recuperative powers? If not, in which of these qualifications do you think she fails? For definite information, see the next issue. The article is entitled, "Woman—The Dominant Sex," by Robert Kingman, M.D.



Modernistic Fire Screen
See LePage's Book, page 13



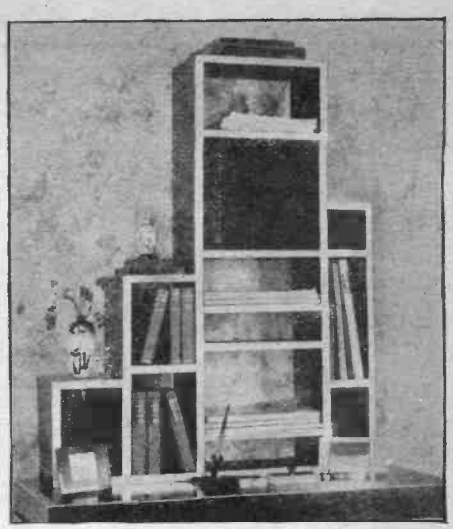
Modernistic Table
See LePage's Book, page 11

12 NEW Job Plans, *Too!*

There is, of course, a limit to what we can give in LePage's New Third Home Work Shop Book for only a dime. But we realize many men want additional projects. Hence our 12 new Job Plans. These also were made by Mr. Klenke. They are projects that require more elaborate presentation than we can give in our book. Each Job Plan presents one project on a single large sheet of paper. Each is well worth its price, one dime. Look over these projects and order those you want by number (see coupon), enclosing 10 cents for each.

16 Sheraton Writing Desk
17 Sheraton Desk Chair
18 Colonial Hanging Book Shelves
19 Smoking and Reading Cabinet
20 Colonial Mirror
21 Tea Wagon
22 Telephone Cabinet
23 Stool for Telephone Cabinet
24 Manual Training Work Bench
25 Home Worker's Tool Cabinet
26 Spanish Galleon
27 Vanity Table

LE PAGE'S GLUE
HANDIEST TOOL IN YOUR WORK SHOP



Modernistic Book Shelves
See LePage's Book, page 9

Now you can make Your Own Modernistic Furniture

At a Fraction of Store Prices

LEPAGE'S New Book Shows How

LePage's latest book, "The Third Home Work Shop Book," contains complete directions for making 20 attractive pieces of household furniture, 5 of which are modernistic in design, so popular today. These include the 3 shown above, and in addition, a Modernistic Desk and Modernistic Folding Screen.

Or, if you prefer, you can make reproductions of 5 famous old Colonial pieces — Cape Cod Chest of Drawers, Alexandria Nest of Tables, Old Salem Ship's Cupboard, Plymouth Built-In-China Closet and Lady Washington Sewing Cabinet.

Expert Instruction

Any man handy with tools can make any or all of these 20 pieces of furniture, for a fraction of their retail price, which a careful check in shops showed would be about $1000 for the 20.

You have expert instruction to guide you. The designs, dimension drawings, photographs, step-by-step directions and the actual furniture itself were made by William W. Klenke, Instructor in Woodworking, Central Commercial and Manual Training High School, Newark, New Jersey. His experience as an expert gives assurance that each project and the directions for making it are thoroughly practical.

The other popular 10 pieces which this LePage's Book shows you how to make, are: Chess and Checkers Table, Smoking Table, Caned Side Chair, China or Book Cabinet, Book Trough and Magazine Stand, Magazine Carrier, Vanity Case, Book Stand, Fernery Stand and Folding Sewing Screen. Where else could you get complete directions for making all these for only 10 cents?

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Simply use the coupon below, sending it to us with 10 cents in coin or stamps, and we will at once send you a copy of this latest LePage's Book, postage paid.

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Street .....

City ..... *State* .....

Please also send the following Job Plans..... (indicate by number those you want. See column at left), for each of which I enclose an additional 10 cents.

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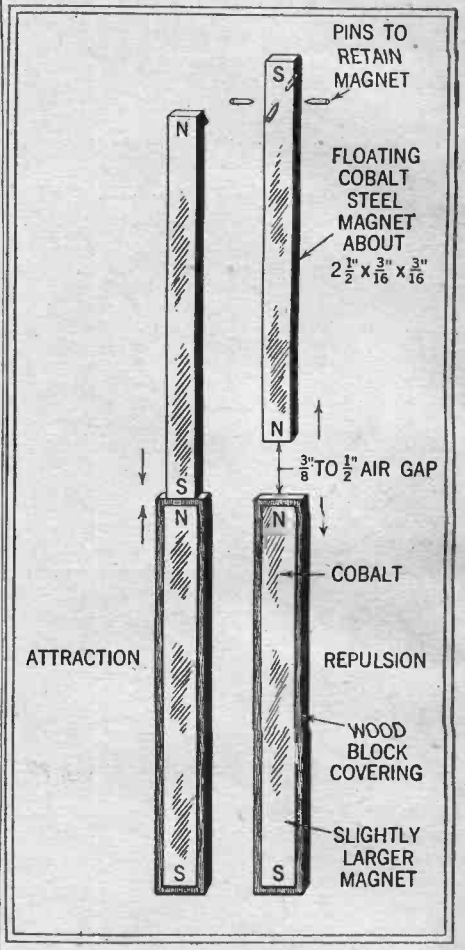
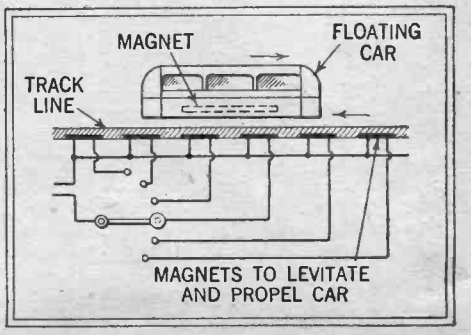
Magnet Defies Gravitation

(*Continued from page* 1035)

that its attractive force (gravity) is practically constant for a considerable distance above its surface. As anyone knows who has sprinkled iron filings around a magnet, the intensity of a magnetic field falls off rapidly, and so as the bar rises the magnetic repulsion soon falls off until its effect exactly equals that of gravity.



The attraction and repulsion force of the cobalt steel magnet is shown above. The floating magnet was retained in position by two channels, so that its north pole would be adjacent to the north pole of the magnet in the wooden block.



The above illustration shows how a car could be levitated and propelled by means of magnets.

Radio Wrinkles Wanted!

The Radio Editor, Mr. John Rider, wants to hear from you, if you have a good idea or wrinkle. Make a pencil or pen and ink sketch of the contrivance, write 50 words or so of description, and mail to the Radio Editor, c/o this magazine.

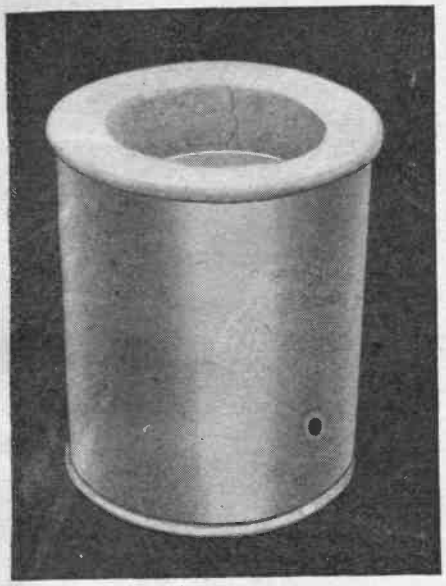
www.americanradiohistory.com

A Home-Made Melting Furnace for the Amateur Mechanic

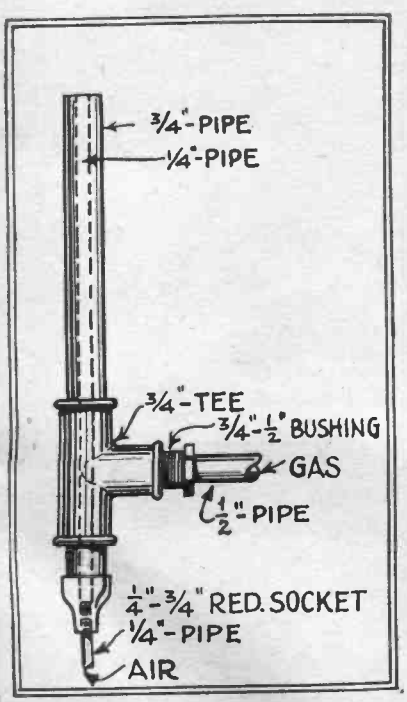
By Raymond B. Wailes

(*Continued from page* 1052)

The laboratory worker or mechanic will find that the temperature range of this furnace usually meets all of his requirements. In operating, as soon as the walls have become warmed, combustion will be more complete and the temperature can be controlled by the operator. A peep hole allows the work to be inspected from time to time.



The furnace itself is shown above. The edge of the crucible may be seen just below the rim of the shell.



Details of the air pipe appear above. This pipe screws into the reducing socket from the outside.

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The NEW Portable

Folds like a suitcase with snap locks and carrying handle. So light and convenient—easily carried wherever you want it. Plays any standard 10 in. disc record with wonderful tone and volume —two 10 in. records with one winding. Covered in red Baby Alligator genuine DuPont Fabricoid (absolutely waterproof.) Hinged lid. Size closed 16x12x3 1-2 in. Many new, exclusive features included — long air column horn of the newest type, the finest reproducer on the market, a strong pulling, even running motor, double nickeled hardware throughout, self contained album to conveniently carry 15 records without breaking or rattling. Weight 17 lbs. Outfit includes 15 double face 75c New Electric Process Records —30 selections. Shpg. wgt. packed complete about 25 lbs.

Order by No. W3136WA—only $1.00 with coupon, $2.50 monthly. Total price, $24.95

30 up-to-date Selections

The Records

$11.25 worth of high grade 75c records included in this offer. 30 selections—15 double face records. Made by the *new electric process;* more life like, more volume, less surface noise. Play longer. Very latest popular songs, dance music, band and instrumental pieces. Read our wonderful offer.

Yes, only $1.00 with coupon below, brings this portable phonograph with a special assortment of 15 latest double face 75c new electric process records—30 selections in all—to your home on

30 Days Trial Use this wonderful portable as your own. See what a wonderful convenience it is to have a phonograph that you can carry from room to room, place to place, wherever and whenever you want it. And the tone and volume—

We Guarantee: That you get everything in this phonograph so far as concerns music reproduction that a $250 phonograph can give, also the exact reproducer, the exact style of tone arm and the same grade of records. That's why you get, on this wonderful offer, **absolutely the best** in music that any phonograph ever gave. If, after 30 days trial and use, you are not satisfied in every respect, send it back at our expense and we'll refund your dollar plus all transportation charges you paid.

$2.50 a Month But if you decide to keep the outfit, pay only $2.50 a month until you have paid that sensational price on this special sale—only **$24.95.** Think of it, a first class, high grade phonograph and 15 latest double face Records (30 selections) a complete outfit, ready to play, only $24.95—and easy monthly terms, besides!

Send Coupon NOW!

Seize this opportunity while it lasts. Our supply for this special sale is limited. Send only $1.00 with coupon now. Remember, you don't risk a penny—your money back if not satisfied. Send the coupon now.

Free Catalog of home furnishings sent on request with or without order. See coupon.

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Enclosed find $1. Ship special advertised Puritone Portable Phonograph with 15 Double Face 75c *New Electric Process* records—30 selections. I am to have 30 days free trial. If I keep the outfit, I will pay you $2.50 monthly. If not satisfied, I am to return the phonograph and records within 30 days and you are to refund my dollar and express charges I paid. **Puritone Portable Phonograph and 15 Double Face Records, W3136WA, $24.95**

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A Magazine for the Experimenting Fan

"TELEVISION" is a magazine pledged to further the art of the infant industry for which it is named, and to supply the "fans" with the latest information and developments in this fast-growing field. Television, as a science, occupies the same position today as radio did ten years ago. Like the radio fans of years back, enthusiasts of this new field have had to fight for whatever meager knowledge they have been able to obtain. This magazine, then, comes as manna to the information-hungry fan. It is our purpose to keep these enthusiasts constantly informed, through "TELEVISION," of each new development. The second issue of "TELEVISION" is now on the newsstands. You will find below a partial list of its interesting contents

In the Television field there are all of the thrills that the radio fan knows so well. Get on the band wagon with your fellow enthusiasts. Be the first in your neighborhood to own a television set. Obtain a copy of "TELEVISION"; it will show you how to build a real Television receiver.

