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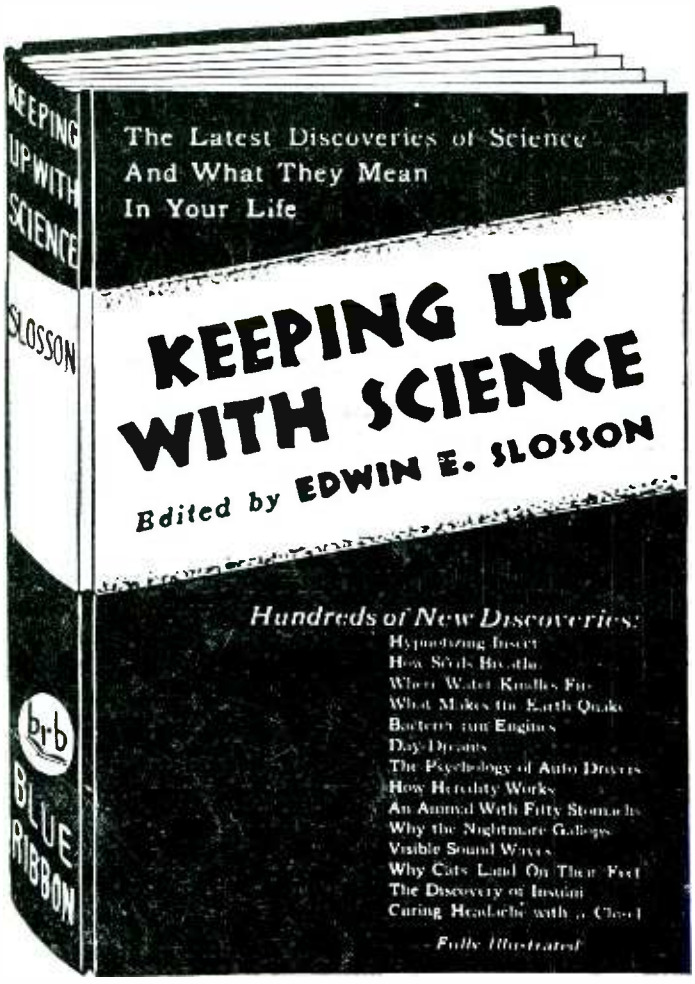

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No. 3

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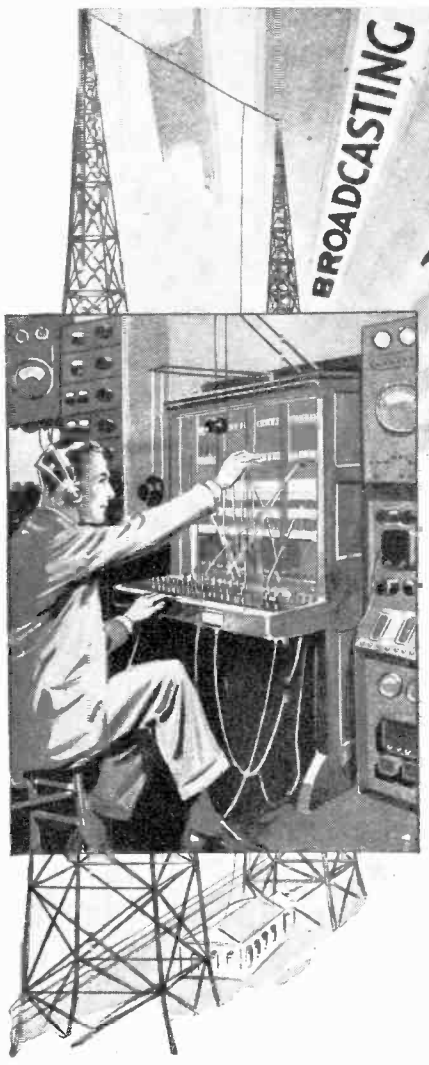

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JULY, 1931
WHOLE NO. 219

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VOLUME XIX

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JOSEPH H. KRAUS, Editor

Editorial

In Quest of Knowledge

SOME time ago we decided to carry on a series of experiments on a subject which, for the purpose of this editorial, need not be mentioned. Like any other avid fan, we hied ourselves to the public libraries and wallowed through musty tomes, reading every book available on the subject and every English and foreign language periodical containing an article pertaining to the matter. We then purchased books that, because of their very recent issue, were as yet unobtainable in most of the libraries, and waded through these. Following this course, we interviewed many of the up-and-coming would-be experts in this new (for it is a relatively new) field.

While the subject is not at all difficult of comprehension, we find at the termination of our research that no one knows anything at all about it. One alleged authority directly contradicts another similarly alleged authority. One article contradicts the findings in another. The writings of a man with several college degrees are openly flouted by the owner of a small shop, who points with pride to his successful results.

There is no excuse for this mystery. When a scientist sets down laws regarding the occurrence of certain phenomena, those phenomena should repeat themselves in accord with the rules set down. One scientific work which we reviewed pre-supposed that the individual knew the primary, secondary and a good portion of the tertiary aspects of the situation. The book started at the middle of the subject and continued on through to the end. We were unable to unearth any details which would be of interest to the beginner. And so, in order to give our readers some first-hand information, we have had to set up our own laboratory, make careful notes of observations and absorb for ourselves what others should have seen and should have recorded. From all sides we have been met with a challenge—"I am the only man who knows anything about this. I defy you to secure adequate information elsewhere."

And such is the difficulty of securing knowledge.

More Parking Space

IN many of the larger cities, the difficulty of conveniently parking cars becomes increasingly alarming. In every one of these cities there is a great deal of waste space on the roofs of the buildings and on building setbacks, where cars could be parked without cutting down the light and without materially increasing costs. Most buildings have elevators which, with very slight changes, could be made large enough to accommodate a good sized car. With another slight change, which will cost but a few hundred dollars, the elevator could be made to run up to the roof. Where buildings are very tall and conform to the legal requirement of the setback style of architecture, it would be a simple matter to use the ordinary freight elevator, provide a runway from the elevator to the wasted area, and allow for the parking of cars there.

The advantages are apparent. Elevators must be run and there are always attendants to take care of them. There would be few fire hazards, because the cars would be stored in an open space. This space now represents a total loss. If parking privileges cost only 25 cents a day, the available space of one of our big buildings would net the owners many thousands of dollars a year.

For example, one building in New York City possesses a parking space capable of accommodating 200 cars. This building can accommodate roughly 1,000 cars a day. With the parking privileges of 25 cents a day, figuring on 300 working days a year, this would net the owners $75,000 a year. Furthermore, it would expedite traffic by clearing the city of parked cars. It would save the cost of many fines due to prolonged parking, and would greatly aid the police in maintaining law and order.

This suggestion is not made without calling attention to the fact that some buildings are not built strongly enough to sustain any material additional weight. Permits would have to be secured and buildings frequently inspected.

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

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can it become Ethyl Gasoline

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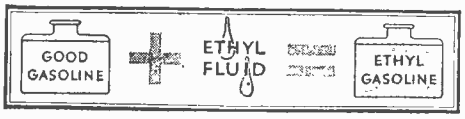
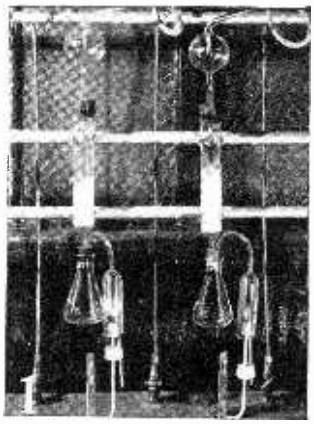
They delve into its ancestry for gum and sulphur, hereditary diseases of gasoline. They sound its nerves to determine how jumpy it is, how quickly it will knock. They test it for volatility—the quickness with which it changes from a liquid to a vapor ready to deliver power.

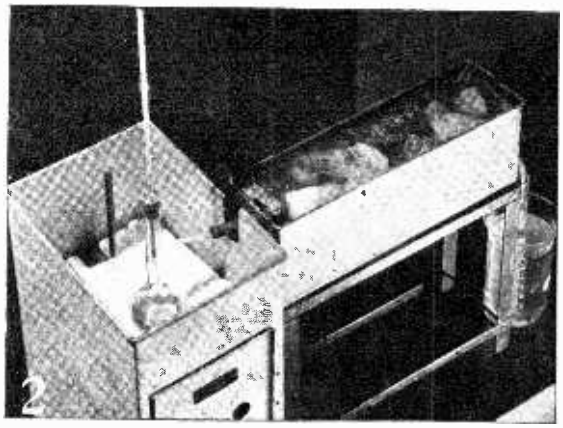
Only when gasoline passes all tests can it be mixed with Ethyl fluid. After it has been mixed at the refinery, it comes back to an Ethyl laboratory to go through the same tests for a second degree. It comes back for the third degree in the samples that Ethyl inspectors buy from roadside pumps.

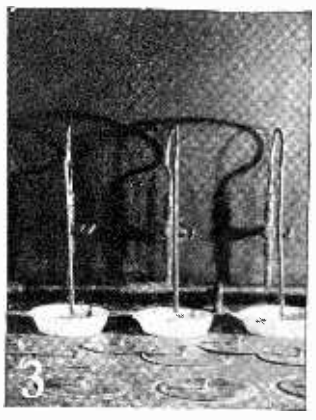
Every time you "fill 'er up with Ethyl," you get gasoline that has passed these strict tests. That's why you always get *good* gasoline—*plus controlled* combustion: the fine performance, the quicker getaway, the added power on hills that only Ethyl can give. Ethyl Gasoline Corporation, New York City.

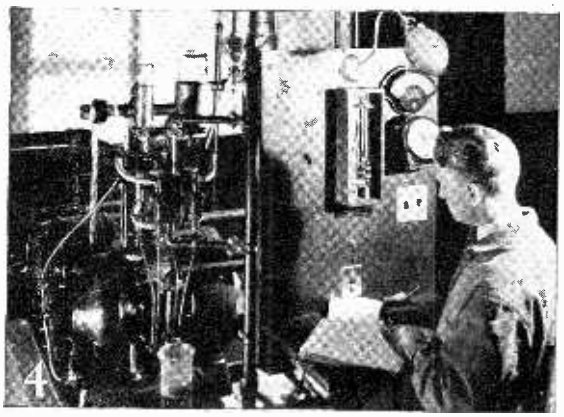


The active ingredient used in Ethyl fluid is lead.









1. **SULPHUR** is as dangerous in gasoline as tonsils often are to people. So Ethyl chemists burn gasoline samples and catch the products of combustion by bubbling them through soda to make sure of low sulphur content.

2. **VOLATILITY** is the quality that makes you jump out of bed in the morning feeling like a six-year-old. And gasoline must have this quality before it can become Ethyl Gasoline.

3. **GUM** makes for intestinal sluggishness in any car. So gasoline that becomes Ethyl must have a low gum content. Shown pictured here are the evaporating dishes used to show how much gum each sample has.

4. **KNOCKING** is the influenza of gasoline. It is cough, sneeze and weakened power rolled into one. This test tells how much Ethyl fluid is needed to make the patient sound and healthy again—free from any knock.

ETHYL GASOLINE

JULY, 1931
WHOLE NO. 219

Science and Invention

VOLUME XIX
NUMBER 3

Twenty Thousand Leagues Under the Sea Today

Jules Verne Wrote His Famous Classic of Imaginative Fiction in 1873, When Submarines Were in a Crude, Embryonic Stage of Development. How Closely He Came to Visualizing the Submarine of Today, and Its Method of Operation, Is Vividly Portrayed in This Article, Which Compares Captain Nemo's "Nautilus," Detail by Detail, With Our Modern Under-Sea Craft

By Lieutenant-Commander H. A. Gosnell, U.S.N.R.

WHICH one of us has not been thrilled by Jules Verne's stirring tales of adventure—"From the Earth to the Moon," "A Journey to the Center of the Earth," "Five Weeks in a Balloon," and many others. But perhaps the most popular and the most intriguing is "Twenty Thousand Leagues Under the Sea," through the fanciful pages of which sails the mysterious Captain "Nemo" on his astonishing voyages in the wonderful submarine *Nautilus*.

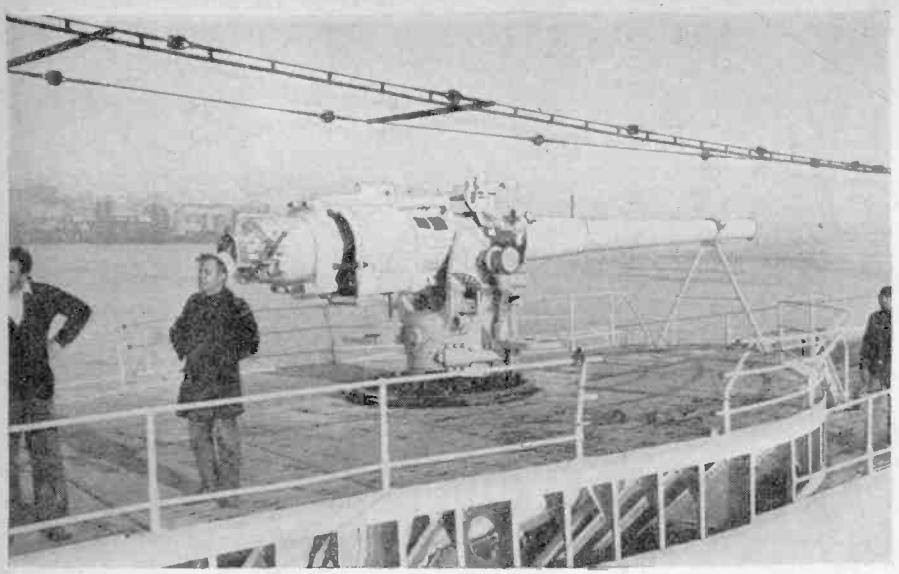
How many of his readers realize how prophetic was the keen imagination of the author? It produced perhaps a better forecast of the future than even he himself imagined when he penned the words. How many realize how fully his dreams have already come true? In some particulars they have not been exactly fulfilled, but in other respects they have been far surpassed. A modern submarine would have been at least as astonishing a contrivance as was the good ship *Nautilus* to Captain Nemo's prisoner-guest, M. Arronax. For it is "M. Arronax" who tells the story of the "Twenty Thousand Leagues." He lived his short, imaginary life in 1868. Jules Verne, speaking through the lips of that chronicler, placed the *Nautilus* as a hundred years ahead of her time. One may well wonder if the author really thought that she might be duplicated in even a hundred years. Little more than sixty years have elapsed thus far.