The first Television magazine was published by the EXPERIMENTER PUBLISHING COMPANY about a year ago. Over 50,000 copies of this magazine, "TELEVISION," have since been sold. This, alone, is sure proof of the popularity of this interesting new art.

Partial List of Contents

New Jenkins Radio Movies
New Belin Photo Transmitter
Vacuum Cameras to Speed Up Television
Infra-Red "Eye" Sees at Night
Valensi Television
Connection of Photo-Electric Cell
Practical Demonstrations Scheduled for Station WRNY
Campbell Swinton Television System
Quartz Crystals Synchronize Television Sets
Baird Optical Lever Increases Speed
Recording Pictures with Air Jet
How to Build a Radio Photo Recorder

and many other articles of equal interest

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Gentlemen: Please forward to me a copy of TELEVISION. Enclosed find 25 cents.

Name.....

Address.....City.....State.....

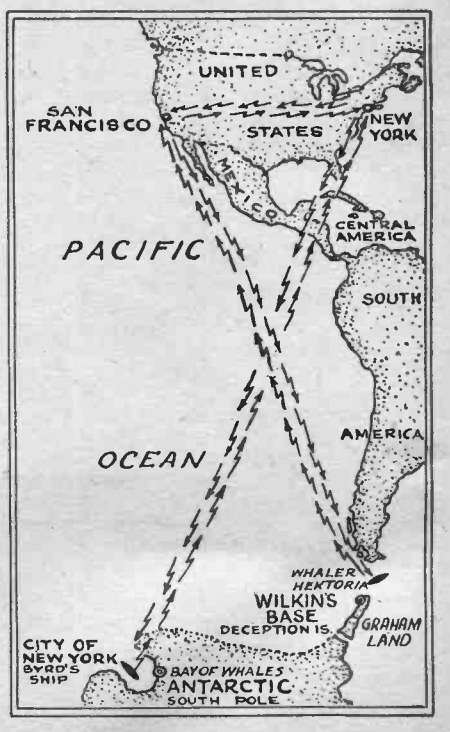
Radios 20,000 Miles to Talk Ten Miles

By Norman J. Stone

(*Continued from page* 1064)

Another novel radio stunt was carried out by members of Byrd's South Pole Expedition when they sent a 20,500 mile radio greeting to Capt. Sir Hubert Wilkins, at his Deception Island base. Although they were separated only about 2000 miles, the message travelled to Wilkins by way of New York. When the report came that Capt. Wilkins had flown over Graham Land and determined that it was an island and not a peninsula, this message was relayed to Commander Byrd by the Times radio station. Commander Byrd sent back a congratulatory message for transmission to Capt. Wilkins. The message to Byrd was sent from short-wave station WHD to station WFBT on the "City of New York." A message came back over the 10,000 mile gap and this was sent by land wire to San Francisco. Station KUP relayed the message to Wilkin's base, a distance of 7,500 miles. The complete distance travelled was 10,000 miles to Byrd, 10,000 back to New York, and 10,500 miles to Capt. Wilkins via San Francisco. The illustration reproduced here shows the course of the messages. Direct communication between the two explorers is possible, but arrangements for wavelengths and a definite time schedule would have to be made by the same indirect method employed in the exchange of these messages.

A map has been reproduced here showing the course of the Byrd-Wilkins messages. They were sent from the "City of New York" to New York City, then to San Francisco and were received by the whaler "Hektoria," situated near Deception Island. The arrows show the course which the messages traversed, a distance of approximately 20,500 miles. Although Captain Wilkins was not so far from Commander Byrd, it was necessary to exchange messages by this devious route because no regular schedules had been made between the two expeditions.



The above map shows the course of the messages sent from Commander Byrd in the Antarctic to Captain Wilkins, at Deception Island.

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Refracting Telescope Can Be Built at Small Cost

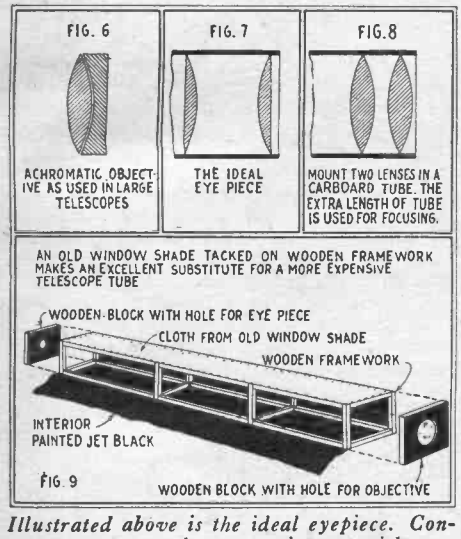
By Donald H. Menzel, Ph.D.

(*Concluded from Feb. Issue, page* 1003)

The best telescopes use compound achromatic ("without color") lenses (Figure 6). First class objectives of this type are very expensive. Without one, however, many of the more interesting celestial objects will be inaccessible to you. If circumstance forces you to choose between two simple lenses, give preference to the longer focal-length. A two-inch objective of 40-inch focus will give much more satisfaction than a four-inch lens of 15-inch focus.

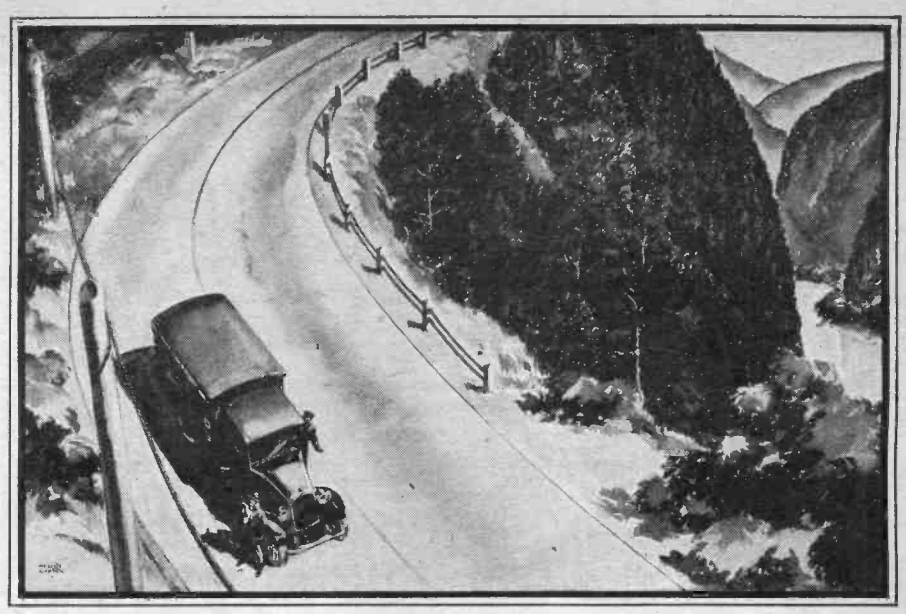
How to Make the Eye-piece

As stated before, the purpose of the eye-piece is merely magnification of the image formed by the objective. The simple lens, such as may be obtained from a pocket magnifier, is by no means to be despised, particularly for the higher powers. It does, however, require careful adjustment and possesses the additional disadvantage that only a small field of view is visible at a time. To determine the focal-length of a small lens, use it as a "burning glass," measuring the distance between the lens and the most intense image of the sun.



Illustrated above is the ideal eyepiece. Constructor can make a good one with two lenses. A substitute for a telescope tube is also shown.

The compound lens is usually more convenient than the simple-eyepiece. In its ideal form, as shown in Figure 7, it consists of two plano-convex lenses, their curved surfaces facing one another, and spaced at a distance equal to half the sum of the two focal lengths. The best results are obtained when the lenses are similar. If, however, they differ, the lens of longer focus should be used as the "field lens," i.e., it should be placed nearer the objective; the other is employed for the eye-lens. If plano-convex lenses cannot be obtained, ordinary double-convex lenses may be used as above. They need not be large—one-half to three-quarters of an inch in diameter will suffice. They should be permanently mounted in a metal, wooden, cardboard, or even paper tube (Figure 8). Beeswax, sealing wax, putty, nails, glue—any number of means—may be employed to hold them in place. Their spacing is not critical. I suggest that you manufacture several eyepieces of various foci so as to have a large range of magnifying powers at your command. Do not aim at too great magnification, however. For single-lens objectives of 40-inch focus, 50 or 60 times is about the limit; 20 is more satisfactory.



Getting there ahead of the trouble

An Advertisement of the American Telephone and Telegraph Company

DURING the afternoon of March 17, 1928, an alarm bell rang in a telephone test station in the heart of the Alleghany mountains. This meant that a puncture had been made in the air-tight sheath of a busy inter-city cable. The men on duty knew that the injury was somewhere within 50 miles.

Highly developed locating devices were instantly applied and in sixty-five minutes the trouble spot was located. By 7.15 in the evening, before the break in the sheath had affected service on any of the 248 pairs of wires in the cable, the repairs had been made. Because of the preliminary warning on the indicator wire and the locating devices that enabled the test station to tell the repair crew just where it would find the trouble, not one conversation was interrupted. This special alarm system is one of the many mechanical and electrical wonders developed by Bell System engineers to guard telephone conversations. The apparatus is placed along the cable routes at intervals of 100 miles. It gives instant warning day or night of any disturbance to the cable within 50 miles in either direction. Automatic warning signals, electrical locating devices, constant testing of all switchboard apparatus and circuits—these are some of the ceaseless efforts that so effectively reduced interruptions to service on Bell lines in 1928.

There is no standing still in the Bell System. Constant progress in accuracy and better service at the lowest cost is its goal.

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Are you hunting a bigger job, or does the bigger job hunt you? Why waste years learning through routine work, when you can acquire at home in a comparatively few months the specialized knowledge which brings promotion and salary increase? Thousands of men have increased their incomes by home-study business training under the LaSalle Problem Method. Let us show you how you can do just as well or better. The coupon will bring you complete information, together with details of our *convenient payment plan;* also your free copy of a remarkable book—"Ten Years' Promotion in One." Make your start toward that bigger job *today*.

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☐ Railway Station Management	☐ Personnel Management	☐ Telegraphy
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☐ Commercial Law	☐ C. P. A. Coaching	

Name .....

Present Position ..... Address .....

Please say you saw it in SCIENCE and INVENTION

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Puzzle fans attention: J. C. Long, Charles Vogtmann, Mrs. J. E. Fields, Viola Javins, Alvin Smith, Mrs. John Gillies, Jacob Braucher, each won sedans in our last auto puzzles. Over 800 prizes awarded in one year. Over $11,000.00 in prizes paid by us in October, 1928. In next few months will award between 300 and 400 prizes through our puzzles. Here's the new one for you.

FIND THE "DIFFERENT" AUTO

The cars in the oval all look exactly alike at first glance. They are not all alike. One is different from all the others. There is a real difference. Something is purposely left off all the other cars but this one. The difference may be in the fenders, bumper, nameplate, radiator or top. The one that is "different" is the real Buick Sedan I am giving away in addition to three other cars in my great friendship advertising campaign. You may be the one who will find it

AND WIN BUICK SEDAN OR $1800.00 CASH

4 sedans and 28 other prizes totaling over $5,000.00. 32 prizes and duplicate prizes paid in case of ties. If you can find the "different" auto you may be the one to get this great prize.

Certificate for $480.00 to apply on grand prize sent immediately as below if you find the "different" car.