In passing, it should be mentioned that the narrative was actually written in 1873. In connection with our author and his book an event of interest took place not so many months past. Jules Verne's eight-year-old great-grandson officiated at the launching of France's new submarine, *Nautilus!*

Captain Nemo at the helm of the "Nautilus." This bare compartment contrasts strikingly with the conning tower of a modern submarine.

Let us now examine in detail the first *Nautilus* and see how she compares with the present-day submarine. We shall consider successively the various features of the vessels, taking up first the imaginary then the real craft in each instance.

To begin with, the size. The principal dimensions of Captain Nemo's cigar-shaped vessel were: Length, 232 feet; greatest diameter, 26 feet, and surface displacement, 1,350 tons; submerged she weighed 1,500 tons. Submarine craft equaled and passed the *Nautilus* before the end of the World War. There is now one vessel which is 425 feet in length and approximately 35 feet in breadth. It weighs 3,250 tons on the surface and 4,300 tons submerged. Now all actual submarines are designed with more scientific lines than a cigar shape with sharp ends. Therefore the maximum depth of the hull of this largest submarine is not a tremendous lot greater than that of the *Nautilus*. It is nevertheless plain that many modern craft far exceed in size the one which no doubt was deemed prodigious when conceived.



Left—The new U. S. Navy Submarine, "Nautilus N-2," is equipped with two six-inch guns. This is the vessel which made the new diving record of 336 feet.

Below—In contrast with the deck armament (for surface use) of a modern under-sea craft, Captain Nema's "Nautilus" had to be defended against hostile Indians by rifle fire from the deck.

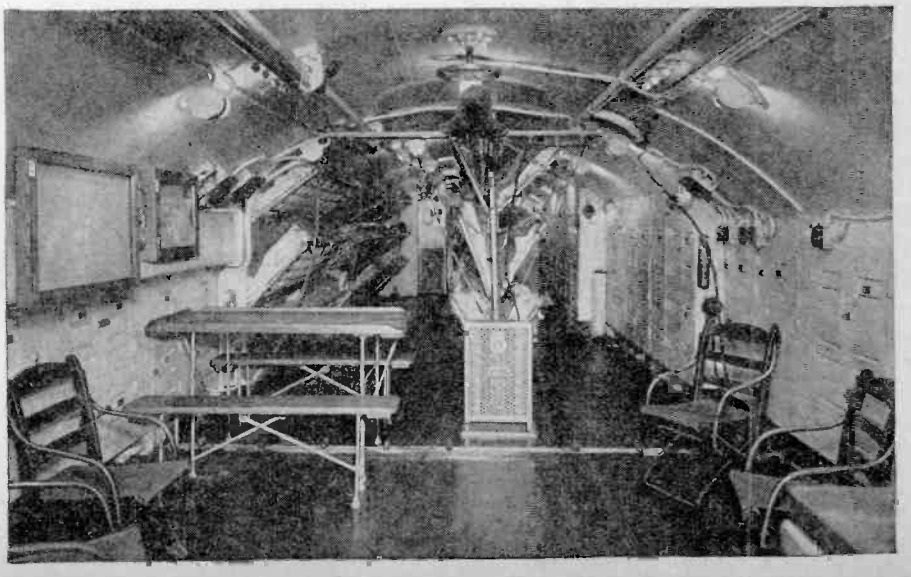
There are two British submarines in existence each of which in the past has mounted a 12-inch gun. Before the London Treaty it was rumored that a vessel of 7,000 tons was being projected. There are few more engineering difficulties in the construction of one of 7,000 tons than one of 2,000 tons. All of these craft being warships, however, other questions than that of size are predominating factors. Unlike surface ships of war, a small submarine may be able to do just as much damage as a large one *if it can succeed in getting into position.*

In the special case of the *Nautilus* the diving limit is pretty well tied up with size and weight. As will be seen below, we should consider linear dimensions rather than displacement. M. Verne has assumed as construction material for his imaginary ship a "steel" of extreme strength which is only seven- to eight-tenths the weight of water! There he has a prohibitively wide margin over anything which has as yet even been dreamed of. No material lighter than water is at present known which is at all suitable for the construction of a hull to withstand high pressures. By M. Verne's one assumption, however, it becomes immediately possible to construct a submarine which can withstand almost any pressure desired. An unlimited addition of material for strength will affect the buoyancy favorably rather than otherwise. So we find that with this marvelous new material Captain Nemo was able to build a double hull which weighed less than 400 tons. It could submerge — though with bare safety—to a depth of 48,000 feet! At this depth the pressure is 20,000 pounds, or 10 tons, per square inch.

The deepest safe diving limit for any craft yet constructed is about 450 feet, with 200-250 feet a much more common figure. Quite a difference between pressures of 20,000 and 200 pounds per square inch. Score one for M. Verne!

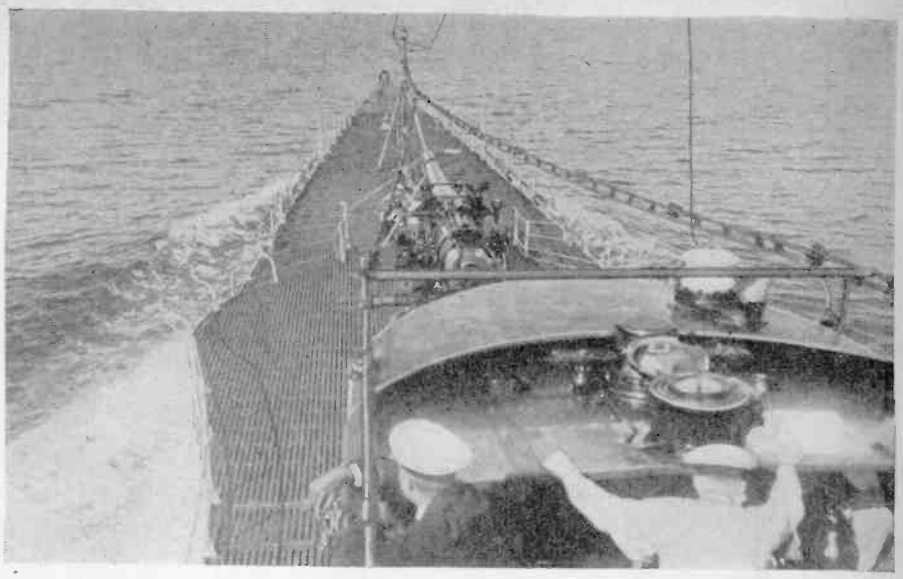
There were great ports in the hull of the *Nautilus*. Their strength was equal to that of the rest of the structure, though it is said they were made only of glass reinforced by copper bands. Through these ports the travelers viewed the marvels of life abounding in the ocean depths, the eruption of the submarine volcano, the myriad dazzling ice prisms on the voyage under the frozen sea to the South Pole and, finally, the gruesome sight of the sinking warship which Captain Nemo rammed and destroyed. He wreaked terrible and mysterious vengeance against his former country, the identity of which he kept secret to the end. These windows and their use are reminiscent of Mr. J. E. Williamson's submarine studio, de-

Above—The crew of the "Nautilus" view the wonders of the deep, a feat not possible from the modern submarine. This picture is strikingly reminiscent of J. E. Williamson's undersea photographic studio, described in the March, 1931, issue of Science and Invention.



Right—By way of contrast we see here the crew's quarters in a modern submarine.

Right—Looking forward from the conning tower of the V-5, one of the largest submarines of her type in the world. During speed trials she attained a speed of 17 knots. Note the wide deck space.



Below—An incident during the 20,000 league cruise of the "Nautilus." These pictures show how cramped her deck space was by comparison with a modern vessel.

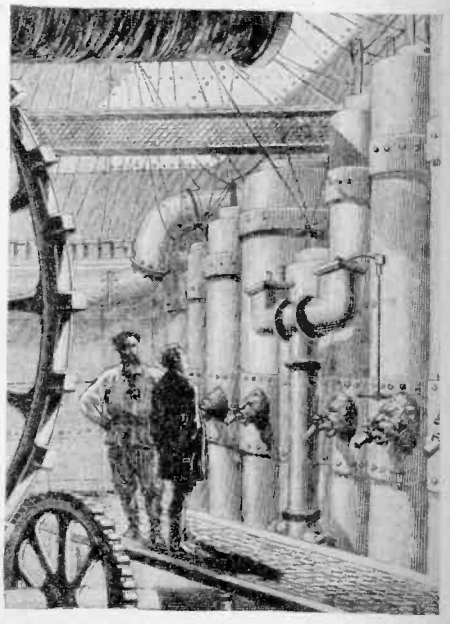
scribed in the March issue of this magazine.

In Jules Verne's time submarine operation had scarcely been thought of. Nevertheless he either had extremely good knowledge of the correct theory or else made a very good guess at it. It may be well to take a few moments at this point to explain the general principles.

It has been said that our *Nautilus* weighs 1,350 tons on the surface and 1,500 tons submerged. This means that when the vessel is in surface trim 150 tons weight must be added, barely to cause her to sink. In other words, she has 150 tons buoyancy which must be reduced to zero. The weight is added by admitting sea water to the "main ballast tanks," originally full of air. (Subsequent replacement of the water by air will cause the ship to return to the surface.) Correct distribution of the water ballast among smaller ballast tanks will keep the vessel in proper trim. Horizontal rudders, or "diving planes," on both bow and stern are important factors in controlling the depth and trim of a submarine when running submerged. As a matter of fact, for good operation one will ordinarily undertake to retain a very slight buoyancy after water has been admitted to the main ballast tanks. The desired depth is then reached and maintained by means of the two pairs of diving planes. It is obviously dangerous to take too much water aboard. The vessel would then actually possess "negative buoyancy." In other words, it would have a tendency to continue to sink.

Now then let us see how closely the builder-owner, Captain Nemo, approximated to the correct application of submarine operation. To start with, his 150 tons assumed for the weight of the main ballast water as against 1,350 tons for the weight of the vessel is not a particularly bad proposition. The ballast is a bit too small a percentage of the whole as compared with best practice. This, however, simply means that the vessel would ride somewhat low in the water with all ballast tanks empty. This was indeed the case according to the text of the story. The other smaller ballast tanks of the *Nautilus* held 100 tons. This is an excessive figure, but it tends to balance off the small capacity of the main tanks. The smaller tanks were used quite correctly, on one occasion at least, to point the bow upward.

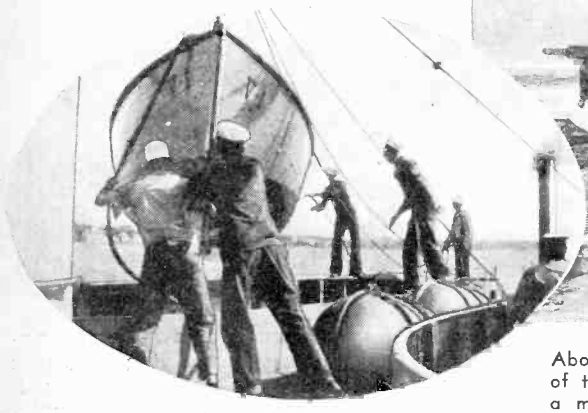
On the other hand, it was incorrectly assumed by M. Verne that the additional ballast was necessary in order to reach abnormal depths. The density of water increases quite negligibly with increasing depth. Simultaneously the volume of the hull is actually decreased to



Above—The fearful and wonderful engine room of Jules Verne's brain child.

Left—By contrast, this is just the engine control room—not the engine room itself—of a submarine of today. It looks as if it would be a tough job to cram in one single extra gadget. The two wheels at left control the bow and stern diving hydroplanes.

a slight extent by the pressure. The net result is that the weight of the displaced water actually decreases. Thus, the deeper the vessel goes, the greater is its tendency to sink. The auxiliary tanks apparently were not used to obtain exactly the correct buoyancy—their main function nowadays. The *Nautilus* depended on her main propelling machinery and on her diving planes to overcome any divergence from neutral buoyancy when operating submerged. We shall see that this practice was not very dangerous or improper, even with negative buoyancy, because the power of her main drive was prodigious.



Above—Boat carried on the deck of the "Nautilus." Left—On board a modern submarine, showing boat being hoisted from the "well" in which it is stowed on deck, and launched over the side.

The greatest flaw in M. Verne's scheme is that only one pair of diving planes was provided, and this pair was located at the *center* of the vessel. Actually it would be impossible to use horizontal rudders for pointing the bow up or down unless they were located either at the forward or the after end of the ship or, preferably, at both ends. Conditions would be very unstable. The trim of the ship could not be altered except by changing the distribution of the water in the ballast tanks. This great handicap, however, did not seem to endanger the *Nautilus* in her novel trip through the "Arabian Tunnel," for instance. This, it will be remembered, was the inclined submarine passage which Captain Nemo had discovered connecting the Mediterranean and the Red Seas.

When the Captain of the *Nautilus* desired to submerge, sea water was admitted to the ballast tanks—quite the orthodox procedure. When the ship was to be brought to the surface, this water was expelled by means of two tremendous electrically driven pumps.

And what of the modern submarine? It has certain refinements not embodied in the fanciful *Nautilus*. In the first place there are the all-important bow and stern diving planes mentioned above. (A submarine has been operated submerged without the use of the diving planes, the substitute employed consisting of a group of men running back and forth between bow and stern as occasion demanded!) For submerging, sea water is admitted through the bottoms of the main ballast tanks while the air in them is being released outboard through upper openings or "vents." The valves used in this operation are moved by power on many craft. The method in use for emptying the tanks is a great improvement over the procedure used by the *Nautilus*. With the vents closed, compressed air is shot into the tops of the tanks, driving the water out through the bottom ports very quickly. No pumps can perform this operation at anything like the same speed. This compressed air is kept in large banks of "flasks" and maintained at high pressure by motor-driven air compressors. The diving planes are motor-operated, both sets being electrically controlled from the central control station. There also are located the controls of the ballast tank valves.

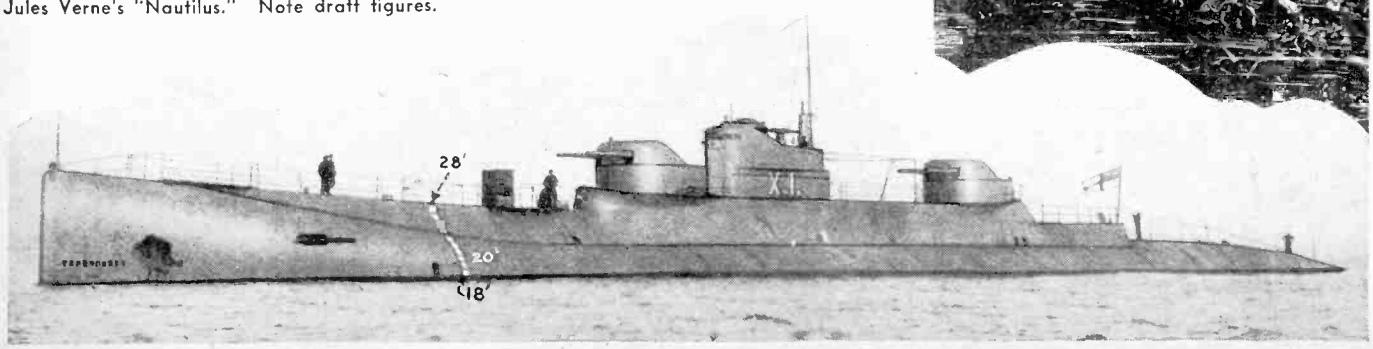
In addition to the main ballast tanks the modern submarine is provided with other "auxiliary" and "trimming" tanks also. Water is distributed to these tanks before diving. They are used to fix, so far as possible, the exact total weight and distribution of water which the ship will require when submerged. In other words, just sufficient water is admitted to these smaller tanks so that the flooding of the main tanks will give the ship nearly zero buoyancy. Final adjustments follow after the vessel is below the surface. Thus there is little change at any one time in the amount of water in any of these tanks. Accordingly they are not "blown" by compressed air under ordinary circumstances; small pumps can perform the same operation much more exactly. Thus the air for the tanks must be taken from the hull itself and returned to it later unless discharged outboard. The quantity, however, is not sufficient to affect the pressure of the air used for breathing. So for this method of operation of the lesser ballast tanks we are back to the scheme adopted by Jules Verne! Similar operation of the main ballast tanks would cause a very decided variation of the air pressure inside the ship. Perhaps it would not be absolutely prohibitive, however.

And now, with the vessel submerged, there is one more point at issue between the old and the new ships. M. Verne has claimed, perhaps unwittingly, a most valuable attribute for his ship. The *Nautilus* apparently was able to remain stationary under the surface without resting on the bottom. It is inconceivable that any craft can be so exactly

(*Continued on page 262*)

The "Nautilus" running submerged, revealing the cigar shape of her hull. The searchlight—more powerful than anything devised to date—illuminates a varied assortment of marine life, principally cuttle fish.

The British submarine X-1, truly an underwater warship, and a striking comparison with Jules Verne's "Nautilus." Note draft figures.



Eclipses Yesterday and Today

An Eclipse of the Sun Brought Terror to the Ancients, Who Did Not Understand Its Cause. Modern Scientists Eagerly Avail Themselves of the Opportunity Provided by an Eclipse to Increase Their Knowledge of the Sun and Planetary System

By Dr. Donald H. Menzel

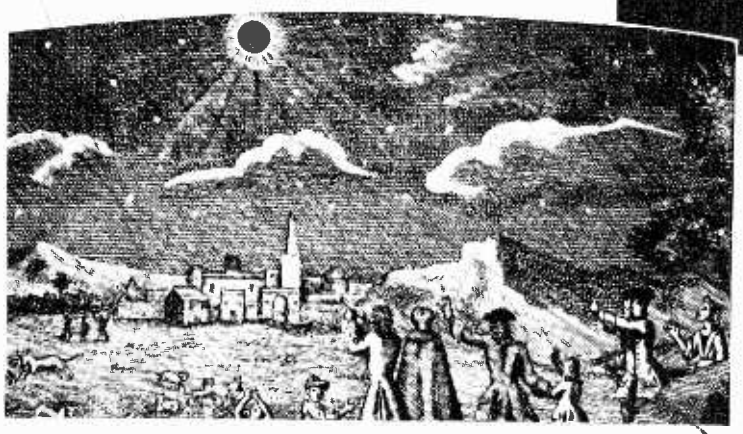
Lick Observatory, Mount Hamilton, California.

ON the night of August 14, 309 B. C., the fate of a nation was hanging in the balance. Sicily and Carthage were at war, and the latter country seemed about to gain a decisive victory over its hereditary enemy. The Sicilian fleet, commanded by Agathocles, had been "bottled up" in the harbor at Syracuse. Seeing no other way open to save himself, Agathocles slipped out of the harbor with his entire fleet of sixty ships, pursued by the Carthaginians, and, under the cover of night, made good his escape unmolested.

The next day dawned bright and clear. Early in the forenoon someone discovered that the sun had an unusual appearance—there was a black notch on one side. As the sailors watched, the "bite" out of the sun grew in size until only a narrow crescent was left. The scene became diffused with a weird, supernatural light. A chill wind sprang up. Suddenly the last rim of the crescent was blotted out, and, instead of the sun, the frightened sailors saw a jet-black disk, surrounded by a silvery halo. No doubt a few of them knew the phenomenon to be a total eclipse of the sun, but this, in itself, was not sufficient to lessen their terror.

The gray-bearded seers who professed to tell the future by the stars, and who were widely believed, had always emphasized that unusual astronomical apparitions heralded events of dire significance. The panic-stricken sailors besought Agathocles to desist from his enterprise, but the commander, more astute than his followers, asked "Does not the eclipse we have just witnessed portend some marked change of affairs?" And when they acquiesced, Agathocles continued, "Then what have we to fear? If some change is signified, it must be either to Carthage, which is in a very flourishing condition, or to us, whose affairs are in a very ruinous state!" Taking heart, his men decided to back their leader. A week later they landed in northern Africa and, after a battle, succeeded in devastating Carthaginian territory.

This is not the only case where an eclipse has played a major part in moulding human history. A hundred and twenty years earlier a somewhat similar situation had arisen. The Grecian fleet was all in readiness to set out upon an expedition when an eclipse of the sun occurred. As in the instance just related, great fear and consternation reigned among the sailors. Pericles, the commander, noting the confusion of the pilot of his own galley, suddenly removed his cloak and, throwing it over the head of his subordinate, asked him whether he found the darkness very terrifying or considered it an ill omen. Upon receiving a reply in the negative, Pericles then asked, "Well, where is the difference between this darkness and the other, except that at an eclipse something bigger than my cloak has hidden the sun from view and thrown us all into shadow."



Total eclipse of the moon. The light which illuminates part of the lunar surface has been bent into the terrestrial shadow by the earth's atmosphere (see Fig. 4). Left—The eclipse of 1724, from a drawing now in the library of the London University. This drawing was issued at the time, with explanatory diagrams and notes, "for lessening the Consternation of People Ignorant of ye Causes and Nature of Eclipses of ye Sun and Moon."

Darkness and shadow! The two have much in common, since they are both due to absence (or partial absence) of light. Light rays travel in straight lines and are unable to bend around corners. Hence, in the sunlight, every opaque object possesses a shadow, though we are unaware of it, unless it happens to fall upon a wall, a table, or other non-transparent material.

Consider the shadow formed by a coin, as in the diagram of Fig. 1, where the sun is to the right. It is clear that all light will be excluded from the umbra, while it will be only partly cut out from the penumbra, though the shadow will be of deeper intensity just bordering upon the umbra. In the case of a silver half-dollar, the shadow-cone will be eleven feet long. We can study the appearance of this shadow by interposing a sheet of paper successively at dif-

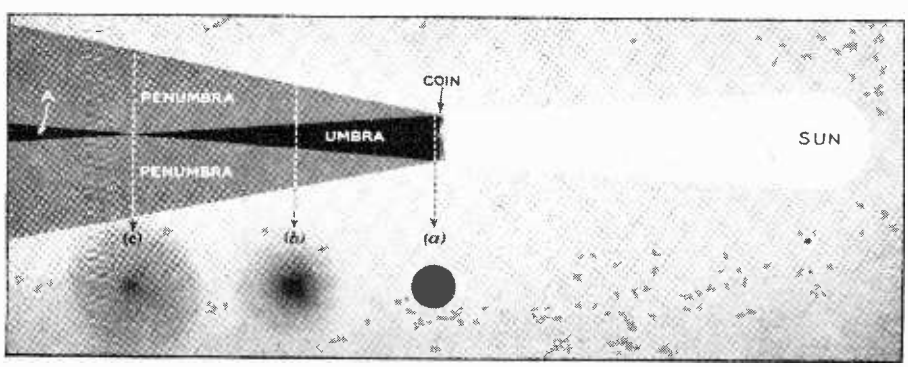
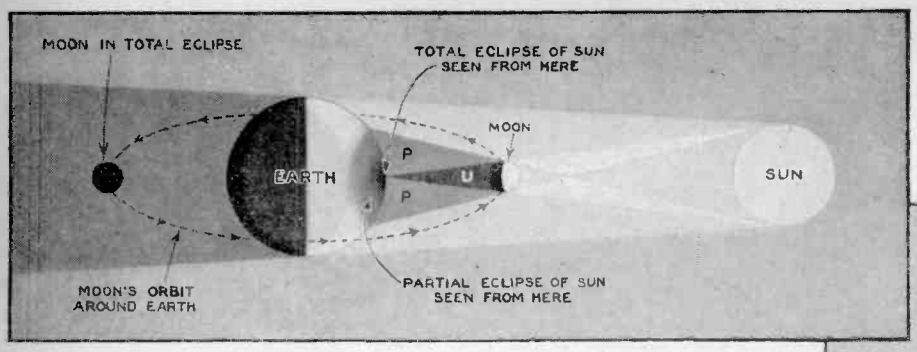
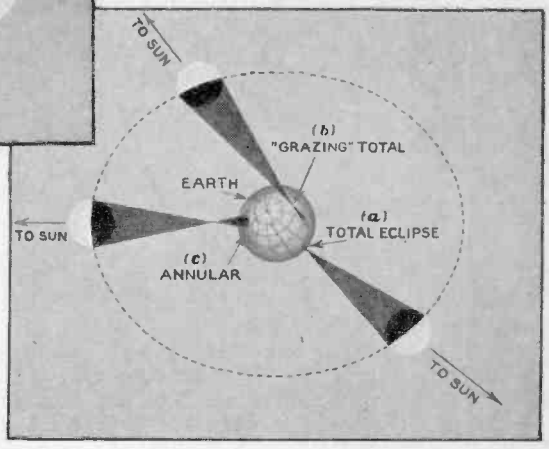


Fig. 1—Illustrating the formation of a shadow.



Left—Fig. 2—Diagrammatic explanation of the circumstances governing solar and lunar eclipses.

Below—Fig. 3—Showing how ellipticity of moon's orbit affects eclipses.



ferent distances behind the coin. When the paper is near the coin, as at (a), the shadow will be perfectly black and well defined. As we draw the paper along, the umbral shadow decreases in size (b), and we can see the hazy penumbra surrounding it. Finally, when the paper reaches or passes the point (c), the central umbra is completely lost and the shadow-patch becomes extremely hazy and ill-defined.

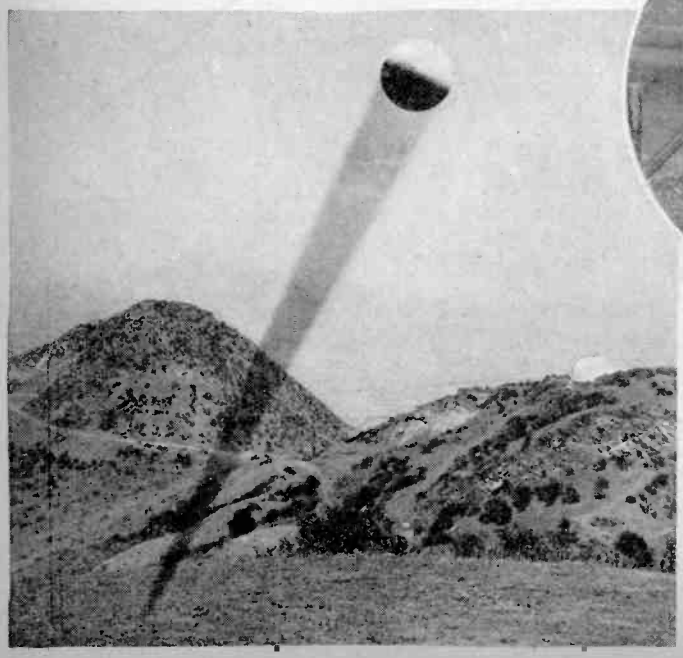
Suppose now that we place our eye within the darkened area and look sunward. As long as our eye is within the umbra, the sun cannot be seen at all. When we move out of the central cone into the penumbra, part of the sun becomes visible. Finally, if we place our eye at any point within the region A, the extension of the umbral cone, we observe the coin, slightly smaller than the sun in apparent size, as a black disk framed by a ring of sunlight. In thus observing the sun, we have, in effect, produced an artificial eclipse, for, like the coin, the moon has a long, tapering shadow with umbra and penumbra.