Immediate quick action—no delay—we send certificate for $480.00 to add to the first prize at once if you win and directions for getting Buick Sedan. We spend over $150,000.00 this way each year to advertise our products. NO MORE PUZZLES TO SOLVE. No lists of words to make or write or any other puzzles. This is all. Everyone rewarded if actively interested. No cost or obligation. Nothing to buy now, later, or ever. Just send the number of the "different" auto in a letter or on a post card. That's all, send no money.

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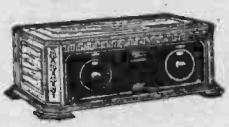

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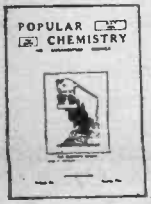

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The Telescope Tube

The tube is really the least important part of a telescope. It serves the double purpose of holding the lenses in place and shielding them from extraneous light. It may be cardboard, brass, or iron tubing of the requisite diameter. A very serviceable one may be built as shown in Figure 9, from a light wooden frame-work, covered with dark cloth, or, still better, an old window shade.

Whatever form of tube you decide to employ, be sure to paint the interior a dead black. Mount the objective at one end of the tube and in the other place a wooden or metal block with a hole that the eyepieces may be slipped in. It must be so located that the image will be in good focus. This requires that distance between the objective and field lens of the eyepiece be equal to the sum of the respective focal lengths.

The Mounting

Observation of the stars is made much easier if the telescope is rigidly held. A wooden fence post makes an excellent foundation. A deep hole is bored perpendicularly in its center to accommodate a metal fork (Figure 10) between which the telescope is swung so that it may be conveniently pointed to any part of the sky.

A Tube "Furnace" and Electro Gas Generator

By Raymond B. Wailes

(Concluded from February issue)

The material is removed from the pyrex tube by means of a metal rod or wire, the tube is cleaned, and is used over and over again for further work. Although pyrex glass softens at a temperature higher than ordinary glass, too much heat should not be applied to the tube as it will soften and will sag in the center. In many experiments, a really high temperature is not at all necessary. Quartz or silica tubes, either transparent or opaque are available for experimenters. These tubes will never bend or sag with the hottest Bunsen burner flame, can be removed from the flame and while hot, plunged into water, without cracking.

Some of the oxidation experiments which can be performed are, the oxidation or combustion of coal, using air, or oxygen gas from the electric generator. If air is used instead of oxygen and passed through the tube very, very slowly, coal heated within can be made to produce gas, tar, and other products. A plug of cotton inserted loosely in the exit of the tube will filter out tar fog and by its coloration show the presence of this substance. Iron, copper and other metals can be converted into their respective oxides. Substances can be heated in the tube and chlorine or other gases passed over them, to form corresponding products. Many organic chemicals can be shown to consist of hydrogen and carbon by heating the substance in the tube through which oxygen is passing. Water vapor and carbon dioxide gas are produced at the end of the exit tube. By bubbling the exit gases through lime water or barium hydroxide solution, a white precipitate will be formed which indicates the presence of carbon dioxide in the gases. The water vapor will condense on the cool portions of the exit tube.

It will be found that the electric gas generator will heat up to some extent when a large current is being passed through it. This heat rise can be offset by placing the beaker in a larger beaker containing cool water.

If the carbon filtering tubes are not available, the experimenter can make his own cells as shown in one of the illustrations. A cork or rubber stopper is used to connect a larger and a small glass tube so that the cell can be assembled without glass blowing.

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Animal Facts Stranger Than Myths

By Raymond L. Ditmars

(*Continued from page* 1023)

There are also some big frogs in Brazil, and while such creatures are usually figured as stupid and inoffensive, those of the New World tropics are anything but frog-like. They are as vividly colored as if they were painted, have long horns, and if annoyed will deliberately jump at your fingers and bite. I saw a keeper in the Reptile House at London bitten by one of these frogs as deeply as if he had been attacked by a rat.

Animal Smoke Clouds and Electric Fish

WE boast about our progress in science, but some of our modern inventions and utilizations of natural power have existed among the smaller wild creatures from the dim ages. There are various insects that eject irritating fumes at an approaching enemy, and this habit of "gassing" opponents takes place among a number of creatures in the sea, which eject acrid fumes and retire behind these protecting waves. The cuttie fish and the octopus are thoroughly familiar with the smoke screen; they throw out clouds of sepia, blacken the water and hide behind the murk. There are marine and fresh-water fish with sets of cells within their bodies which, by voluntary action, not yet understood by science, can generate powerful electric shocks. The fresh-water electric cat fish and the electric eel are good examples. A four-foot specimen of the latter can nearly render a man unconscious by its crashing shock, yet with no more effort on the eel's part than a graceful flirt of the body. I have been severely shocked by a three-foot electric eel when standing on a wet floor six feet from the aquarium containing the animal. In this instance, the eel did not even appear to move.

Bug Flashlights

WHEN science prowls around among the very small wild creatures, observations of remarkable habits may be noted. Down in the American tropics is a beetle about an inch and a half long. On either side of its thorax is a lobe, just about the size of a lead shot cut in half and fastened on the creature. This is actually a transparent port, or window, in the beetle's shell, and the creature can voluntarily flash a brilliant light from this pair of ports. It is not like the flash from a lightning "bug," which lasts but a second or two. The light will last five minutes or more at a time—in fact, it appears to be inexhaustible. Its normal use appears to be for mating purposes, as these creatures prowl at night, but the beetles will immediately give off the light if the least bit disturbed—and the natives know this. They are often kept in tiny wicker cages in the thatched houses and used to temporarily illuminate dark nooks and corners by the simple process of picking up the little cage, giving it a few taps, and carrying it around like a flashlamp. In South America I saw one native device which closely resembled an approach to the modern flashlamp. It was a piece of hollowed sugar cane, about four inches long, cut in half longitudinally and hinged to form a cylindrical box. One of the halves was filled at the ends and covered with a removable strip of netting. Its use, as explained to me, was to carry about six of the luminous elaters at night. For food, they were provided with a strip of pith from fresh sugar cane, which was placed in the meshed half. The whole contrivance was carried in the native's shirt

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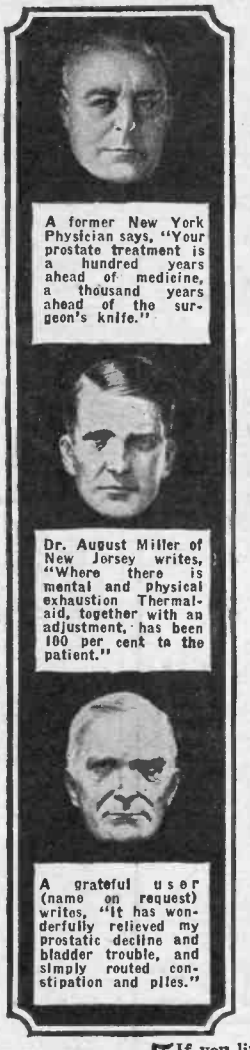

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LYLE DOUGLAS Station A-3, Dallas, Texas

or on his belt. If he wanted to examine the ground or some small object, he opened the little box and tapped it. The device was better than trusting to matches that might get wet or blow out. I have used one of these beetles to read my watch at night, and the face was brilliantly illuminated when the insect was held a foot away.

Ants' Cows

ANTS furnish many illustrations of thrift, ingenuity, ability to accomplish tasks requiring systematic labor, and feats of enormous strength. Their huge colonies are as orderly as if influenced by a controlling government. Their systems of living curiously parallel the ways of human races. They understand the methods of raising good domestic animals for their own uses, as we do cattle. This is illustrated by their care of the delicate green plant lice known as aphids. These small creatures eject sweet fluids, of which ants are very fond. The aphids are "milked" by the ants, are herded on delicate green branches, where their pointed proboscis may be inserted to suck plant juices. If these "pasture" branches become poor feeding grounds by thickening of the surface, the ants will transfer their dairy stock to better grounds, with softer stems.

Speedy Animals

I MENTIONED animals that can run sixty miles an hour. This has been demonstrated as antelopes have been chased over hard plains by automobiles, and carefully timed. As to animals sleeping on their feet, consider the elephant. Despite the restless weaving and pacing of these great beasts, some of them never appear to lie down. In the twenty years that the African elephant "Khartum" has been at the Zoological Park, during which time he has grown from a little over five feet in height to the towering monster of nearly eleven feet high he is today, I have never seen him lie down, and the watchmen who go through the building at night have made the same observation.

Sloth Walks Upside Down

FOR eccentricity of gait, take the sloth, which has no strength to stand on its legs, but always moves among the trees with pendant body. Animal voices are equally varied. The roar of the lion rolls along the ground for great distances—and the voices of some insects, weighing but the fraction of an ounce, are so pitched in "frequency" of vibration, they will carry almost as far on still air. Then again, some animals are silent, and probably find it safer to be so. The giraffe appears to be dumb. I have never heard them utter what might truthfully be called a sound.

With all these things happening, carefully observed and verified again and again, it seems curious that we hear so little about them, while animal myths are generally paraded in our midst. The hoop snake fallacy persists, yet the actual flying snake gets little or no credit. The allegation that the horned "toad" can be sealed up and survive in an air-tight pocket in rock makes a big hit, while carefully verified observations of these animals to eject quite copious jets of blood from their eyes at an intruder, is not generally listed among their accomplishments.

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Space-Time and Relativity

By Donald H. Menzel, Ph. D.

(*Continued from page* 1043)

actually exists. An interesting bit of philosophy.

Object Moving in Fourth Dimension Disappears

PERHAPS the most startling effects of all would be the sudden appearances or disappearances from our three-dimensional world. As I have shown, when any object is moved in the direction of the fourth dimension, it instantly vanishes from view. Suppose, for example, that you are standing entirely in the fourth dimension, and then thrust only your head into our view, a most weird apparition would result. What, indeed could be a more gruesome and unnatural sight than a living bodyless head, or the reverse, a headless body? (Figure 6.)

For a time, the fourth dimension fell into somewhat evil repute because certain spiritualists postulated it as the abode of departed spirits, thereby accounting for supposedly ghostly materializations and the escape of the soul from its three-dimensional boundaries. They even attempted to justify their assumptions by such scriptural quotation as "—may be able to comprehend with all saints what is the breadth, and length, and depth, and height." (Ephesians iii 8.)

I wish to emphasize that the foregoing reasoning is not to be taken as definite evidence for the reality of the fourth dimension. It simply shows what would be the properties of that dimension if it does exist. Argument by analogy is always precarious. Even the two dimensional world cannot exist outside of our imagination, for a piece of paper or a blood corpuscle cannot be infinitely thin. A shadow on a wall is the nearest we can come to two dimensional reality and, analogously, if there were a four dimensional world, we of three dimensions, would be its shadow. Most of us, at least, would claim a slightly more real existence than that; it is unlikely that the fourth dimension, as commonly interpreted, is anything more than interesting mathematical fiction.

The fourth dimension, as it appears in the theory of relativity, is not a spacial dimension in the sense explained above. The Einstein theory does not deal at all with such concepts. In the following articles of this series I shall discuss the theory of relativity and explain how the fourth dimension comes within its jurisdiction, not in the restricted sense we have here discussed, but in the more general way considered in the opening paragraphs of this article.

(*Next article will appear soon*)

JOHN DALTON

A CHEMIST should never be color blind, yet John Dalton had abnormal color vision. The story goes that desiring to give his mother a birthday present, John bought a pair of silk stockings of the newest fashion. This, he thought, would be a change for her, who was accustomed to wear her own home-made drab-colored woolen hose. "Thou hast brought me a pair of grand hose, John, but what made thee fancy such a bright color? Why, I can never show myself in them." John was greatly surprised, for to his eyes these stockings were of a dark blue proper color. "Why, they're as red as a cherry, John. Varra fine stuff, but uncommon scarlet."

This was the first incident that opened John Dalton's eyes to the fact that his vision was not as other men's, and led him to study the basic principles underlying color blindness.—*Contributed by J. Abrahams.*

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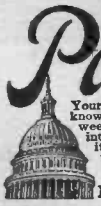

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Can We Control Sex?

(*Continued from page* 1082)

Shakespeare married Ann Hathaway, a woman eight years older than himself, their children consisted of two daughters.

In genetical science, it is a well known fact, that the period of gestation for a female child, in the majority of cases, runs longer than the period for a male child.

A solution of this mystery has never yet been presented with proof, but our theory will not only offer a reasonable solution, but also advance a good proof of our theory.

We have said before that the production of a female child is dependent on a condition of lower vitality in the mother. It naturally follows that if her vitality is lower, she must take a longer period to accumulate sufficient of the vital qualities to build her child.

At the Carnegie Institute of Research, experiments with mosquitoes showed that when they were starved the offspring were nearly all males.

This is in accord with our theory, showing in the first place that by starving and thus lowering the vitality a difference in the sexes of the offspring is the result, and females have been shown to be able to stand starvation better than males. Hence the male offspring.

In this experiment possibly the sexes were not evenly matched, no doubt more females than males, and in accordance with our theory, these matings would result in more male than female offspring.

There is undoubtedly a difference in the chemistry of the blood, between those living creatures that are weak physically and those that are stronger, and this difference is termed in this theory, the *difference of vitality*.

The life history of the honey bee offers a fine illustration, that chemistry of the blood is alone responsible for maleness and femaleness, and the chemistry of the blood is fixed by the kind of diet.

For instance the queen bee was born without any particular sex. For some unknown reason she was selected for this high position, from among many others of neutral sex. She alone was fed on bee jelly, a composition of pollen, from particular flowers perhaps. This diet undoubtedly changed the chemistry of her blood and thus also fixed her sex.

Possibly the strongest argument in favor of our theory, that vitality rules in sex production, is to be found in the life history of the oyster.

The oyster changes its sex, or rather food environment changes it.

It does not seem to have a permanent sex. In the colder months of the year or those months having the letter R, the oyster is a male, but when the warmer months arrive it becomes a female.

Dr. J. H. Orton suggests that the cause is chemical and that the accumulation of unusable protein during the female period necessitates a change to maleness.

The summer months of sunshine have instilled vitamin qualities and created food of protein content and therefore a higher degree of vitality.

Dr. Riddle of the Carnegie Research Institute, experimenting with pigeons and doves, has shown that the mating of these different species results in an all male offspring. Can we reconcile these results with our theory?

If the birth of males only is not nature's way of keeping the species inviolate, we would ask, "Were the pigeon and dove of the same age? Were they given food of equal vitamin quality? And were they subject to equal sunlight and exercise? Also which the longer domesticated?"

We believe that wild life under other equally favorable conditions would have a higher de-

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gree of vitality than domesticated. A well fed wild lion would overcome in mortal combat one of equal size long held in captivity, or if this wild lion was mated with a female long held in captivity, our theory would indicate that the offspring would consist of more females than males.

Dr. Manoilov, a Russian scientist, has proven that there is a *difference in the chemistry of the blood* of a mother bearing a male child, as compared with a mother bearing a female child.

Dr. Manoilov's theory has been worked out in Germany by Professor Gruenburg, and by Dr. Sellheim, professor of gynecology at Halle, and his assistants, Doctors Lutge and von Mertz, also by Sophia Satina and M. Demerec of the Carnegie Institute of Research, Washington, D. C., and proved successful in over ninety percent of the cases.

By this method the sex of an unborn child can be determined.

In Dr. Manoilov's opinion, the haemoglobin (coloring substance in the blood) is responsible for the differential male and female reactions he obtained.

Since chlorophyll (the pigment which gives vegetable matter its green color) is closely related to haemoglobin it may be safe to say that Chlorophyll, haemoglobin, and vitamins are closely related if not the same thing, as such very green plants as spinach, and lucern clover are found with highest vitamin qualities.

Experiments conducted at the Oregon Experiment Station and other United States Stations, have shown that sprouted oats fed to cows and heifers that have failed to get in calf, will overcome the sterility troubles. It is stated that five out of six open heifers which were non-breeders, got in calf, after they had been fed sprouted oats for thirty days. In another test, six cows which had produced calves and afterwards became sterile, were fed sprouted oats and conceived after a feeding period of from nineteen to seventy-one days.

The foundation of this work was probably laid at the University of California, where similar breeding studies have been made with small laboratory animals regarding the effect of vitamin E on reproduction.

Similar experiments have been made with dairy bulls at Beltsville, Maryland. The animals were put on a daily regimen of sprouted oats, which are known to contain a large amount of vitamin E, which prolonged their lives of usefulness. Systematic exercise was also part of the experiment.

Professor Champy, a renowned French scientist, was able to change the sex of a salamander, by severe fasting. A male Triton when subjected to a long period of fasting, lost its male characteristics and assumed a neuter condition, somewhat like salamanders assume in winter. By the next spring, this and other males in the experiment, definitely lost all male characteristics.

Two males severely fasted, were later intensely nourished. The following winter they were found to have assumed a female appearance.

The analysis and tests with milk from cows has shown that it contains more vitamins, when the cows are in the open air and under sunshine and feeding on grass in the summer time, than when penned up and on dry feed in the winter time.

From all this we wish to point to the conclusion that there is a difference in the chemistry of reproducing animals, that this chemistry may be changed by different feeding, exercise and access to sunshine, that this difference in chemistry is a difference in vitality, and it not only determines reproduction but also proportion of sexes of the offspring.

So that when we say that sex is determined by the *difference* of *vitality* of the parents, we also mean the difference in the chemical composition of the blood.

The sex of the majority of the offspring will be the opposite to the parent having the greater vitality.

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To control sex then, is simply to control vitality and this may be done in several different ways.

For instance if among humans a boy is desired, it will be necessary to vitalize the mother to a higher degree than the father, and this may be accomplished by dieting, exercise outdoors, and particularly subjecting the mother to an abundance of sunshine.

For dieting we would recommend foods high in vitamin E particularly, but also other vitamins, which may be found in such foods as milk, uncooked fresh eggs, butter, liver, cod liver oil, the germs of grain, and green vegetables such as spinach, tomatoes, carrots, cabbage and clover leaves.

The father must avoid these, taking little exercise, living indoors as much as possible and in fact practically reversing the formula laid down for his wife, but not so much so as to establish sterility.

If a girl baby is desired, then the above formulæ must be reversed, but in all cases the differences of the ages of the parents must be taken into account, as youth has the greater vitality.

This formula for sex control is equally applicable among domestic animals and other living creatures as well as humans.

(To be continued)

RULES FOR MODEL CONTEST

(Continued from page 1048)

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

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BOOK REVIEW

THE ELECTRIC WORLD, The Rise of Radio, by Paul Schubert. Stiff cloth covers, 5¾" x 8¼", 311 pages. Published by the Macmillan Co., New York City. Price $2.50.

The growth of the art of radio communication from its first use by Marconi, to its present day importance, are taken up in this interesting narrative, in a popular style, making the book primarily of interest to the layman rather than to the amateur.

THE TROPICAL CROPS, by Otis W. Barrett. Stiff cloth covers, 5¼" x 7½", 445 pages, illustrated. Published by the Macmillan Company, New York City. Price $4.00.

"Tropical Crops," a most fitting name for a book which deals with agriculture in the warmer climates and discusses cropping systems, conditions and methods for growing the major products. The book suggests future prospects of growing crops in the tropical regions, and will be of interest to the planter, as well as to the student and those having commercial interests in the tropical regions. For 35 years the author has been associated with agriculture in the Philippines, Mexico, Porto Rico, and other similar countries, and has presented data which is very largely composed of observed information. A chapter is devoted to each of the important crops, dealing with the botany and origin, economic status, cultivation, harvesting, pests and diseases, and the varieties of that particular plant specie.

SHIP MODEL MAKING, Volume II, by E. Armitage McCann. Stiff cloth covers. 6" x 9". 203 pages. Illustrated. Published by The Norman W. Henley Pub. Co., New YoYrk City.

This is Mr. McCann's third book on the subject of ship model building. The book contains a set of scale drawings and folder on the back cover, which will be of great benefit to the many readers who may wish to construct a model of the U. S. Frigate "Constitution," simplified or with complete details. The many details of the ship are clearly shown by 109 illustrations, and make possible the construction of a genuine miniature of the "Constitution" as it was in 1812. The commercially available ship models are in nearly every case not replicas of anything that ever existed, but just poor imitations of real ship models. The instructions and drawings make the construction of the model of the "Constitution" so simple that a person equipped with a few necessary tools could hardly resist the urge to build one for himself. —DeW. B.

THE OUTLINE OF RADIO, by J. V. L. Hogan. Stiff cloth covers, 5¼" x 7½", 266 pages, illustrated. Published by Little, Brown & Co., Boston. Price, $2.00.

This book is newly revised and brought up-to-date by the inclusion of many new developments in the radio art. For the layman who wishes to gain a knowledge of the principles underlying this method of communication they are dealt with in a simple and non-technical style. Without resorting to mathematics, the author handles the various subjects presented in the text in a manner which makes the book easy to read and understand. Beginning with a historical review of the subject, the complete panorama of the art of radio communication is opened to the reader. A handy glossary has been placed in the back of the book. —P. L. W.

(*Continued on page* 1103)

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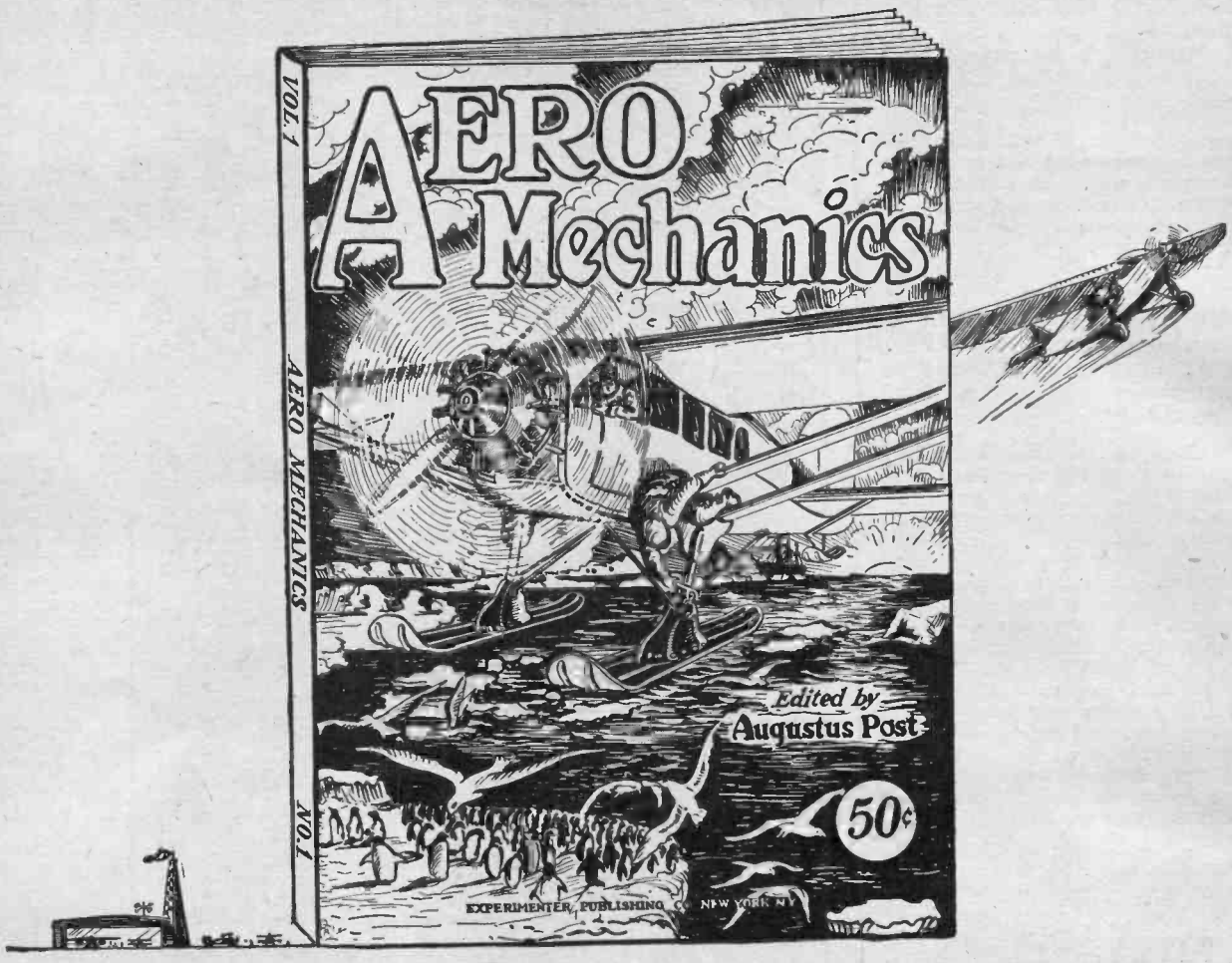

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BOOK REVIEW

(*Continued from page* 1101)

A POPULAR GUIDE TO RADIO, by D. Francis Dashiell. Stiff cloth covers, 5½ x 8¼ inches, 286 pages, illustrated. Published by the Williams & Wilkins Co., Baltimore, Md. Price, $3.50.