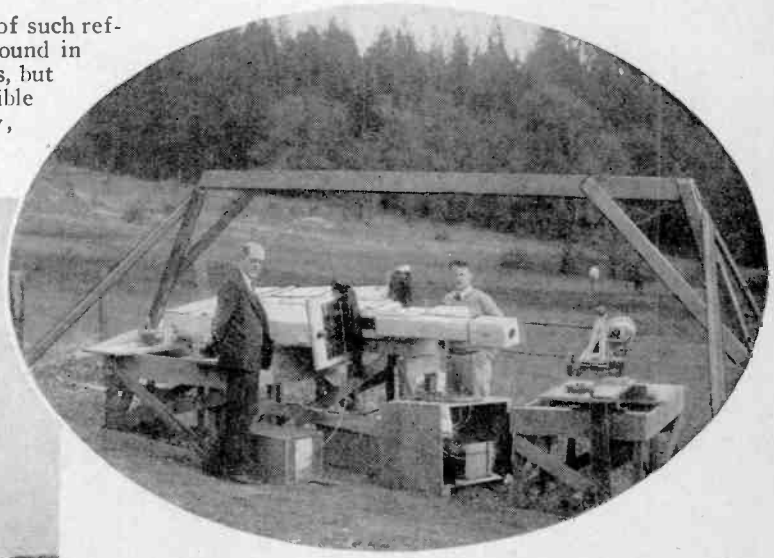
The sun has a diameter approximately 400 times greater than that of the moon, but it is also about 400 times farther away. Hence the two objects appear to be about the same size in the sky. The conditions that give rise to an eclipse are shown schematically in Fig. 2. An observer will view a total eclipse from the umbral region U, a partial one from the penumbral region P, or an annular one when the shadow-cone is not quite long enough to reach the earth. Since the moon's orbit is not exactly circular, the moon's distance from the earth varies considerably. Sometimes the moon appears slightly larger and at other times slightly smaller than the sun (Fig. 3). The nature of an eclipse of the moon is also illustrated in Fig. 2.

Like the moon, the earth has a tapering shadow. When the moon happens to move into the umbra, the sunlight is cut off and the moon fades into darkness that would be complete were it not for one circumstance. The earth has a very dense atmosphere, the curved semi-transparent edges of which act much like a lens in that they bend light-rays into the shadow (Fig. 4). Air is much more transparent to red than to blue light (witness the redness of the setting sun). Hence most of the light within the shadow is of a ruddy hue, and the moon, even though totally eclipsed, still shines with a weird coppery light. Ancient statements about the sun being "turned into darkness and the moon into blood" unquestionably refer to eclipses.

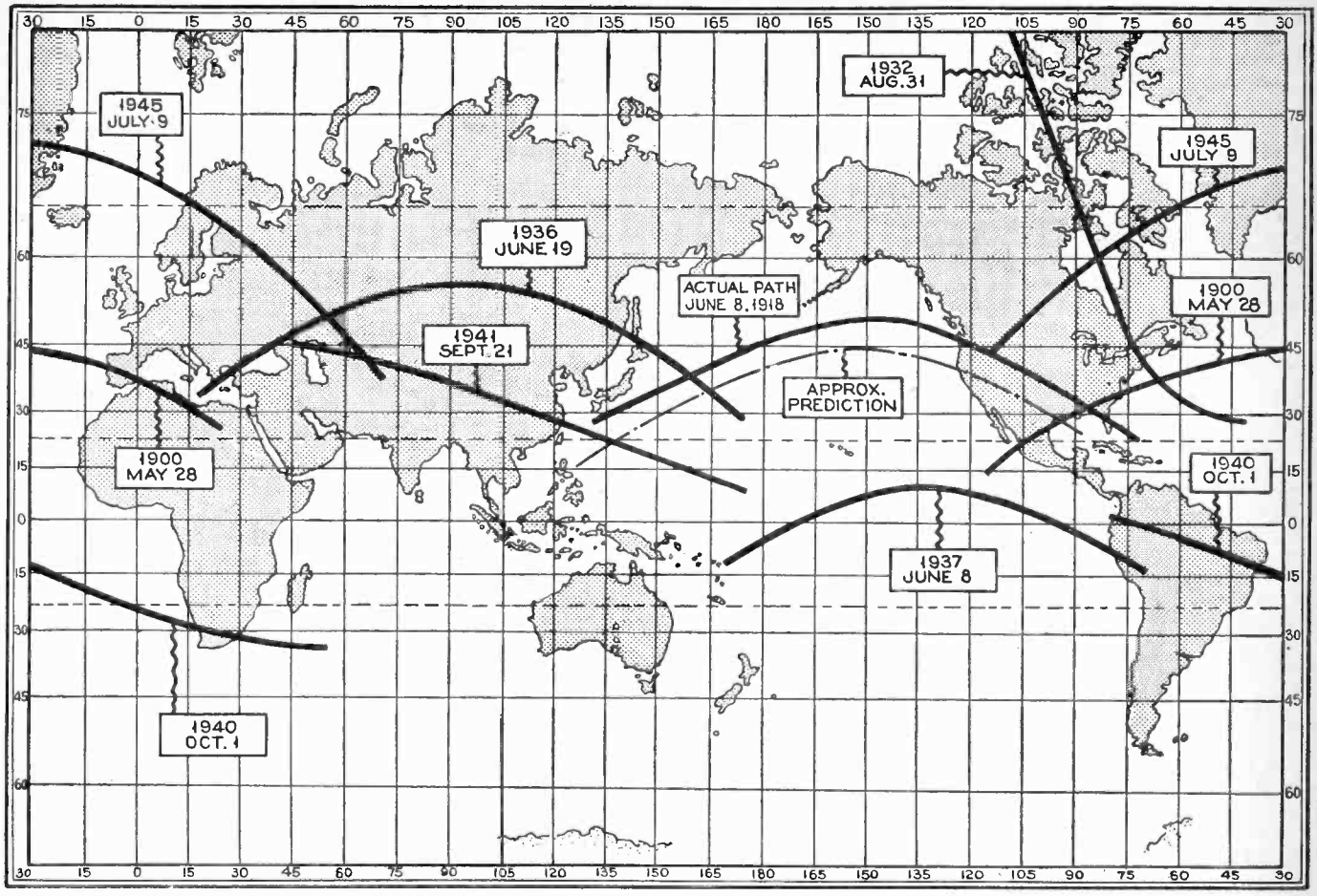
A number of such references are found in the Scriptures, but it is impossible to identify, with certainty, most of these with eclipses actually known to have occurred, since the chronology of the Old Testament is extremely uncertain. Ancient inscriptions at Ninevah tell of an eclipse that happened in the eighth century B. C. Calculating backward, we find that one took place on June 15, 763 B. C., and it is probable that this is the eclipse referred to in Amos viii, 9, "I will cause the sun to go down at noon and I will darken the earth in the clear day," for the date set in the margins of many Bibles is 787 B. C.

It is frequently stated that the darkness at the crucifixion was due to a total eclipse of the sun. The Jewish months were lunar and commenced with the new moon, and the Passover was eaten on the fourteenth day (Exodus xii, 2, 6). The crucifixion took place directly after the Passover, when the moon was full, hence there could not have been a total solar eclipse, which can occur only at new moon. It seems likely that the Biblical account is a figurative rather than a literal account of what happened, in which case it is not necessary to find any natural explanation.





Dr. J. H. Moore and the author (right), with their spectrographs used at the April, 1930, eclipse, Camptonville, Calif., during which the tip of the moon's shadow just grazed the surface of the earth, as shown in photograph at left.



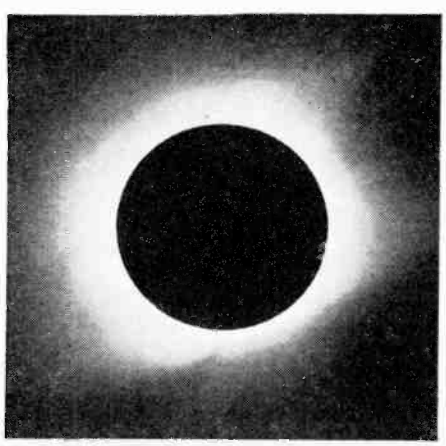
Map of the world, showing the tracks of several interesting eclipses of the sun, past and future.

The earliest eclipse of which we have any record happened more than four thousand years ago. In the Chinese Annals we read that the two royal astronomers, Hsi and Ho, having imbibed too freely of intoxicating liquor, failed to predict an eclipse. The people, thus taken unawares, were unable to perform the customary rites supposed to be effective in driving away the dragon that was devouring the sun. Ordinarily there was great wailing, shouting, torch-light processions, beating of drums, and aimless shooting of arrows. To punish the official scientists for their laxity, the emperor ordered them beheaded, though there is no evidence given in the fragmentary documents handed down to us that this extreme penalty was ever exacted. One authority, Oppolzer, fixes October 22, 2137 B. C., as the date of the eclipse.

Probably the most famous eclipse of all is the one predicted by the Greek astronomer, Thales. He can scarcely be credited with unusual ability, however, since he merely foretold the year (585 B. C.) in which the event was to occur. The historian, Herodotus, records the following interesting fact regarding this eclipse: "There was a war between the Lydians and the Medes for five years, each winning many victories from the other. . . . They were still warring with equal success when it chanced, at an encounter during the sixth year, that during the battle the day was turned into night. . . . So when the Lydians and Medes saw the day turned to night they ceased from fighting, and both were the more zealous to make peace."

Eclipses are of great importance to the historian, for they enable him to check and correct certain dates. Likewise they are of value to the astronomer. Precise prediction of the path of a total eclipse requires accurate knowledge of the positions of the sun and moon and the rate of the earth's rotation. Ancient eclipses, therefore, can provide the astronomer with information regarding these quantities.

Though a detailed prediction of eclipses is a problem involving intricate mathematical analysis, approximate prediction is really a very simple matter. Eclipses occur whenever the moon, sun, and earth get exactly into line. As a result of the earth's revolution, the sun appears to make a circuit of the sky once every year. If the moon's orbit and the earth's were in the same plane, we should have an eclipse of the sun every new moon. Actually the orbits are inclined and eclipses can occur only when the sun is near the point where the two orbits cross. The moon takes about 27⅓ days and the sun 365¼ days to make one circuit of the sky. The crossing point of the two orbits, which is called a "node," is not a fixed point but slowly and gradually moves toward the west. Since the moon moves from west to east, the interval between two successive passages of the node is slightly less than the revolution period because the node moves forward to meet the moon. This interval, the *eclipse* or *draconic* month*, is 27.21222 days in length. In the same way the *eclipse year* is less than the true year, it takes the sun 346.6201 days to move from a node back to the same node. Now there happens to be a very peculiar relation between the above numbers. 242 eclipse months are found to be almost exactly equal to 19 eclipse years, or 6,585⅓ days. Hence, if at any time there should be an eclipse, with moon and sun together at a node, 6,585⅓ days later both bodies will have returned almost to their original positions and we will have another eclipse very similar in character to the first. (*Continued on page 264*)



Total eclipse of the sun, 1922 (Australia). The black disc is the moon; the streamers of light are known as the solar corona.

*So-called from its association with eclipses, which once were thought to be caused by a great dragon (Latin: *draco*) that swallowed the sun.

Fortunes in

The Old Illusion That the Grass Is
Applies with Equal Force to Man's
Young Man Is Convinced That His
Migrate to a City, or, if He Is Already
Another City, or Country. Similarly,
Big "Strikes" of Gold or Oil, When in
Feet, if They Did But Know How to
Discarded

By Orville

Courtesy Canadian National Railways

Alberta bituminous sand walk, Jasper Park Lodge, Alberta. This walk has been in steady use for three years, under heavy extremes of temperature, and is still in perfect condition.

THERE was a great gold rush a few weeks ago. A lucky miner turned up a huge nugget, near the famous "Golden Mile" of Australia, that weighed 94 pounds and was valued at $23,000!

Men scour the world on the chance of finding such fortunes. But others today are taking fewer chances, often working in their spare time, while seeking fortunes nearer home. In the next ten years a new crop of millionaires will be made. Those of us who are less "lucky" will wonder how we missed these "fortunes in plain sight."

A young carpenter in Scotland, years ago, wondered if there was some use for the great piles of waste and unburnable "cannel" coal around the mines. Studying chemistry in his spare moments, he found out how to distill petroleum and kerosene, bought up vast piles of the waste, also oil shales never before utilized, and in twenty years became a millionaire.

The cannel coals of Kentucky gave us our "coal oil" till petroleum wells were drilled. The low-grade coals, lignites, oil shales, etc., contain petroleum, and yield valuable by-products such as ammonium sulphate, the fertilizer sold by Ford plants. There are over eight million acres of oil shales alone, in Colorado, Utah, Wyoming and other states. The vast deposits of cannel coals, lignites and shales in Canada, Nova Scotia, Wales, Australia, South Africa and other lands, hold an incalculable quantity of useful products. But today they cannot be economically extracted.

It is estimated that in our western reserves of these oil-soaked layers of shale clay over 100 *billion* barrels of oil are locked up. If you can devise a process giving you a profit of only one cent a barrel, a fortune of one billion dollars is yours!

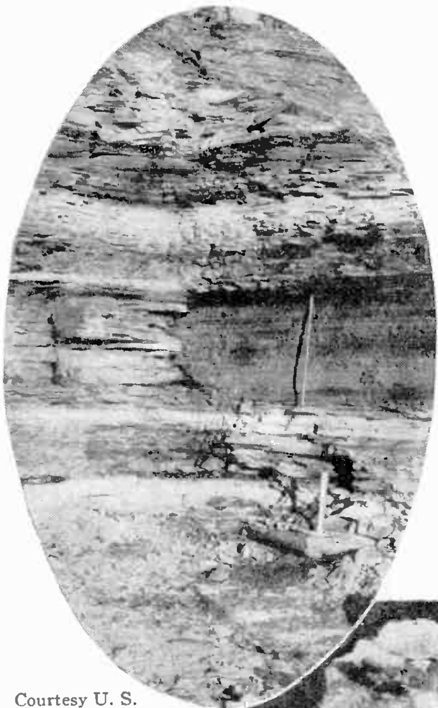
Mine wastes will probably make many a millionaire of tomorrow. Years ago the owner of an asbestos mine near Quebec accumulated great piles of "cotton-stone" or serpentine rock waste. The fibers were too short to be separated. He failed, and the new owner called in chemists and engineers. They devised a method of crushing the rock and asbestos, mixing with cement and producing the asbestos shingles, insulators and thousands of other products that have made many fortunes since.

Canada supplies 96% of our asbestos, but our mines in Arizona and other states are being worked. New processes would make them more valuable. Sometimes untrained men, becoming expert in some special line, have opened up entirely new fields to engineers and technical men.