The author of this book writes a story of scientific achievement and gives the reader a good understanding of the developments made in radio, and also the functions of radio receiving and transmitting circuits with associated fundamentals of electricity and magnetism. A chapter has been devoted to each of the more important phases of radio operation, which are explained in non-technical terms.

DRAFTING FOR ENGINEERS, by Carl Lars Svensen. Stiff cloth covers, 6 x 9 inches, 400 pages, 583 illustrations. Published by D. Van Nostrand Co., Inc., New York City. Price, $5.00.

The purpose of this book is to properly present drafting and its engineering concepts, and systematic methods with an appreciation of the relation of science to our everyday life and progress. The book treats with the theory of dimensioning, so that the draftsman will think in a graphic language and will visualize shape and size specifications. The arrangement of the book is such that its study may be pursued to good advantage by anyone interested in drafting and it will also serve as a college text.

THE MODERN GASOLINE AUTOMOBILE, by Victor W. Pagé, M. E. Imitation leather covers, size 6½" x 9", 1,150 pages, 1,000 illustrations. Published by the Norman W. Henley Pub. Co., New York. Price, $5.00.

This new edition of the standard text is the latest volume on design, construction, operation and repair of gasoline automobiles. The systematic arrangement of the subject will enable the reader to gain an understanding of the location of all parts, and also the principles upon which they operate. The new edition has material on busses and rail cars, front wheel, and four- and six-wheel drive systems, four-wheel brakes, and in fact, every modern motor car development is covered comprehensively in detail. The book contains twenty-five chapters, is written in non-technical language and is well illustrated. As a text for the users of present-day automobiles, or those who wish to study their construction and who are engaged in repair work, the book will be exceptionally valuable, as it is a thorough study of the motor car of the present day.—P. L. W.

THE MECHANICAL DRAFTING HANDBOOK, by Frank R. Kepler. Soft paper covers, 6 x 9 inches, 128 pages, illustrated. Published by the Bruce Pub. Co., Milwaukee, Wisc. Price, 60c.

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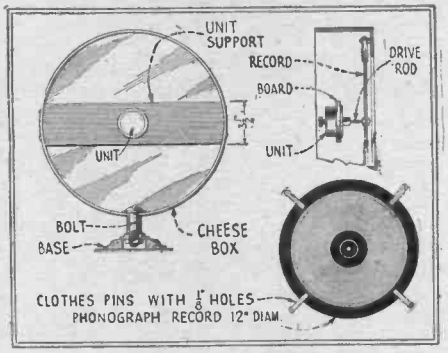
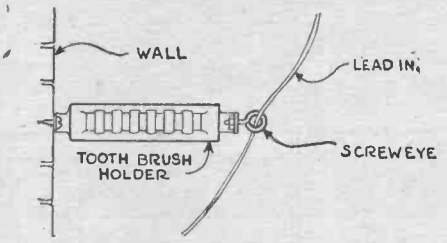


An inexpensive speaker can be built from a cheese box as shown. Four clothes pins are slotted in order to receive a phonograph record which is clamped to the back of the box. The speaker unit is supported by a board which fits inside the box. The drive rod is fastened to the center of the phonograph record.—Wm. Tevendale.

Stand-Off Insulator

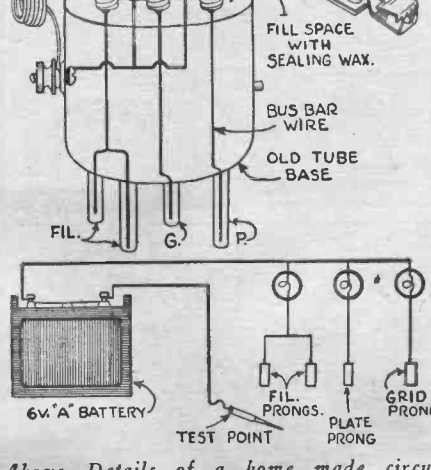
A cheap stand-off insulator can be made from an old toothbrush holder fitted with



an eye bolt as shown. Cotton soaked in paraffin is stuffed in each end to keep out moisture.—Weiden Cone.

Circuit Tester

Time can be saved in testing radio circuits by employing the simple tube socket tester shown below. The accompanying illustration is self explanatory as to connections and parts. The filament battery can be used as a voltage source.—B. B. Bryant.



Above—Details of a home made circuit tester.

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The Speeding Stars

By Donald H. Menzel, Ph. D.

(*Continued from page* 1045)

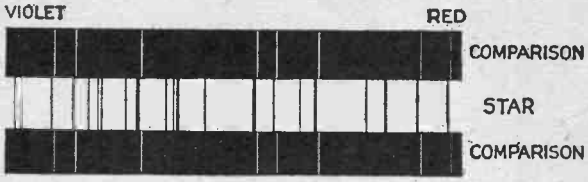
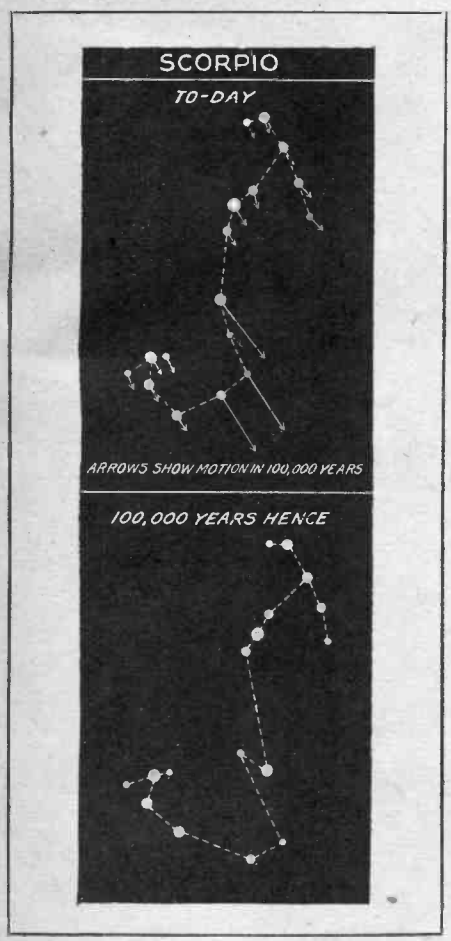


Fig. 3, at the right, shows the spectrum of a star and iron comparison. Note how the iron lines of the star are shifted to the violet with respect to the colors from the terrestrial source. The remaining stellar lines are due to substances other than iron.

voted practically all his time to the determination of stellar velocities.

Star Velocity Catalogue Available

THE reduction of the plates has now been completed and a few months ago astronomers saw the publication of final results in the form of an extensive catalogue, that contains the *radial velocities* (velocities toward or away from the observer, *i.e.*, along a radius) of 2,771 stars brighter than



magnitude 5.5—only sixty nine stars of the group being, for various reasons, omitted. Stars of magnitude 6 are about three-fifths as bright as the above and are just at the limit of visibility to the eye. This catalogue, which tabulates about half the naked-eye stars, will undoubtedly prove of great value to astronomers the world over.

One of the most striking results obtained is the effect of the solar motion referred to earlier in this article. The stars in one-half of the sky appear, on the average, to be approaching the sun; in the other hemisphere they are receding. It does not seem reasonable to assume that the stars are truly moving in this manner. The spectrograph makes no distinction between the motion of a star toward the sun and of the sun toward a star. Hence the stars appear to approach us only because the sun and planets are moving toward them, and the spot toward which we speed, practically agrees with that determined by the other method—the shifting constellations.

We find, from a study of the individual star velocities, that the sun cannot truly be called a stellar speed-demon. On the other hand it is no sluggard in the celestial race. The most rapid star speeds with some 180 miles a second, about 15 times the solar velocity, but there are many slower moving. Our sun appears to be in more ways than one merely an average star.

The layman may wonder as to the actual value of such investigations as this and others in which astronomers engage. Unquestionably the results are interesting, but the practical man, who measures values only in dollars and cents, will probably not be satisfied with this answer alone. Let him remember that the practical man of centuries past would undoubtedly have denounced the painstaking work of Tycho Brahe in tabulating the positions of the stars and planets, observations that were invaluable to Kepler and Newton in establishing an ordered universe. Most people have forgotten, or, more probably, do not know that Newton invented the mathematics of calculus solely to compute celestial orbits and test his theory of gravitation. Yet modern engineering could scarcely exist without calculus.

What may seem without value today may sometime be of great importance. It should not matter if we have to wait a decade—even a century or two, perhaps. From the standpoint of present values alone, there is much to be said for knowledge for its own sake. Exploring the universe we live in is no less important than exploring our terrestrial globe. In fact it presents more problems, is far more extensive, is more divorced from material greed, and leads men to higher thoughts than any other science does.

Our knowledge of astronomy and the various stars is rapidly increasing and we may expect some interesting discoveries in this field in the near future; particularly with the completion of the new 200 inch telescope which will be erected at Mt. Wilson Observatory. This instrument will be the largest in the world.

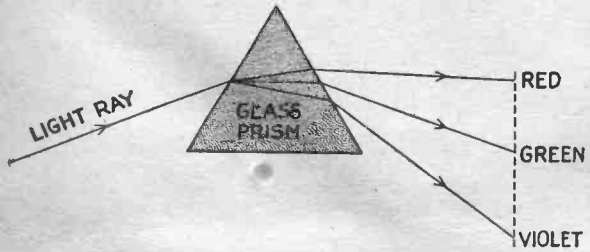


Fig. 2. A diagram of a spectroscope, showing how the entering light ray is broken up by the glass prism into the spectrum of rainbow colors appears at the left. It will be noted that the violet ray is bent much more than the red ray.

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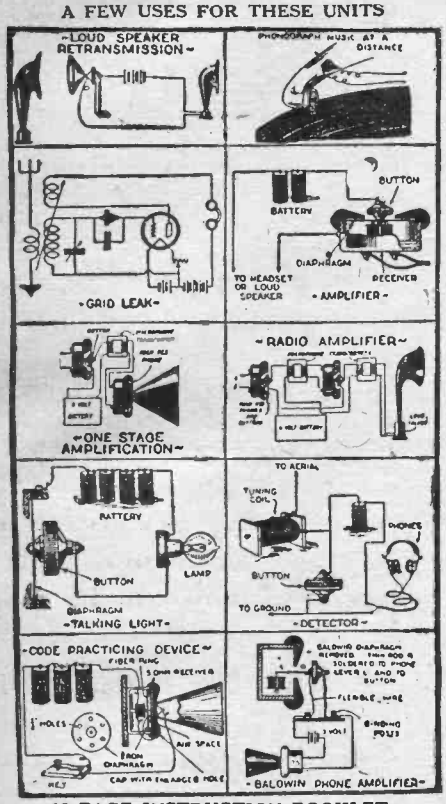

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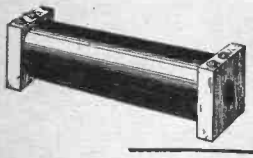

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The Air We Breathe

By William Lemkin, Ph. D.