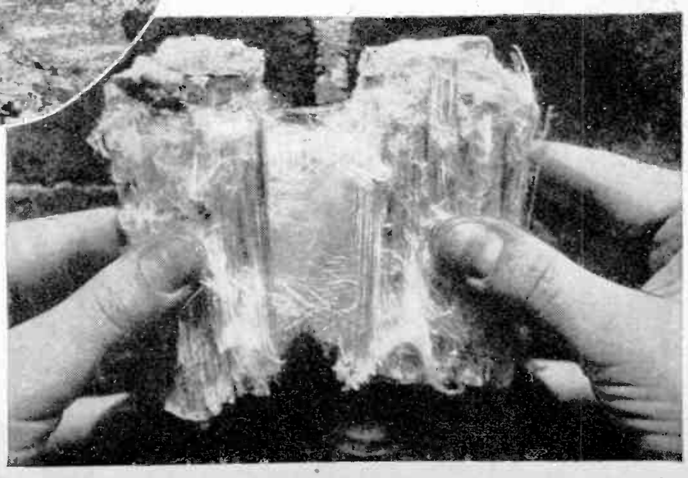
Thus Jim Ledfad of Butte, Montana, one day threw some tin cans into a stream in his backyard, that came from one of Butte's great copper mines. Next day the tins were dissolved, leaving a coppery mass that assayed 98% pure copper! He promptly contracted for all the mine-water thereabout, and is said to have cleaned up $90,000 in recovered copper before the year was out.

Today all the world's sulphide copper mines use this process. Tin cans are still used, too, but pig-iron is more used because there are not nearly enough tin cans to be found! Recently an Arizona concern invested $6,000,000 in a plant to recover only about $1.65 worth of copper per ton of ore. There are vast quantities of such low-grade ore—mine "tailings" today contain perhaps a third of the amount of unrecovered copper as they did twenty years ago. Our dumps will be re-worked in future years by even better processes, such as that developed by George Carson.

Carson was a roving prospector in Nevada and California. He made a living, but decided to study metallurgy and chemistry. Eventually he invented a vastly improved reverberatory furnace for smelting copper from low-grade ores. Friends financed twenty years of lawsuits against companies that adopted his process, and today he is rated as a millionaire several times



Courtesy U. S. Bureau of Mines



Above — Close-up view of oil shale layers. Right — A piece of asbestos as it comes from the "serpentine" rock in which it is found. Asbestos is the oldest material on earth, and remains unchanged, regardless of volcanic activity or earth pressure.

Courtesy Johns-Manville Co.

Plain Sight!

Always Greener in the Next Field Still Unceasing Quest for Wealth. Every Only Chance to Make a Fortune Is to in a City, Then He Must Needs Go to Men Scour the World in Search of All Probability a Fortune Lies at Their Extract It from the "Useless" Material by Others

H. Kneen

Courtesy U. S. Bureau of Mines

Gru-de-koks stove, burning lignite specially prepared, with cooking compartments opened. This stove has proved quite successful in European countries.

over. About every nine years the world's need for copper is doubled.

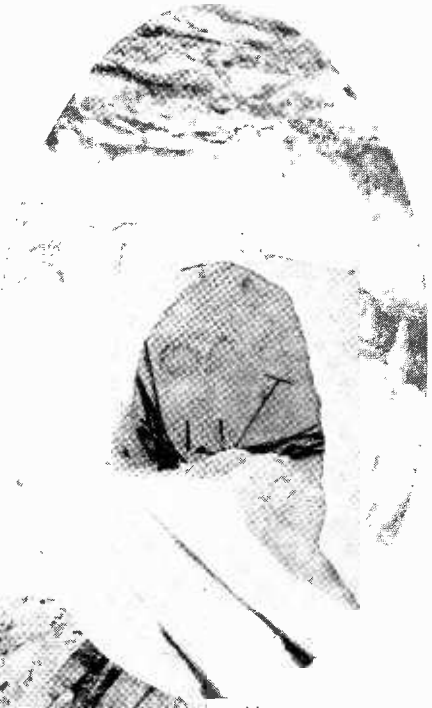
The early "Forty-niners" cleaned up millions of dollars in gold that could be easily washed and picked from the placer streams. But the companies that followed with dredging and other methods made far greater fortunes. Today there are very large known areas of gold-bearing gravel that they cannot economically work — until someone shows them how.

"Many hundred million dollars," says a report of the Colorado School of Mines, "remain locked up in ancient river 'channels' of Colorado, to be kept there forever, unless some wonderful plan is worked out to handle the enormous deposits economically. In a more or less cemented condition, so far no economical method has been found to take the place of hydraulicing, which is now handicapped by lack of grade to run the tailings off, and storage capacity to hold them back."

G. F. Loughlin of the Bureau of Mines declares that unrestricted hydraulic placering would produce perhaps $700,000,000 in gold from the famous Mother Lode and Alleghany districts of California, in the next twenty years. Of the mountains of low-grade ore he says: "Immense quantities await adequate prospecting."

Gold is a by-product of low-grade copper ores in Arizona, Utah, Nevada, Montana, etc. From this source, which furnishes half this country's gold today, Loughlin calculates *two billion dollars* in gold is obtainable within twenty years.

There are many known deposits of minerals in Canada, some of them of immense value. Amber mica, graphite, feldspar, diatomite, corundum, bentonite and phosphate rock are among these. On the Belcher Islands, near the east coast of Hudson Bay, I was told recently that great deposits of iron ore have been located. There is no coal near by, as far as is known—but tremendous waterfalls pour into the Bay from the Ungava plateau. a railroad now runs to Churchill, on the Bay; and steamer transport to Europe is beginning. Another Charles M. Schwab will some day bring these together in a vast iron and steel development.



Above—View of an open face gypsum mine. Gypsum is a natural hydrous calcium sulphate, and contains 32.5% lime, 46.6% sulphur trioxide, and 20.9% water. It is used for making plaster of Paris, fireproof building blocks, fertilizer. Alabaster is a fine grade of gypsum. Left — Mining Alberta "tar sands."

In eastern Texas, too, are more than 1,200 square miles of iron ore deposits, running 40 per cent to 60 per cent pure iron. In place of coking coal are the natural gas wells of the nearby Monroe field of Louisiana. A young metallurgist who today begins an expert study of smelting, devising new methods like the sponge-iron process, and perhaps living in such regions of potential riches, should in twenty years become the leader in a vast industrial field.

The Institute of Scrap Iron and Steel reports 30 million tons of scrap iron and steel reclaimed annually, most of it remelted into steel ingots. Numerous research chemists, metallurgists, etc., are employed by such associations, to find new ways of reclaiming and utilizing lead, aluminum, copper and brass, and other wastes. Most reclaimed gold and silver come from old jewelry and dentists' offices. The makers of photographic films, plates and motion pictures furnish great quantities of reclaimed silver, though the solutions treated usually contain less than half an ounce of silver to the gallon.

A surprising recovery of mercury is being obtained today from old dumps and "slimes" of Nevada, where in old times gold and silver ores were obtained by mercury amalgamation, and the mercury wasted.

New methods are being continually devised to reclaim lead from battery plates, lead cable, lead pipe, babbit bearings, type metal, etc. The mines furnish only about 50% more than is recovered from old uses.

The same is true of tin, of which $40,000,000 worth is recovered each year. But tin cans furnish little of the reclaimed tin, contrary to general belief. The process does not pay.

The aluminum recovered annually amounts to nearly 50,000 tons, coming mainly (*Continued on page* 254)

The Romance of Glass

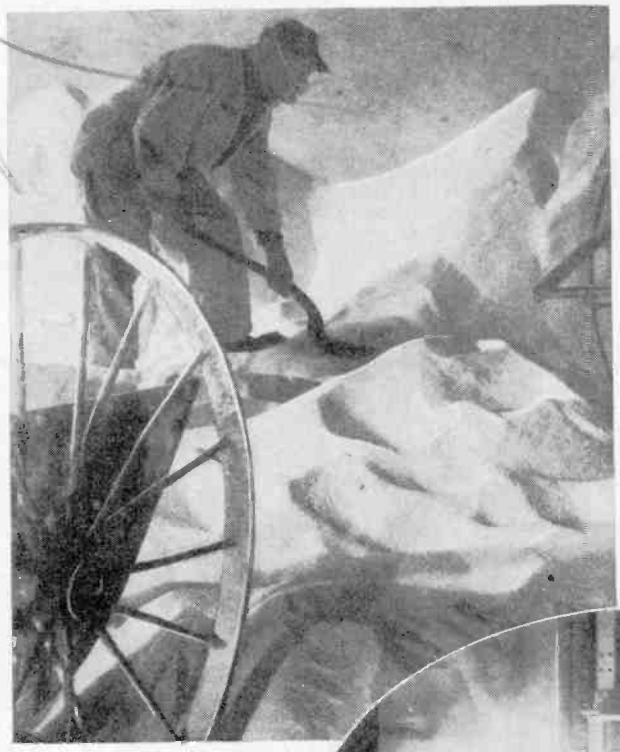
Everyone Has at Some Time or Another Wondered How Glass Articles Are Made. This Fascinating Article Takes You on a Tour Through a Glass Works and Explains the Various Processes. Incidentally, There Is Much of Romance Still Left in the Glass Industry, for Machinery Has Not Yet Entirely Displaced Skilled Craftsmen

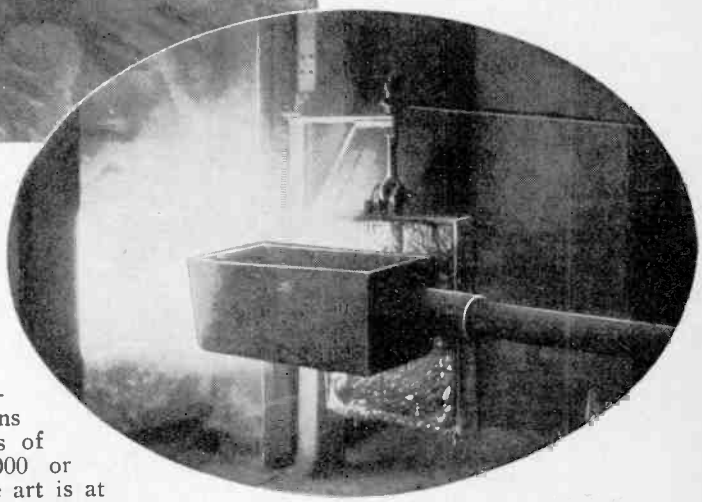
By A. Dinsdale

A DEEP, sonorous, brain-paralyzing, earth-shaking roar; blinding flashes from molten glass; skin-searing heat on one's face and a piercing cold draught on one's back (it was zero weather outside); feverish activity on the part of a handful of men tending ever-demanding, ceaseless machines; an uncomfortable pressure on the ear drums and, later, a singing in one's head, due to compressed air—these impressions might well constitute what the entertainment industry calls a "theme song" descriptive of one section of the plant at Corning Glass Works in Corning, N. Y., which I was recently privileged to visit. I should perhaps add that the workmen are equipped and accustomed to withstand the conditions, whereas I was not.

Other sections of the plant proved equally impressive, and even more fascinating. But perhaps I should begin at the beginning.

The art of glass making is one of the oldest on earth. According to Pliny, the ancient Phoenicians first discovered how to make it, but according to Egyptologists the Egyptians made sham jewels of glass at least 5000 or 6000 B. C., so the art is at least 7000 or 8000 years old. Venice, the great centre of glass making in mediaeval and modern times, commenced the industry with the foundation of the city itself in the 7th century, A. D. Germany took up the art in the 16th century, and in 1665 twenty Venetian glass workers founded the industry in Paris. In this country, the industry commenced in 1608, at Jamestown, Va., and in 1868 the first glass works was started at Corning, N. Y.





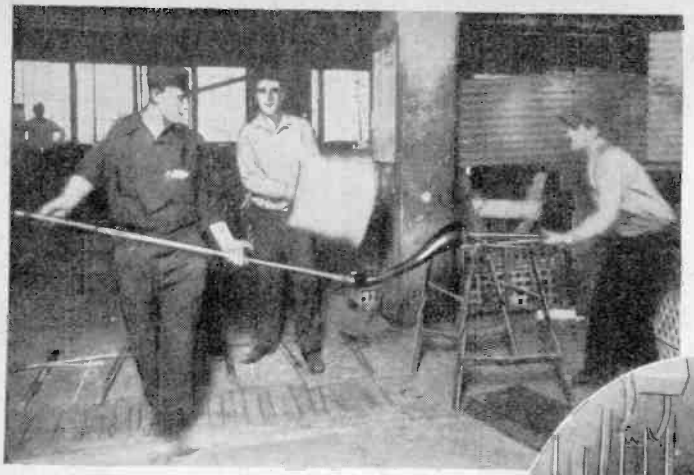
Above — Mixing the raw, or "batch" material ready for melting. Right — Feeding one of the furnaces with raw material for melting into glass.

Taking a "gather" from a "pot" of molten glass simmering at about 1440°C. Small quantities of glass are removed by dipping in the end of a gathering iron which is revolved until sufficient glass adheres to it.

Ordinary glass used for windows, bottles, etc., is primarily composed of soda ash (dehydrated "washing soda"), limestone or quicklime, and silica (sand). These materials are mixed in different proportions for different purposes, and other materials are sometimes added either by design or otherwise, according to the requirements of the final product, and the process of manufacture. For example, "fining agents" are sometimes added to aid in freeing the glass from gas bubbles during melting, coloring material may be added, and adventitious additions result from container corrosion during melting. Each "batch" of materials, mixed ready for melting, also contains anything up to 50% of "cullet," which is the trade name for waste and broken up glass, of which there is always a considerable residue from later operations.

The actual melting is carried out either in "pots" or in "tanks." Both are constructed of earthenware, the former holding about a ton of glass, and the latter many tons, according to size. In the case of pot melting, a batch of materials is placed in the pot, melted, and then worked out by hand, whereupon the process is repeated. In the case of tank melting, a continuous supply of materials is fed into the furnace at one end and molten "fined" glass worked out at the other, thus permitting continuous production by any method—by hand, by semi-automatic or fully automatic machinery.