(*Continued from page* 1053)

the task of wresting, bit by bit, the unsolved secrets of the atmosphere, especially the facts pertaining to the upper regions of our tremendous air ocean.

What Is the Air Composed Of?

TO the amateur chemist there is a wealth of qualitative data which he may gather from the application of some simple tests on the wonderful medium in which we all live. The first question he naturally asks is: What is the air composed of?

The atmospheric air surrounding the earth is quite uniform in composition. However, it is not a compound of definite constitution, but a mixture of gases. The following table gives the average composition, by volume, of moist air:

Oxygen	20.94%
Nitrogen	78.09%
Water Vapor	.84%
Carbon Dioxide	.04%
Argon	.09%

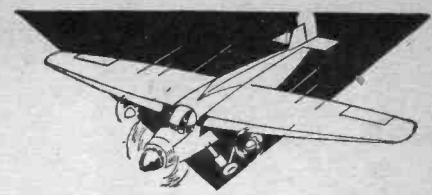
In addition there are traces of certain other gases, some of them very rare, totaling a small fraction of a percent, some of which are of growing importance to us. Most air also contains bacteria and particles of dust, which are, however, not found in pure air.

The most important of the constituents of the air is oxygen, which is indispensable to combustion and breathing. The amount of this essential gas found in the air in different localities varies between very narrow limits. Of course, the most important value of oxygen is in respiration. During both day and night we breathe about sixteen times each minute. By this process of breathing, with the help of our circulatory system, all parts of the body are provided with oxygen, which helps our digested food to burn and to release heat and energy for carrying on life. In a somewhat similar fashion oxygen is useful to all animals and to plants as well.

Oxygen—the Life-Giver

TO find the proportion of oxygen in the air the following experiment may be performed: Float a small flat tin box cover on the surface of some water in a shallow dish. The experiment can be seen better if a few drops of red ink are added to the water. Place a small piece of yellow phosphorus on the floating tin cover. (In this as well as in all other experiments in which phosphorus is handled, always be careful never to touch it with the hands, because it is highly inflammable and may ignite spontaneously, producing serious burns.) Now touch a lighted match to the phosphorus and invert a small glass jar over it as it burns. Lower the jar over the phosphorus and cork until its edges touch the bottom of the dish. You will note that the phosphorus will burn with the production of a dense white smoke, which is phosphoric oxide. At the same time the water will rise in the jar and occupy the space left vacant by the oxygen that has been consumed. Wait until the white fumes have been absorbed by the water and then measure the level of the water inside the jar above the original outside level in the glass dish. You will find that the water has risen approximately one-fifth or twenty per cent of the way up to the top. This is a rough measure of the percentage of oxygen in the air.

If phosphorus is not available for this experiment it may be performed successfully, and with almost the same accuracy of results, by using a burning candle instead.



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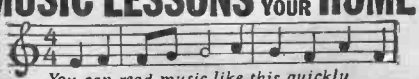

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Fasten a piece of candle about an inch in length to the flat cork, light it, and after it is burning well invert the jar in the same way as described above. Allow to stand for a while after the candle goes out. The water will rise in the jar just as it does when phosphorus is used. The only error involved in this procedure lies in the fact that a certain amount of carbon dioxide is generated by the burning which remains in the enclosed space in the jar, and does not permit the water to rise to the level that it otherwise would. This will eventually dissolve in part in the water. When phosphorus is used, the white oxide produced by the combustion is absorbed by the water, thus resulting in a more accurate reading of the percentage of unused gas left.

Nitrogen—Its Important Function

THE remaining space in the jar is occupied chiefly by nitrogen. Perhaps the most outstanding property of this gas is its inactivity. It does not burn nor support combustion, and it is difficult to make it unite chemically with other elements. Although it is so inert and apparently unimportant in its elementary form, in combination it finds a large number of special uses, as in nitrates, explosives, fertilizers, alkaloids and dyes, and as an essential body builder in all animals.

The chief use of nitrogen in the air is in diluting or diminishing the power of oxygen to burn other substances. If air were one hundred per cent oxygen it would be so active and powerful that it would destroy all animal and plant life. Once a fire were to start in such an atmosphere it would oxidize all unoxidized material with which it came in contact. Even metals like iron would rapidly be consumed by such a conflagration.

Some simple notion of the proportion and properties of nitrogen may be obtained from the previous experiment performed with either the phosphorus or the candle. The fact that the vacant space left in the jar after the burning ceases measures roughly four-fifths, or eighty per cent of the total volume, demonstrates the proportion of nitrogen gas in the air. Since the combustion stops after a time, we are convinced of the inertness of nitrogen so far as it neither burns nor supports burning.

Testing for Carbon Dioxide

CARBON dioxide, although present in the atmosphere to an extent, normally, of only .04 per cent, is one of the most vital of the constituents of the air. Chemically it is the result of oxidation processes, either in respiration, fermentation, the burning of fuel or chemical action in the soil. As a separate gas, carbon dioxide is heavier than air, and therefore tends to settle at first into its lower layers, but soon is diffused through the air. Indeed, it is so heavy that it can be poured from one vessel into another like water. As it neither burns nor supports combustion, it is produced by fire extinguishers. Carbon dioxide is not poisonous in the ordinary sense of the word, any more than water is poisonous. Animals may be said to drown in carbon dioxide just as they drown in water; in either case death results from the exclusion of the life-giving oxygen.

The prime value of carbon dioxide to all living matter is that it is one of the chief factors entering into the production of starch by plants. This process of photosynthesis consists of the uniting of carbon dioxide with water in the leaf of the green plant. The combining agent is the green coloring matter or chlorophyl of the leaf. The determining energy comes from the sunlight. This synthesis is the basis of the production of all our carbohydrate food. It is indeed the one chemical reaction upon which all life, both plant and animal, depends.

In order to show the qualitative presence of carbon dioxide in the air pour some lime water in a shallow dish and allow it to stand

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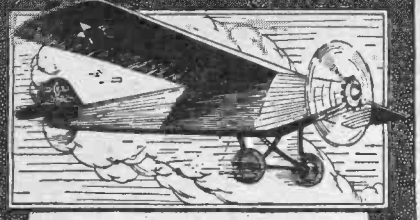

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for an hour or two. The white coating that forms on the surface of the liquid is calcium carbonate, and indicates that carbon dioxide is present in the air. This test is often used to determine whether certain places such as the bottom of wells, galleries in mines or cellars contain any large quantities of this gas. As one cannot live but a few minutes breathing carbon dioxide alone, it is hazardous to enter any place where considerable amounts of it have been found present. The objectionable substance is detected by lowering a small container of lime water into the space which is under suspicion. If an excessive amount of carbon dioxide is there the lime water will acquire a milky appearance soon after being exposed. Sometimes a burning candle is let down for the same purpose. If the flame is extinguished the air below contains a fatal proportion of carbon dioxide.

A simple experiment may be performed to show the production of carbon dioxide by combustion. The materials required are a funnel, a flask, a two-hole rubber stopper, a candle, some rubber and glass tubing, lime water and a suction pump. Set up the apparatus as shown in the accompanying illustration. Before lighting the candle draw some air through the lime water for a few minutes. Observe that the minute quantity of carbon dioxide in the air does not make the lime water milky. Now light the candle beneath the funnel and continue the suction process; you will notice that the liquid will become turbid immediately.

A somewhat modified procedure is followed in showing the relation of carbon dioxide to breathing. This experiment requires the following materials: Two flasks with two-hole rubber stoppers to fit, glass and rubber tubing, lime water and a rubber band. Arrange the apparatus as indicated in the diagram. The two long tubes are fastened together by the rubber band and used as a combined breathing tube. In order to work the device, close up the short bent tube from flask B with the forefinger of one hand, and inhale. Air will be sucked into the inlet tube of flask A, being forced to bubble through the lime water in that flask before it enters your mouth. This gives you air free from carbon dioxide. Your finger over the outlet tube of flask B will prevent your drawing up any liquid from that flask. Now by closing the inlet of the first flask, and releasing your finger from the corresponding tube of the other, meanwhile exhaling, you force your breath through the lime water in flask B. With a little practice you can open and close the inlet and outlet tubes of the respective flasks in perfect unison with your normal rate of breathing. After a few minutes of this action you will note that the lime water is turbid in flask B, while remaining relatively clear in flask A. If you keep it up long enough the turbid water will become perfectly clear, because calcium carbonate is soluble in water.

(To be concluded)

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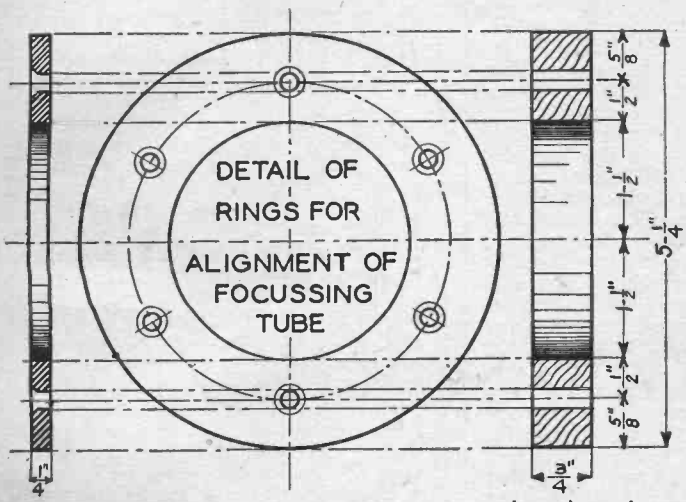
A Home-Made Reflectoscope

By R. J. Robbins

(*Continued from page* 1055)

and 12-inch focal length. If desired the original ring-mounting may be retained if means can be found for adapting it to the present construction. It will be entirely practical, however, to remove the lens and fit it directly to the focussing-tube. The latter should be either of a diameter which will exactly accomodate the lens or a little large. If larger a layer or two of blackened paper inside will reduce it to a size which will give the proper diameter. The lens is held in place by two heavy cardboard rings which are slipped into place from front and rear and securely glued to the inner surface of tube.



Details of the rings for the alignment of the focussing tube.

Some means must be provided for guiding the tube in its motion backward and forward as the picture is focussed. This may be accomplished by the use of two specially constructed rings, one of bakelite the other of maple, both being bored out to a diameter which will just pass the tube snugly. The holes for mounting screws are drilled in both pieces simultaneously to insure proper alignment. In assembling, the tube is first placed in the aperture in body. The discs are then slipped on from front and rear as shown and the nuts tightened into place. The maple ring being of ¾-inch thickness and the bakelite piece (of bakelite for appearance only) being ¼-inch thick there should be ample support for the tube.

The mirrors and focussing-tube being completed we have but to connect the two sockets together in parallel, one wire connecting to the snap-switch through a hole in the baseboard. The other goes to a binding-post as shown. A wire from the switch to the other post completes the wiring. It will be well to procure a length of twisted lamp-cord equipped with a screw-plug which will serve to connect the projector with any standard socket.

If a series of pictures of uniform size is to be used with the projector a small frame may be constructed of black-iron or wood to accommodate them. If, on the other hand, objects or pictures of assorted sizes and shapes are to be exposed some ingenuity on the part of the builder will be necessary.

Operation of Projector

TUNGSTEN or nitrogen lamps of the highest available candlepower should be used in this projector. The size of picture, of course, will depend entirely upon the distance from the screen, also to a certain extent upon the power of the lamps used. The proper distance being determined, the focussing-tube is next adjusted until the sharpest possible outlines are obtained. The mirrors are then slowly rotated until every detail of the picture is sharp and distinct.

Machines of this type are more or less standard apparatus and have been on the market for years. They were seldom built with a useful purpose in mind, however, but have nearly always sold as toys. In the present projector the design has been effected along more ambitious lines as the dimensions and details will testify and the writer believes that it may be put to practical uses. Perhaps the vertical design may render its construction more interesting.

IMPORTANT

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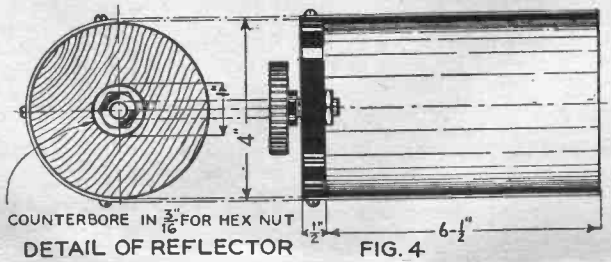

DETAIL OF REFLECTOR FIG. 4

WINS $1000!

Here's my prize winner for 1928! $1,000.00 in cash and solid gold medal awarded to Danny Gully for the greatest improvement in physical development. Nation-wide contest proves another amazing demonstration of *Miracles in Muscle!*

BEFORE

Here's how Danny Gully looked before he started Titus training. He had no development at all. He was flat-chested, hollow-cheeked, soft and flabby. Everybody laughed at him when he put on a bathing suit. He was only HALF alive.

AFTER

But look what happened when he tried Titus training! In 30 days his whole body was covered with massive layers of powerful muscle. The puny "scarecrow" was transformed into a broad-shouldered, deep-chested MAN!

You're *Next*

FELLOWS, it was a wow! My 1928 muscle-building contest ended with a bang! I wish you could have been there when the winner was selected. It was a great occasion! Famous authorities of the Physical culture world were present. You should have heard their exclamations of wonder as the records of thousands of applicants were presented to the jury.

Man, you should have seen those records! Photographs of my pupils and actual measurements taken "before and after" I developed them. Talk about building muscles! You can't blame me if I feel proud of what I did for those boys. Now we're off on my 1929 Contest. It's YOUR turn to show what Titus Training will do for you.

Now Watch *Your* Muscles GROW!

See what I did for the man shown above! Changed him from a puny weakling into a physical GIANT! Looks like magic, doesn't it? But it's just an example of what Titus Training has done for thousands. I've taken fellows of every age—every size and condition—and transformed them almost overnight into perfect specimens of manhood!

30 days—that's all I want! And just a few minutes a day. I'll put layer after layer of muscle all over your body. I'll make you over from head to foot, inside and out!

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Home Movies

By Don Bennett

(*Continued from page* 1051)

decorations go. Your audiences will see every little defect, every departure from correctness and you will most certainly hear about it later.

"Now let us assume that our studio is ready, our story selected and we are all ready to *shoot*. The actors are on the set made up. This means that they are within easy call of the director but not actually on the set where they would be in the way. The property man has finished tidying up the set, adjusting furniture, dusting off the tables and all that goes with the final preparations. The *grip*, or handy man, sweeps off the floor and removes all foot marks and other foreign things that would show in the camera. Your cameraman has his general illumination adjusted to his entire satisfaction and calls on the players so that he may adjust the individual lighting. The director puts them into their respective positions and the cameraman sets his reflectors so that each actor is receiving enough light to register on the film. The cameraman uses what is known as a *blue glass* for this, a glass that reduces everything to various shades of black and white. It also reduces the visual strength of the light about eight times, and if any places on the set are too brightly illuminated they will show up very strong under the blue glass. *Hard places*, as the spots with overstrong light are called, are softened down by easing up on the reflector; or if it is top light, by putting more gauze over the top where the light comes through too strongly.

"After everything is in readiness, the director rehearses each actor in his or her part until they are good enough to film. He then places them in their starting positions and calls 'action'—'camera' at which time the actors and camera start.

"It is customary to take the long shots first, and where the long shot is merely used to establish the setting, enough footage is taken to overlap the first close-up or medium shot. If a long shot is to be used at the end of the scene, it is taken while the camera is in position and then the camera is moved up for the medium and close shots. The angle may and should be changed for the closer shots, not moving straight in along the axial line of the lens unless that effect is particularly desired. When individual close-ups of actors are made, it is not necessary for all the actors to be on the set, only the one being photographed. Each actor should take mental notes of his or her position at every point in the filming, as they may be called upon to take that position for a close-up. Similarly, if an actor stands in the background in line with a camera taking a medium shot of another actor, if the camera is moved in for a close-up, the actor in the background should take his former position, so that he will show on the screen in the close-up.

"A *script clerk* should be appointed to take care of the records of scenes shot, and of the costumes each actor wears in each scene. Attention to detail in making movies is of paramount importance and lack of detail reflects on the producers."

At this point Jones thanked his listeners and resumed his seat. Blake, as chairman, took charge of the meeting again and after a lively and enthusiastic discussion, it was decided to form the Rockland Movie Club with Blake as president and Jones as production supervisor. Committees were appointed to take charge of club organization work, and the production committee was directed to select a story and get the actors from the town's Dramatic Club.

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by Professor A. M. Low

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(Next month Jones will explain how you can use the new panchromatic film to get both beautiful and tricky pictures with your home movie camera. He will explain what panchromatic film is and how it differs from the regular films. Some unique experiments in "color subtraction" will be presented for you to try out.)

Photoplay Review

The films reviewed here have been studied with the amateur foremost in our minds. We will try to point out the features of each picture that are of special interest to the amateur and, when space permits, will describe any special features or tricks.

The Terror

The amateur, in order to improve his own films, must keep pace with the times, and the most logical way for him to do this is to watch and study the results achieved by our professional producers. *The Terror* (Warner Bros., Vitaphone), is a step forward in the motion picture art and should be studied carefully so that the amateur, when "talkie" equipment is made available for him, can be up with the times. *The Terror* is a talking picture, dialogue being used all the way through. From a cinematic viewpoint, the picture is good. Excellent use has been made of the moving camera to follow the characters around as the story builds up. Excellent lighting effects enhance the value of the picture and the camera angles in some cases are excellent. One we have in mind, is where the camera is placed about thirty feet vertically above a group of characters who are in the midst of a spiritualistic seance (Mr. Dunninger take note). The effect is uncanny, a circle of white hands standing out in an otherwise dark scene. We believe *The Terror* is a picture for the amateur to see as it carries many lessons for him.

MOVIE QUESTION BOX

Snow Scenes

A. Pam queries:

Q. What allowance should I make for snow scenes? Is a filter essential?

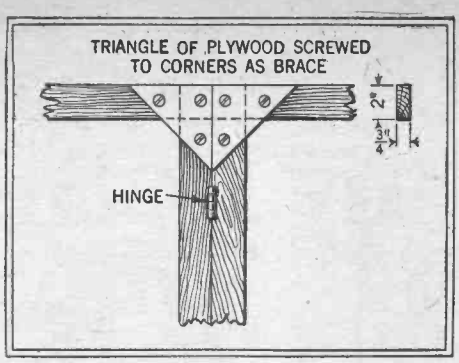
A. A filter is not essential but it adds greatly to the effect when shooting snow scenes. The actual allowance to make in exposure is governed by the kind of film you are using and a slip accompanying the roll of film will give you the exposure data. It is roughly two points of the diaphragm or one-fourth the normal exposure. When using a filter make the necessary exposure allowance for it.

Close-ups Dim

J. Carron writes:

Q. My close-up shots do not seem to be bright enough. Is there any way of overcoming this?

A. By using a reflector to concentrate light on your subjects when making a close-up, you greatly improve the appearance of your films. Your projection screen may be used as a reflector or you can make one of beaverboard, three feet square, hinged in the middle. Paint it with glossy white or aluminum paint. If aluminum paint is used, allow it to harden and then polish the surface with a piece of cheesecloth. A wooden frame, braced and hinged as shown in the sketch will lengthen the life and increase the rigidity of the reflector.



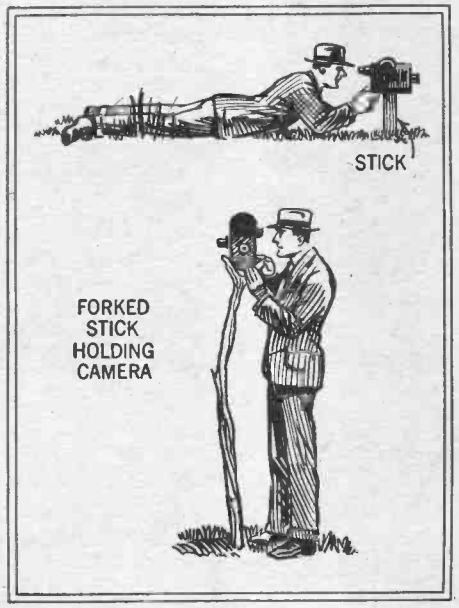
How to brace frame of home-made reflector.

Focal Length

R. Weart asks:

Q. What is the longest focal length lens it is safe to use without a tripod?

A. A tripod should be used whenever possible as it insures steadiness of your pictures on the screen. However, you may safely use up to a three inch lens without a support *if you are very steady.* In an emergency a stick may be used as shown in the accompanying illustrations.



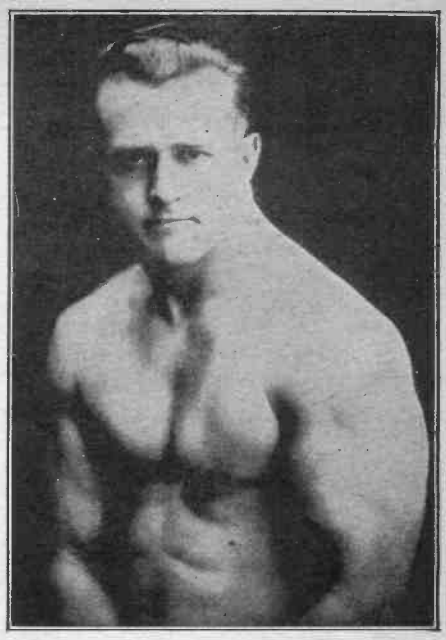
Two ways in which to support camera when no tripod is handy.

Spotty Films

A. Marks asks:

Q. After developing my films I notice that they are spotty. How can I overcome this?

A. When your film has been put on the drying rack, run it through a chamois rag that has been wet with water. This will squeeze all excess moisture from the surface of the film and prevent these drying marks you complain of. Be sure to allow slack for the shrinkage of your film when drying or it will not run through the projector.



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An example of the way in which each hand is illustrated.

FIG. 32

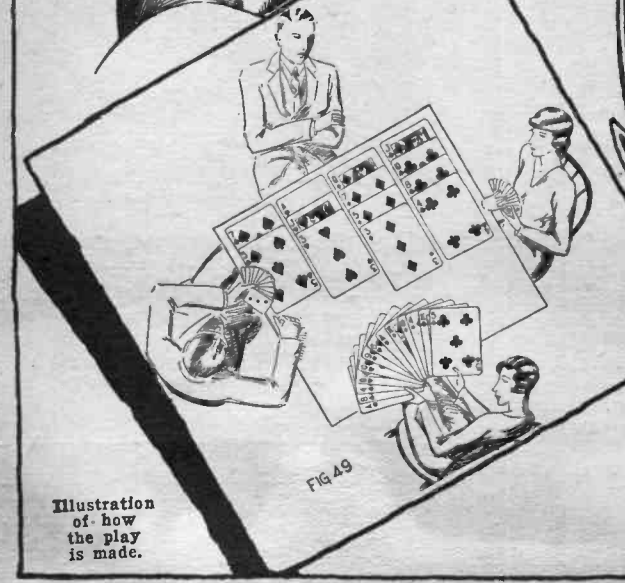

FIG. 49

Illustration of how the play is made.