Dr. J. C. Hostetter, Director of Development and Research at Corning, describes the process of melting glass in a clay container as being "something like



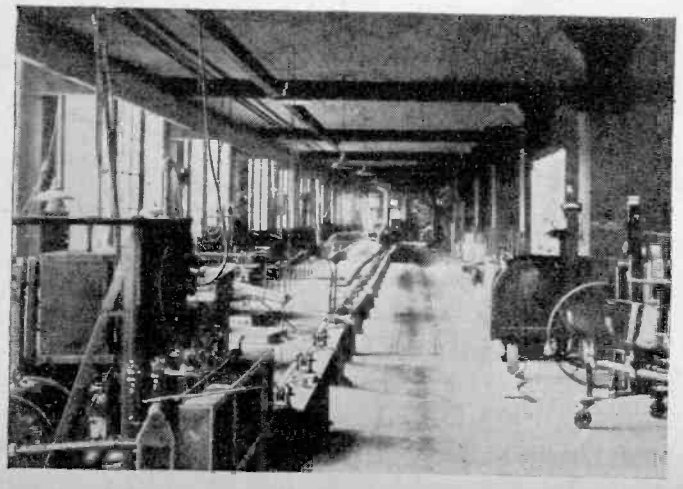
Left — Hand tube drawing. The man at left slowly pulls the semi-liquid mass of glass attached to the end of his blow-pipe, into tubing of the correct diameter. Below—At the base of the thermometer tube drawing tower. A "gather" of glass is set in a long vertical corridor where it is drawn upward.

the classic problem of finding a container for the 'universal solvent.' The process has been likened to the melting of ice in a container made of sugar. The ice will melt under these conditions, but as water is produced, it, in turn, dissolves the sugar of the container. The result then will be water containing sugar. So, with our glasses, there is always a certain amount of pot material dissolved away by the glass, but continual experimentation and development of refractories is rapidly helping to solve this problem."

It takes six months to dry out a new clay pot, and then it will last something like sixty days in service.

Producer gas mixed with compressed air is used to melt the glass, which must be heated to between 2500° and 2800° F., depending upon the kind of glass.

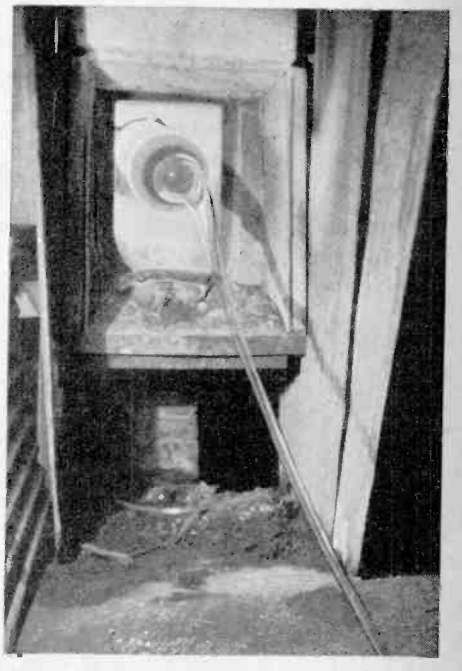
One of the most interesting processes to be seen at Corning is the manufacture of glass tubing, which is made there both by hand and by machinery. In the hand process, a "gatherer" first of all dips a tubular blow iron into a pot of molten glass, revolves it until he has picked up a sufficiently large "gather," and then hands the iron to a glass blower. The latter blows into the blow iron until he has produced an elongated bubble of glass about eighteen inches to two feet long. Then he drops the lower end of the bubble on to a "punty," (a solid iron rod with a clay ball on the end) which is held by an assistant so that the clay end rests on the floor. Contact established, the glass blower then walks slowly backwards, drawing out the bubble into tubing, and blowing an occasional puff of air into the blow iron as he does so, so as to keep air in the attenuating glass tubing and prevent outside air pressure from crushing it to too small a diameter. Meanwhile, another assistant, stationed a few feet from the "punty" from which the glass is drawn, continually tests the diameter of the tubing with a pair of calipers just at the point where the glass solidifies, while with his free hand he energetically wields a foot-square sheet of tin as a fan to cool the tubing when it has been drawn to the correct diameter. In this manner lengths of tubing about one hundred feet long are drawn to the required dimensions.



Automatic tube drawing. At the end of the runway, remote from the furnace, the tube-drawing machine automatically cuts the tubing into lengths and stacks them. One of these machines, making tubing of small diameter, can produce well over 100 miles of tubing a day.

At one time, clinical thermometer tubing used to be drawn horizontally in the same manner, but the extreme liability of the tubing to twist slightly, thus destroying the accuracy of the lens, led to the development of a method of drawing such tubing vertically. For this purpose a tower 150 feet in height is used, and the tubing is drawn by means of small elevators. In this case, a "gather" of clear glass is first of all brought to the expert who shapes the semi-molten mass of glass (of the consistency of cold molasses) into a triangular form. This done, another worker arrives with a "gob" of semi-molten white glass which is run on to one of the flat sides of the triangular mass of clear glass. When just the right amount of white glass has been deposited, this is shaped so as to round off the third side of the triangle, the manner of doing so being reminiscent of a housewife modeling a pat of butter.

The glass blower then blows an elongated bubble which he carries, dangling from the blow iron, to the elevator shaft. The bottom of the bubble is attached to a "punty" fixed at the bottom of the elevator shaft, clay end upwards (the glass, being semi-molten, sticks easily), while the blow iron itself is attached to the elevator which immediately proceeds to rise in the shaft, drawing out the glass into tubing as it goes. Since the bore of the thermometer tubing has to be so fine, no air is blown into the blow iron as it rises.



Glass tube drawing by automatic machinery. Molten glass runs off a hollow mandrel through which a current of air blows steadily. A machine located 150 feet away draws the glass into tubing of the correct dimensions.

In this way perfectly shaped thermometer tubing is obtained, free of twists which might distort the reading. Everyone is familiar with the form of clinical thermometer in which the back

is rounded, and made of white glass, while the flat sides converge to a rounded edge at the front, which edge acts as a lens to magnify the extremely thin column of mercury. Some idea of the fineness of the bore of a clinical thermometer can be obtained from one of the accompanying illustrations, which shows a microphotograph of the bore by comparison with a human hair, magnified to the same degree.

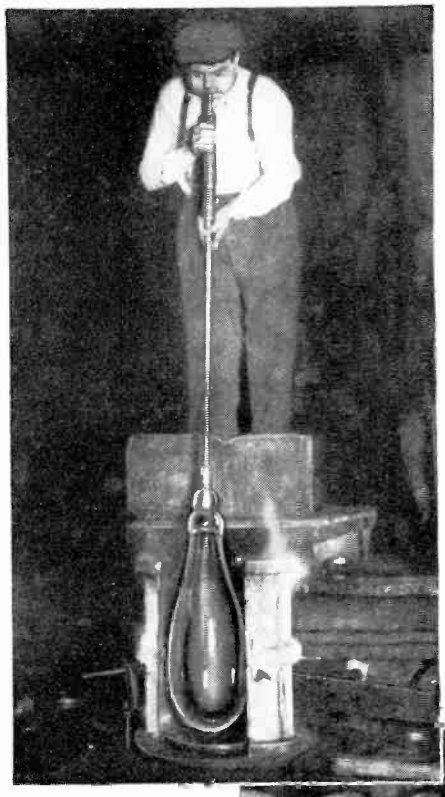
At this point I must pause to say a few words about the glass workers themselves. No one can watch them at work without being greatly impressed by both their skill and their demeanor. They work with the precision of machines, yet without the machine's soulless, mechanical monotony. The amazing skill with which they gather just the right amount of molten glass, shape, blow and work it, must be seen to be believed. And all their actions, though rapidly carried out, are impressively unhurried, precisely timed. One senses that here are men who have grown up in the atmosphere and surroundings in which one finds them. There is an air of conscious power and superiority about them. They *know* glass. To them it is a thing alive. They can *feel* it. Unlike most skilled artisans, they do not resent the intrusion of automatic machines. They have their place. But manual methods will always be required for the finest class of work. If anything, their attitude towards machines is one of commiseration for their complete inability to "feel" the glass which they handle, and one of regret for the unfortunate glass which must suffer such unhallowed handling. Truly a race apart, these glass workers, yet friendly withal to common mortals such as myself, who have but a faint glimmering of the susceptibilities of glass.

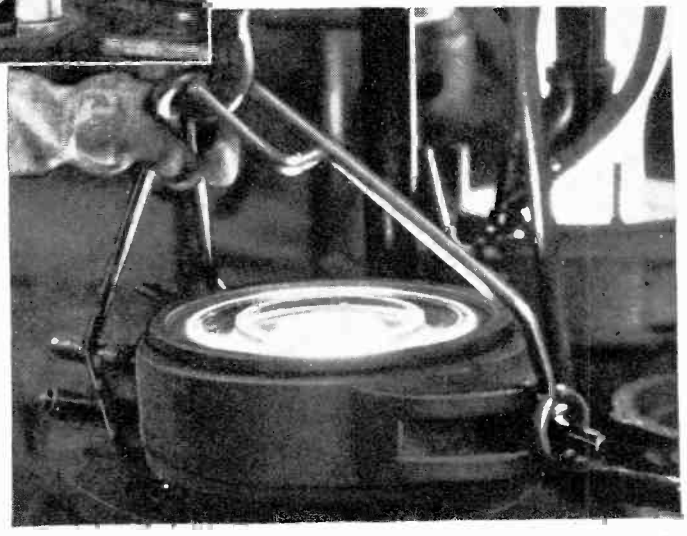
The hand method of tube drawing has been largely supplanted by the Danner automatic process, which is better able to cope with the enormous demand created by the needs of electric lamp bulb manufacture. In this automatic process, batch materials are continuously fed into one end of a tank furnace, while molten glass flows steadily out at the other end in the form of a thin ribbon which falls on a slowly rotating hollow mandrel inclined downwards at an angle. Through the hollow mandrel a current of air blows continuously, so that when the mass of molten glass runs off the mandrel it does so in the form of a bubble. This bubble is gradually drawn out into tubing by a machine located some 150 feet away, the intervening distance being equipped with a narrow runway fitted with small rollers every few feet, over which the tubing steadily runs. The machine also cuts the tubing into lengths of four or five feet, and these lengths are then automatically tested for diameter and, for some purposes, further sorted by automatic weighing. The tube lengths are then stacked and baled. One of these machines, making tubing of small diameter, can produce well over 100 miles per day.

One of Corning's greatest activities, electric lamp bulb making, dates back to 1878, when Thomas A. Edison appealed to the glass works to make him a thin bubble of glass in which he proposed to seal his carbonized thread filament. Today, the annual demand for large tungsten-filament lamps exceeds 300,000,000!

In one circular type of machine used for bulb making, lengths of tubing are mounted vertically and travel around and around the machine until they are used up. The lower end of the tubing is first heated in gas flames until it becomes semi-molten and closes up. Then a puff of compressed air is blown down the tube and as the end expands into a bubble, a two-piece mould closes round it. The tube is then rotated in the mould while the blowing continues until the bulb conforms to the shape of the mould and cools sufficiently for the mould to be opened. The newly formed bulb then passes on round the machine while knife-edged gas flames play on the tubing above the bulb until they cut it off, whereupon it falls upon a conveyor belt. Meanwhile, the glass tubing has made a complete tour around the machine and arrived back at the starting point, where the tubing is fed downwards the appropriate amount, and the process of making another bulb starts.

The conveyor belt carries the new bulbs into the "lehr," which is a kind of oven in which the glass is first heated and then gradually cooled in order to anneal it. From the lehr the conveyor belt carries (*Continued on page* 252)





Above — When the glass blower has blown a bubble of approximately the correct size, a two-piece cork-lined mould is closed around it to assist in arriving at the final shape. Below—A striking comparison. At left is the bore of a clinical thermometer shown in comparison to a human hair at right. Both are magnified to the same extent.

Cooling—but the highlights it casts on the irons of the carrier, which has just lifted the heavy press mould from its bed, are proof enough that the newly pressed Pyrex insulator is still fiery hot.

Having marked the main guiding lines of the design, the craftsman starts out to make a beautiful cut-glass bowl.

Are You Getting Enough Sleep?

If You're Not, Try These Remedies. Health and Happiness Require Sufficient Rest

This young lady is trying to snatch a nap in the afternoon. The raucous blast of radio and music from neighboring apartments, and the noise from a nearby air drill, do not help her very much. And most likely the volume of noise will not be lessened before midnight.

By Frederic Damrau, M.D.

IN this jazz-crazed age it is no exaggeration to state that millions of Americans are starving for sleep. If there is any one thing that strikes a nerve specialist about his patients, it is the fact that most of them do not get enough rest. Many, in fact, are burning the candle at both ends. Some make it a habit to stay up until the small hours of the morning. Others cannot rest when they go to bed.

One more waltz, before the musicians go home; one more rubber of bridge, before we drink our coffee; or one more distant station, dialed only after midnight: These are the modern Macbeths that murder our sleep.

Married women who have all the next day to make up lost sleep frequently forget that their husbands must work.

The harm done to the system by insufficient hours of rest is more real than you might imagine. If you could see the nerve cells of your brain under the microscope after a hard day's work followed by staying up late, you would probably be badly frightened. You would find them shriveled up as contrasted with the plump outline of a healthy cell; the little nutritive granules, needed for nervous energy, would be broken up or absent; and the nucleus, the centre of the cell's life, would be faded and pushed to one side.

In short, the nerve cell, even after a moderate period of fatigue, begins to show signs of degeneration.

This is not mere theorizing. I have seen these striking changes in the nerve cells of animals deprived of sleep and forced to run hour after hour on a treadmill. Also, the same thing has been observed in human beings.

But do not be unduly alarmed over what takes place in your nerves when you are fatigued. There is one sure cure—sleep. After a sound rest, the nerve cells soon come back to health.

Many prominent Americans have declared that four or five hours of sleep a night are sufficient for anybody. But these men have not been physicians. When they presume to instruct us on matters of health, their knowledge is about as practical as that of the famous lawyer who, when he fell overboard, realized that he knew his Blackstone thoroughly, but had never been taught to swim.

For full health and efficiency, the average person requires about eight hours' sleep. Some need more, while there are others who are thoroughly rested at the end of seven hours. In general, older people can do with shorter hours of rest; but they are inclined to take a nap or two during the daytime.