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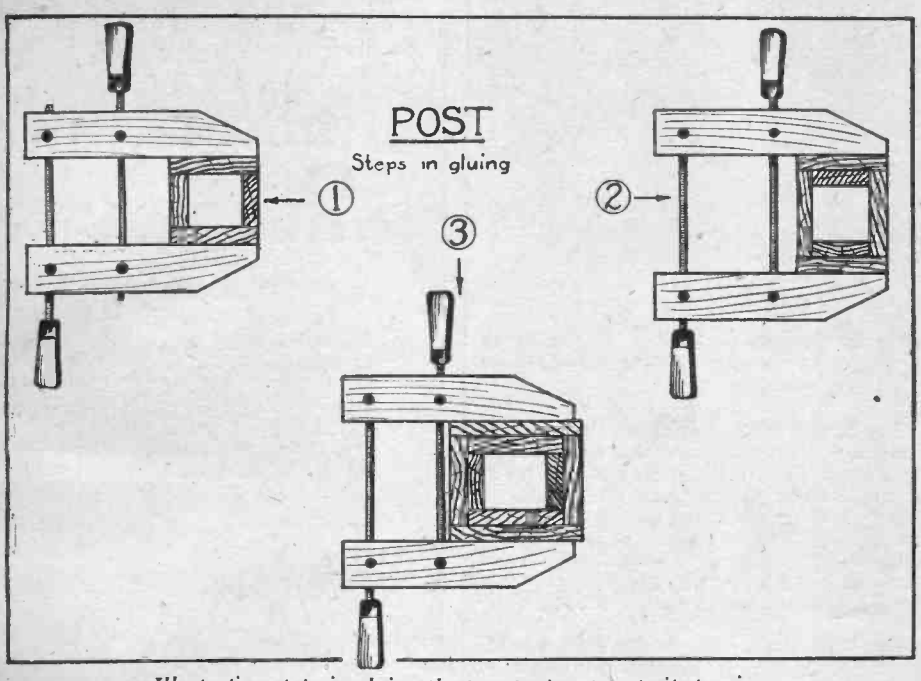
Wood-Turning

By H. L. Weatherby

(*Continued from page* 1057)



Illustrating steps in gluing the post preparatory to its turning.

2 pieces ¾″ x 10¾″ x 16″.

Cabinet back: 1 piece ¾″ x 10¾″ x 18¾″.

Top front rail: 1 piece ¾″ x 1¾″ x 18¾″.

Middle and bottom front rails: 2 pieces ¾″ x 1½″ x 18¾″.

Drawer fronts: 2 pieces ¾″ x 3¾″ x 17¾″.

Moulding for panels on sides and back: ⅜″ x ½″ x 5′-0″.

Knobs: turn in one piece 1½″ x 1½″ x 8″.

Leaf supports: 2 pieces ¾″ x 1″ x 10″.

Post: 2 pieces ¾″ x 2″ x 19″; 4 pieces ¾″ x3½″ x 19″; 2 pieces ¾″ x 5″ x 19″.

Base: 1 piece 1¾″ x 11″ x 22″.

Feet: To be turned in one piece, 2¼″ x 2¼″ x 8″.

Drawer slides: plugs for post, dowels, etc., to be made of common wood, also the following:

Post stretcher: 1 piece ¾″ x 5″ x 18¾″.

Drawer sides: 4 pieces ⅜″ x 3¾″ x 16½″.

Drawer bottom, plywood, 2 pieces ¼″ x 18⅜″ x 16½″.

Drawer back, plywood, 2 pieces ¼″ x 3¼″ x18⅜″.

Screws for assembling.

Construction of the Post

THE new turning feature involved this month is in building up large work, such as columns, pedestals or posts like the one used in the sewing table. Vibration in a light lathe is one of the chief obstacles in turning, and large work should be kept as light in weight as possible. For that reason if no other, the post should be built up. For another reason it is difficult to secure a solid piece of the size required, that is not defective from uneven drying. If boards are simply glued with flat sides together, making a solid post, long ugly glue joints will show on the finished job; and so for many reasons it is best to work the material up in the manner indicated in the illustrations. Care must be taken to get good joints to use good glue, and to use sufficient pressure in clamping to get results. The gluing of the post will require three clamping operations, each of which will require twenty-four hours for setting. After the final clamping operation it is well to plane or saw the corners of the post, forming an octagon, thereby further reducing vibration when placed in the lathe. A two-inch hole will be left through the entire length of the post, the ends of which must be plugged during the last gluing operation to permit centering on the lathe. The turning should be started at slow speed, and as the post is reduced to a cylinder the speed may be increased. Care should always be taken with built-up work. Tremendous force is exerted at high speed, and there is always the possibility of work breaking up and resulting in physical injury to the operator. If the joints are well glued and the work is started on slow speed, no fear need be felt regarding this, however.

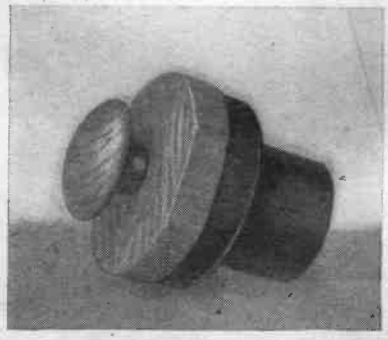
Turning the Knobs and Feet

INSTRUCTIONS were given for turning feet similar to the ones on the sewing table in a previous article. The drawer knobs can best be turned between centers, turning all four at one operation. They should then be centered in a chuck, as illustrated, for final smoothing, after cutting apart.

This will complete the turning operations with the possible exception of two short ⅜″ dowel rods, which are used as stops on the table leaf supports. These can probably be planed down by hand to better advantage, or dowel rods may be secured already prepared.

General Construction

THE general construction is very simple and the average wood worker will experience no difficulty in building and fitting up the different parts.



Each knob is centered in a chuck for final smoothing with a skew and sandpaper.

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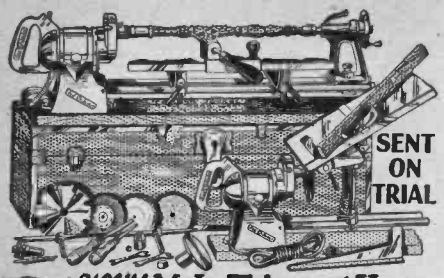

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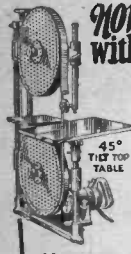

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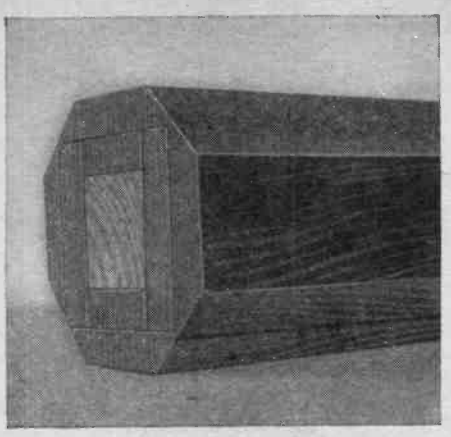


After the final step in gluing, plug the ends for centering and bevel the corners to reduce vibration in the lathe.

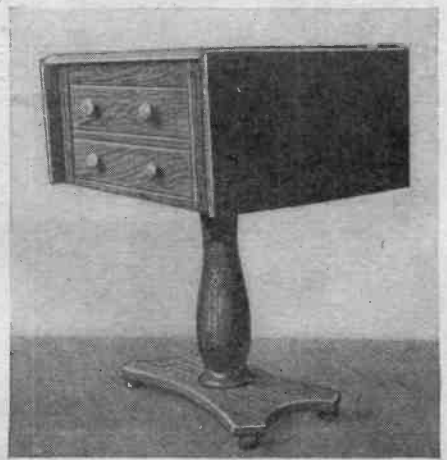
The base should be laid out according to pattern, and cut with band saw or substitute hand tools. The top and shelves will probably need to be glued up, and the hinge edge may be left square if the shaped edge looks too difficult of construction. This edge may, however, be cut with a combination hand plane or even with saw, gouge, and round wood file, as the writer shaped the one illustrated.

The body of the table, or the section holding the drawers, is joined up as the drawings indicate. Care must be taken to get this part absolutely square and all parts fitting well. The post is fastened to the bottom centerpiece or stretcher, with four long screws. The drawers are separated by slides which run the entire length of the sides. The drawers themselves should be built up in the usual manner. A simple drawer joint is indicated, connecting the fronts with the sides, to take the place of the more troublesome dovetail joint. The grooves for the bottom and the back should be made with combination plane or circular saw. The drawer material, with exception of the front, may be of cheaper material. A suggestion for the treatment of the upper drawer is to provide it with a partitioned tray, to care for buttons, threads, snaps, etc., that every woman needs a place for.

After careful sanding, and final assembly, including hinging of the shelves and gluing the knobs in place, we are ready for finishing. The top is to be attached with screws from inside through the center of the post, holding the body to the base.

The Finish

IF genuine mahogany has been used it may be finished natural, and yet given the ap-



The finished table is shown in the photograph above. A long bolt may be used to hold the pieces together.

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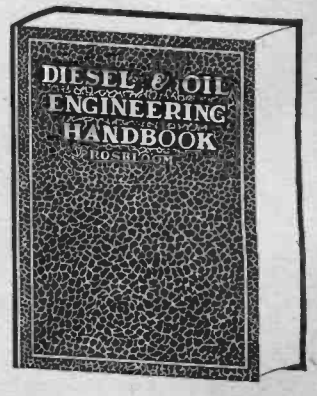

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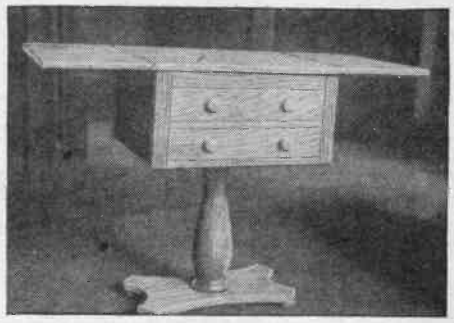

The finished table with the leaves extended.

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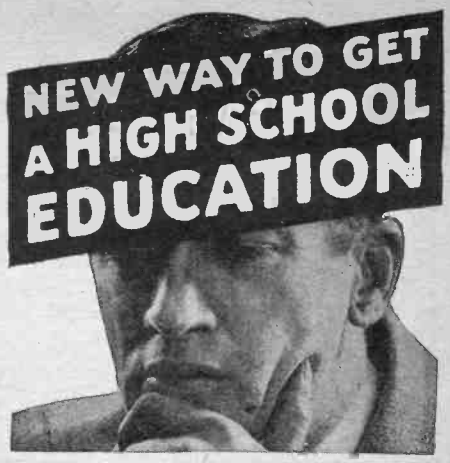

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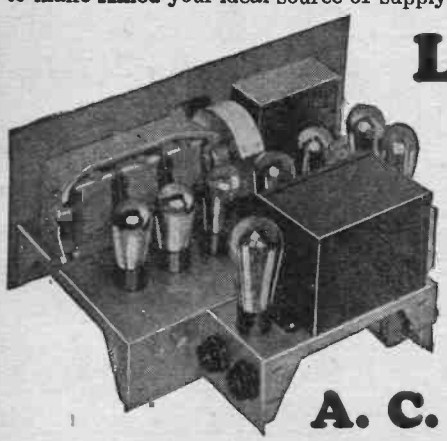

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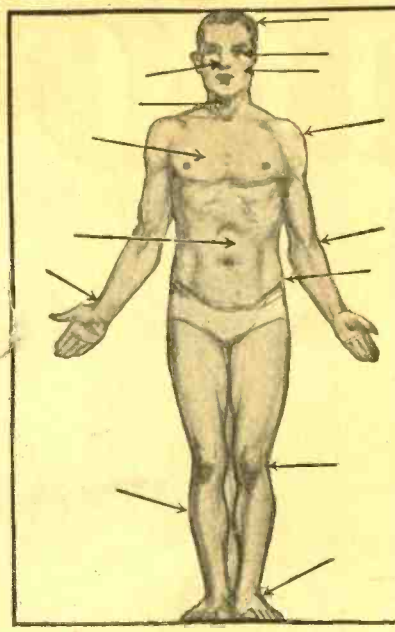

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