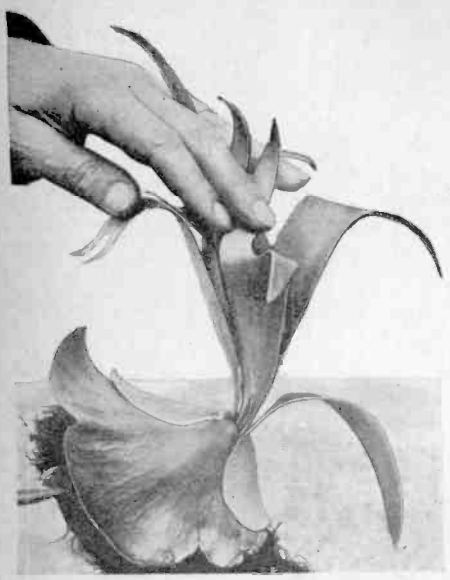
The most successful remedy for insomnia is reading a book that will bore you, like the "Congressional Record." It's never been known to fail.

I know an executive who preaches the doctrine of four hours' sleep to his subordinates. He says he practices what he preaches, but he keeps a couch in his private office. He explains that thoughts come more freely in the reclining position. But I suspect that dreams frequently take the place of thoughts, because on several occasions I caught him fast asleep. These were times when business callers were told that the vice president was in conference.

If you look back on the days when you did good work, when everything you tackled turned out right—whether it was turning in a low golf score or accomplishing something more important—you will probably find that you did it after a good night's sleep.

I have made a study of wrinkles. They are not the product of years so much as of a set facial expression brought about by insufficient relaxation and unpleasant emotions. A girl still in her teens, whom I know, is already forming deep wrinkles around the corners of her mouth by wearing a continual expression of disdain. The only way she can avoid looking like an old woman, before she is twenty-five, will be by breaking her set expression, smiling once in a while, and cultivating a kindlier feeling toward humanity in general.

(*Continued on page 257*)



The Platycerium, or staghorn fern, which makes its own flower pot by clasping itself around anything which may be handy. The leaves also serve as a repository for rain, dew, moist leaves or moss.

Amazing Camels of

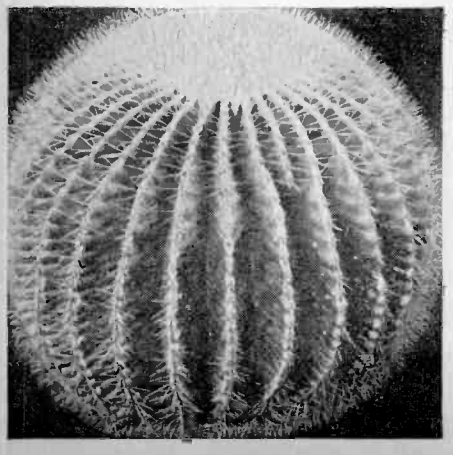
Most of Us Are Familiar With the Amazing Facility With Which Plants, Too, Can Adapt Themselves to the Most Rigorous Conditions. But It Requires the Expert Knowledge of a Scientist to Occupy. Are Able to Adapt Themselves to Environments for Intelligence in Accommodating Themselves That One Is Able to Adapt Themselves to Environments for Which Describes How Some Plants

By Forman

New York

WHILE New York is worried about her diminishing water supply and the people in the famine area of western great plains are just recovering from the bad effects of a succession of crop failures, it may be interesting to study the ways in which lowly plants meet similar emergencies.

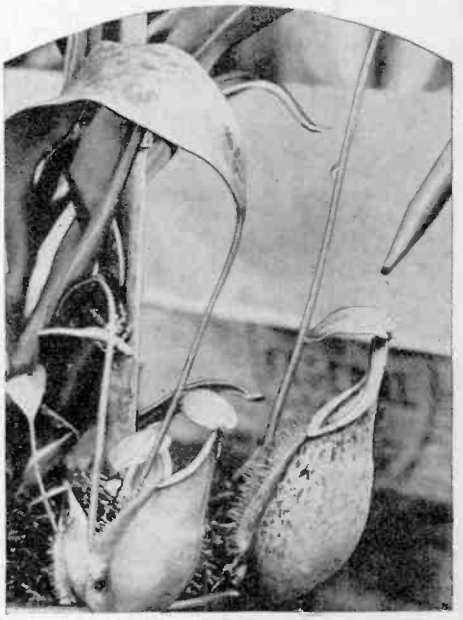
The great hedgehog cactus of the Mexican deserts has worked out its problem of water storage by transforming its structure to a great round ball with bellows-like seams running from top to bottom all around. When the desert soil is wet by rain, this plant, by its wide spreading roots, quickly takes up water and fills its large central mass of pith with water, swelling out the whole plant and filling up the creases in its outer skin. Then this water is gradually evaporated as the plant continues to carry on its life processes; and as the water is depleted the great barrel-like spherical stem shrinks, drawing in its folds, just as the bellows would collapse. Meantime the tissues remain moist and continue to function normally. In one experiment one of these spherical cacti lived for about five years, continuing to grow and blossom every year with no outside source of water at all. Any plant that can store up enough water for five years and safeguard it by such a rugged armor of thorns as this plant has is certainly entitled to human respect.



While the hedgehog cactus has developed such a very efficient water reservoir, the little Ceropegia Dichotoma shows a transition stage toward this ideal. It still develops leaves on its fleshy cylindrical stems, but the leaves are short lived and the green stems serve all of the purposes of normal leaves, in addition to being effective water reservoirs. The leaves are always detrimental to desert plants, because their spreading surfaces lose water too rapidly by evaporation.

Above—Here is the cannibal plant which eats its own parents. It is called the Ceratopteris Thalictroides, and has no seeds or roots. The pencil points to new leaves sprouting from old leaves, which are devoured by the young growth. Left—The Echinocactus Grandis or hedgehog cactus of Mexico, which can live for five years without a drop of water. When it rains the accordion pleats distend to form a reservoir.

In conserving the water supply, the desert plants have developed remarkably efficient mechanisms, and their problem is fully as complex as that of the city. Just as in the city water is needed for purposes of cleanliness and sanitation as much as for food and cooking, so in a plant the greater part of the water is used not for direct nutrition, but rather for indirect needs. Most of its food comes as carbon-dioxide from the air which is absorbed through the leaves and stems. The amount in the air is so small that to efficiently handle it the plant must expose a wet surface, carbon-dioxide dissolving in water at the rate of one volume of carbon-dioxide for one volume of water. Of course, such a saturated surface exposed to the dry desert air will dry out rapidly and lose water, so the problem of plants is to absorb the precious carbon-dioxide through its wet surfaces, and at the same time reduce its loss of its precious store of water. Accordingly, the desert plants are made up of thick, leathery outer coatings pierced by narrow channels to admit the air and to lose as little water as may be. When its water supply comes infrequently and in scanty amounts, as in the desert, then the plant needs to build up a reservoir from which it can draw, keeping its tissues constantly moist and ready to absorb the carbon-dioxide.



The Nepenthes Intermedia, which actually has a stomach like a human being, and sometimes has indigestion, too! Pencil points to the umbrella which keeps torrential tropical rain out of the stomach.

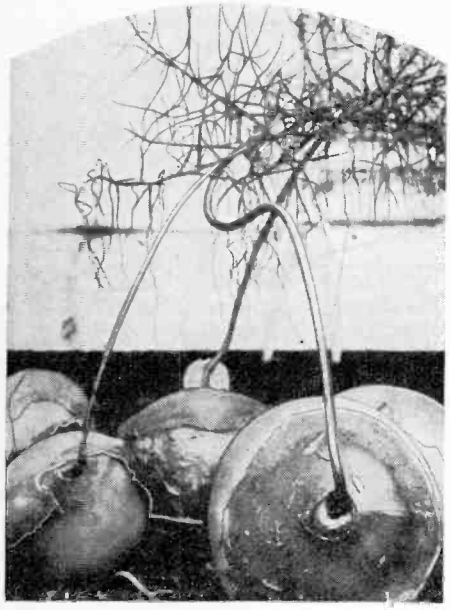
the Plant Kingdom

Which Members of the Animal Kingdom, including Man, They Are Not in the Least Suited, or Originally Designed Botanist to Reveal to Us the Astonishing Ways in Which Conditions. Plants, in Fact, Appear to Display so Much Tempted to Ask: "Can Plants Think?" This Article Exist Under Drought Conditions

T. McLean

Botanical Gardens

The Aloe of Africa, and its relatives, the Century Plants, have converted their leaves into thick, fleshy water storage

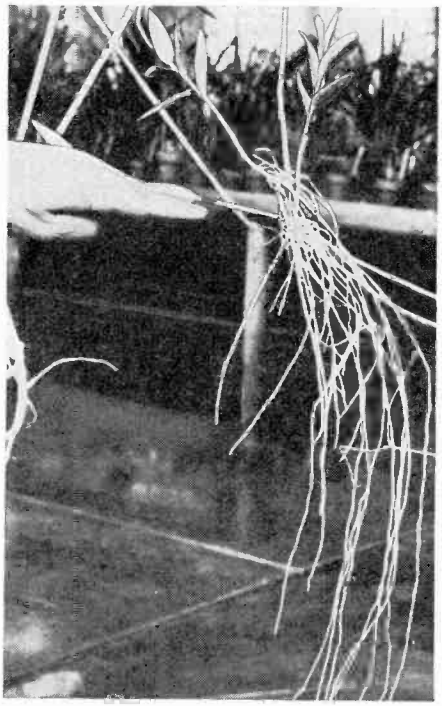


This plant, called the Boweia Volubilis, conceived the idea of building for itself an almost concrete-like reservoir long before man ever thought of building a water reserve system. The small opening also catches dirt.

tissues coated with a heavy, waxy skin, and guarded by such strong and vicious spines that the natives in some instances use them for needles. The Aloe also has a resinous sap which helps to prevent drying out and it so happens that its resin is of medicinal value as well.

In regions of seasonal rainfall and long droughts, such as South Africa, many of the plants develop thick, fleshy bulbs which serve more as water reservoirs than for food storage. One of the most conspicuous of these is the Twining Bowea, which has huge water storage bulbs above ground, sometimes weighing several pounds each. Its thin, delicate flowering stem makes a luxuriant growth during the wet season, but dies down promptly after the fruit is mature, leaving the huge green bulbs to carry on until the next rainy season, which is sometimes delayed two or three years in South Africa.

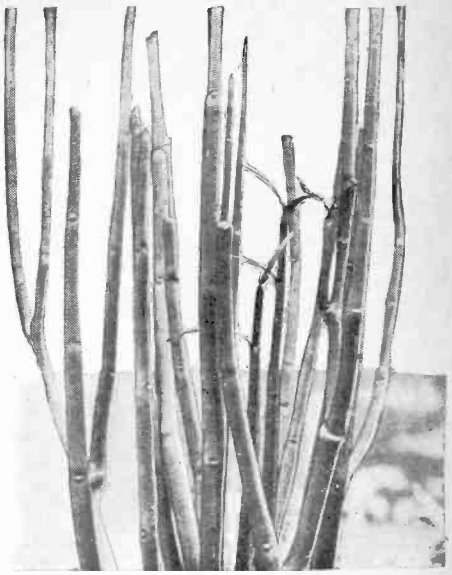
The Orchids, growing as epiphytes (air plants) high in the tree tops, have a different water problem to meet. Theirs is a really hard existence, for they grow in tropical forests where the rainfall is frequent, but having no soil supply of moisture and food to draw upon, every dry day or two constitutes a real drought to them. They have the typical thick leathery leaves of desert plants and have developed long aerial roots covered with a papery coating often thicker than the root itself. This papery material is called velamen, and absorbs water as readily as blotting paper, so that the water trickling down these roots during the rain is promptly absorbed, and every scant bit of nourishment contained in the water is taken in likewise. Thus the little Epidendrum plant here pictured is subsisting entirely on the water and food supply which it gets from the sprinkling in the greenhouse, as it has no soil in which to grow.



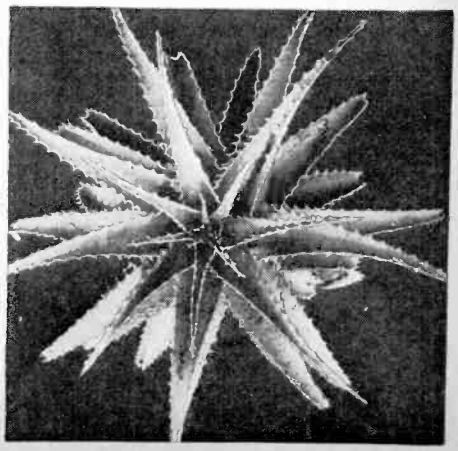
Above—The Epidendron orchid, which has reversed the basic law of nature; if its roots are placed in soil, it will die at once. The pencil points to where the leaves grow up and the roots grow downward in the air. Right—Aloe Spinosissima, or spiny aloe. The highly developed shark-like teeth of this plant ward off animals. Only such spiny plants can exist in the desert where animals eat all unprotected vegetation. This is still another example of the survival of the fittest.

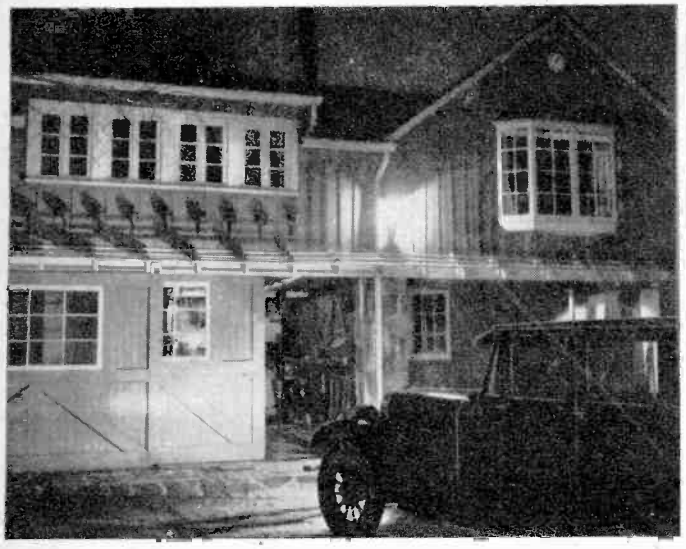
Many of the epiphytic plants growing in the tropical treetops find their problem of food supply a critical one. Of course, they have perched high in the trees to get in the sun, but in so doing they have moved far away from the soil and its abundant supply of moisture and minerals. The Staghorn fern, which grows high in the trees of the tropical forests of Africa, Australia and the East Indies, starts life on any little scrap of moss that may cling to the side of a tree trunk. This makes an entirely inadequate anchorage and source of water and food for the huge Staghorn fern into which the tiny plant will ultimately develop. Accordingly, Staghorn has developed a special kind of clasping leaf which spreads around the trunk of the tree, clinging close to it at bottom and sides and spreading open on the top to catch any leaves or trash, dew and rain that may fall into it. These clasping leaves make for the Staghorn fern a begging cup that serves as a shelter for its clinging roots and a repository for any gifts the air may bring it. Besides these clasping leaves, which are short lived, the plant develops normal fern leaves shaped like the antlers of a stag, a combination of the two giving the impression of a smooth deer head with horns.

(*Continued on page* 251)

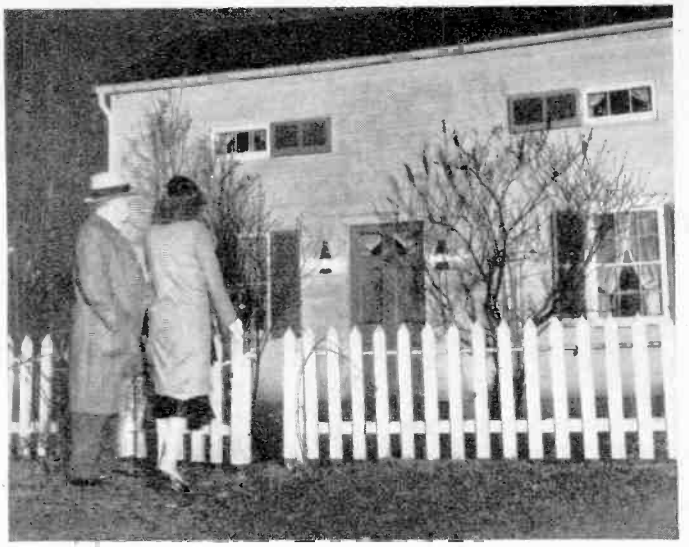


Leaves lose water so rapidly that they are a danger to the life of this plant, the Ceropegia Dichotoma, so it sheds them in order to conserve its water supply, and thus becomes bald-headed very early in life.





The doors of O. H. Caldwell's garage open automatically as soon as the beam of an automobile headlight is trained upon them. Simultaneously the lights of the garage turn on. Photo-electric cells are utilized.



This is an exterior view of Mr. Caldwell's converted farmhouse at Cos Cob, Conn., where everything is done by electricity. The house is flooded with lights when the gate opens.

The House of Tomorrow

An interview with Samuel G. Hibben, Manager Commercial Engineering Dept., Westinghouse Lamp Co.

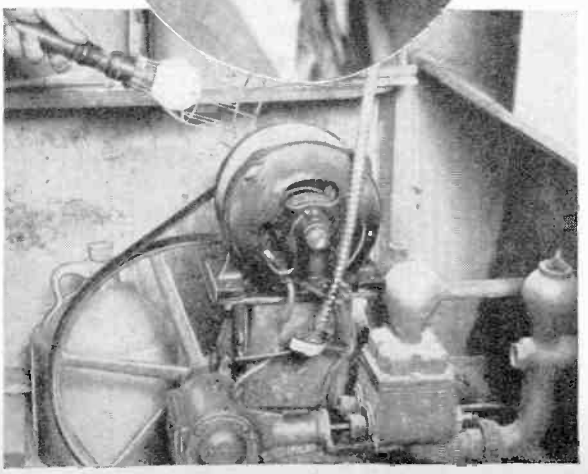
By Mary Jacobs

"WITHIN ten years the morning newspaper in many homes will be passé. Instead of propping the morning *Times* against the coffee percolator, you'll look up at a panel in your breakfast room on which will flash a pictorial representation of the latest events, with talkie accompaniment."

That is just one of the changes which a decade will bring, prophesies Samuel G. Hibben, Manager Commercial Engineering Department, Westinghouse Lamp Company. In practically all of them electricity will play an important role.

Take lighting—Mr. Hibben believes that within this period the photo-electric cell or "electric eye" will be put to work in the average residence. You won't have to switch lights on and off; as nightfall approaches or recedes, the intensity of its shadows will intercept a photo-electric cell, and automatically switch lights on or off as needed.

Samuel G. Hibben, B.S., E.E., the subject of this interview, is a well-known engineer, particularly prominent in the lighting field.



The electric pump which is used for circulating cool well water through the steam radiators of the house in the summer is seen below.

This electric eye will function in countless ways. For example—it may spell the doom of the doorkey. Instead of fumbling for your key in the wee hours, just play the proper code of dots and dashes on the keyhole with a flashlight picked from the door jamb. Presto, the door flies open.

Planning a trip to Cleveland, Chicago, and points west? At the turn of a switch the weatherman, figuratively speaking, will appear. An automatic reading, motivated by the reaction of the sensitive photo-electric cell to atmospheric conditions, will indicate what weather you may expect.

Indoor weather, according to prophet Hibben, will be entirely artificial. The air we breathe in our homes and offices is to be electrically treated, free of dust and of disease-bearing germs. Though no windows need be used to bring in sunshine, ultra-violet sunshine will play upon us at our command.

"Windows, as means of ventilation, will no longer exist. They can be superseded by glass partitions, running along the top third, or in fact all of the wall to allow light to penetrate. Of course," he continued earnestly, "this will radically affect the building construction and provide the architect with almost unlimited play for his ideas. He will no longer be restricted by the ever important question of adequate support for window casings.

"The plan of sealed window space is no phantasy. Already the large Pittsburgh and Lake Erie Railroad office building in the Smoky City ventilates its rooms entirely through registers. All windows are permanently closed. The smoke and soot coming from the nearby coal yards can not penetrate within. And the manufactured air in the rooms is much purer than that breathed by you and me. Ozone can purify it; germs and dust are taboo. ultra-violet will furnish health containing properties." (*Continued on page* 256)

King of Mediums Made Ghosts to Order

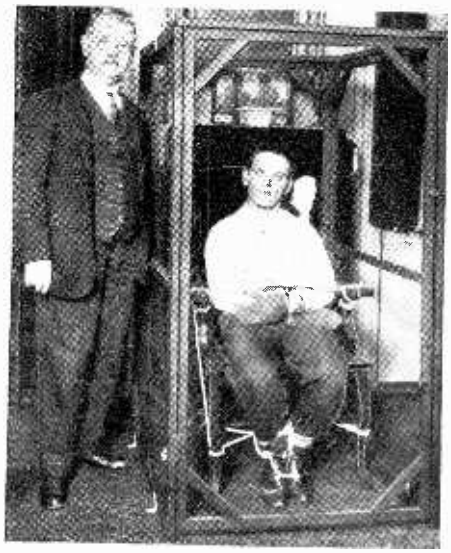
Nino Pecoraro, Spirit Medium for Eleven Years, Who Sat Before the Late Sir Arthur Conan Doyle, Famous Spirit Investigator to Demonstrate His Supernatural Ability, Now Confesses That Everything He Accomplished Was Achieved Without the Aid of Spirit Force

By Dunninger

"I NEVER saw a genuine ghost in my life, and I don't believe that any one else ever did." This quotation recently came from the lips of the once world famous medium, Nino Pecoraro. To my mind a statement of this character, coming from the lips of anyone else, would simply mean that the person making it had a good sound mind and knew what he or she was talking about.

But coming from Nino, it spells a turning point in present day spiritualistic history. For eleven years, this odd, mystic-looking little Italian gentleman has caused the ghosts to walk. Scientists throughout the country have sat for hours, many times in dimly lighted rooms, before Nino's curtained cabinet, awaiting the appearance of a ghost's hand, the sounding of a trumpet, or perchance, a life-size manifestation of some celebrity who had passed to the realm of the great beyond. Spiritualistic journals throughout civilization sang praises of the marvelous spiritualistic powers of Nino. Lecturers, among the believing element, have often told thousands of interested listeners their experiences at Pecoraro's many successful seances.

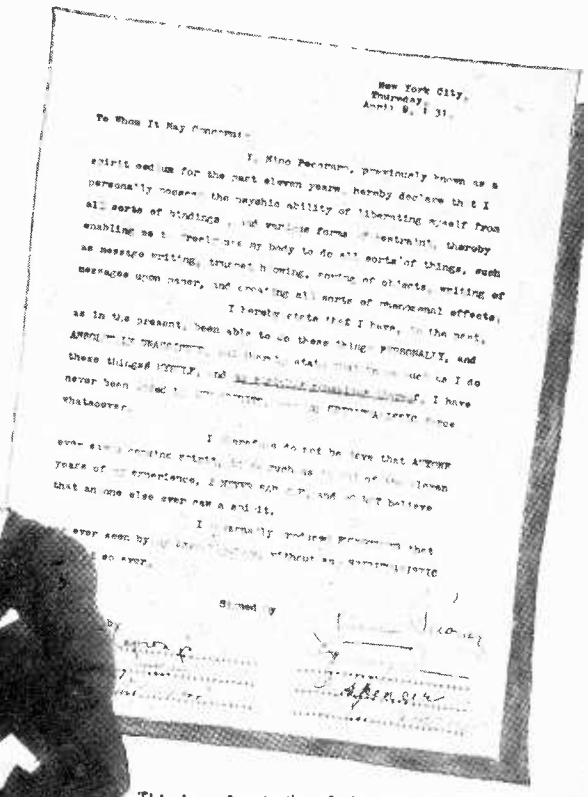
On four occasions Nino has attempted to collect the $21,000 prize offered by *Science and Invention*, of whose psychical Investigating Committee I am chairman. Needless to say, Nino has failed on each occasion not because of the lack of interesting phenomena that he produced, but simply because there was nothing about his manifestations that we considered supernatural or spiritual. We ourselves had no difficulty in reproducing all of the many things he offered as spiritualistic proof.



Nino Pecoraro bound fast to a chair in a sealed wire cage, as he sat before Hugh F. Munro (to the left), an investigator for the Philadelphia Branch of the Psychical Research Society. Munro believed phenomena genuine.

To the right is Joseph Dunninger, Chairman of the Psychical Investigation Committee of Science and Invention.

Pecoraro proving his ability to free his hands of gloves that have been sewed fast to his shirt sleeves. He is completely bound during the test.



This is a facsimile of the signed confession of Nino Pecoraro, in the possession of Joseph Dunninger, who was one of the witnesses.

This publication has in the past carried numerous illustrated articles, which proved beyond contradiction that the writer had submitted himself to be bound in a fashion similar to that in which Pecoraro was secured, and duplicated Nino's entire performance by purely natural means.

The late Harry Houdini had often witnessed the work of Nino Pecoraro, and, in fairness to this past genius of spiritualistic investigation, it is but just to note that Houdini was not mystified by Nino's ghost parade. Many years ago Houdini confided to the writer that he suspected that Nino's ability to mystify lay in his power of self-liberation. So the remarkable statement that Nino Pecoraro has broadcast throughout the world tosses a bombshell into the very foundation of fraudulent mediumship, and shatters its artificial shrine.

Had Nino simply been a medium, as the majority of spirit demonstrators are, content to offer his wares in some side street to avoid undue suspicion and publicity, his name would probably be associated with the thousands who are at this time making a comfortable livelihood, and a little more, from the business of bringing spooks back to the earth plane at so much per head. Yet this was never Nino's intention. A higher aim, at all times, urged him on, and so it may be said, in fairness to our little mystic, he not only ranked high among the various spiritualistic clans throughout the nation, but flaunted his ability to such an extent as to completely mystify the late Sir Arthur Conan Doyle.

Unfortunately, Nino's confession seems to prove that the great writer possessed the mind of Dr. Watson, rather than that of Sherlock Holmes. For had he observed as closely the work of Nino, as his phantom, Holmes, would have done, he would not have written as he did of Nino, in one of his late works on spiritualism, entitled "Our American Adventures." On page 38 of this book, Sir Arthur begins a lengthy description of Nino's seance, in these words: "I thought the youth was a true medium, and might develop into something remarkable." In another paragraph, Doyle describes weird, spiritualistic breezes. (*Continued on page* 258)

How and Why Tools Cut

The Razor Blade You Use Must Have a Rough Edge If You Want a Smooth Shave. Tool Edges Must Have Definite Shapes to Properly Do the Work for Which They Are Intended

By Alfred S. Kinsey

Professor of Shop Practice, Stevens Institute of Technology, Member American Society Mechanical Engineers

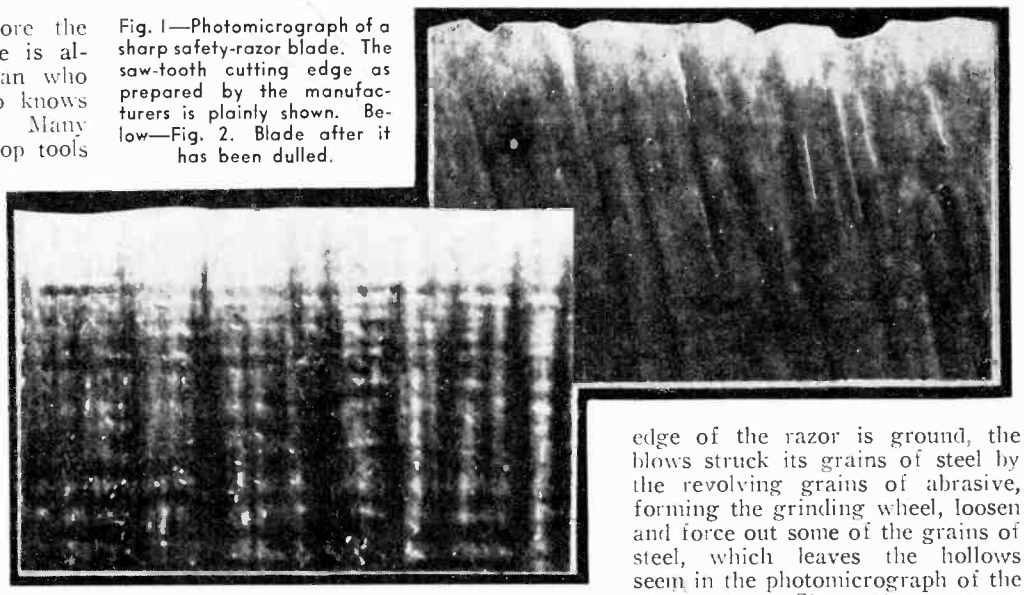


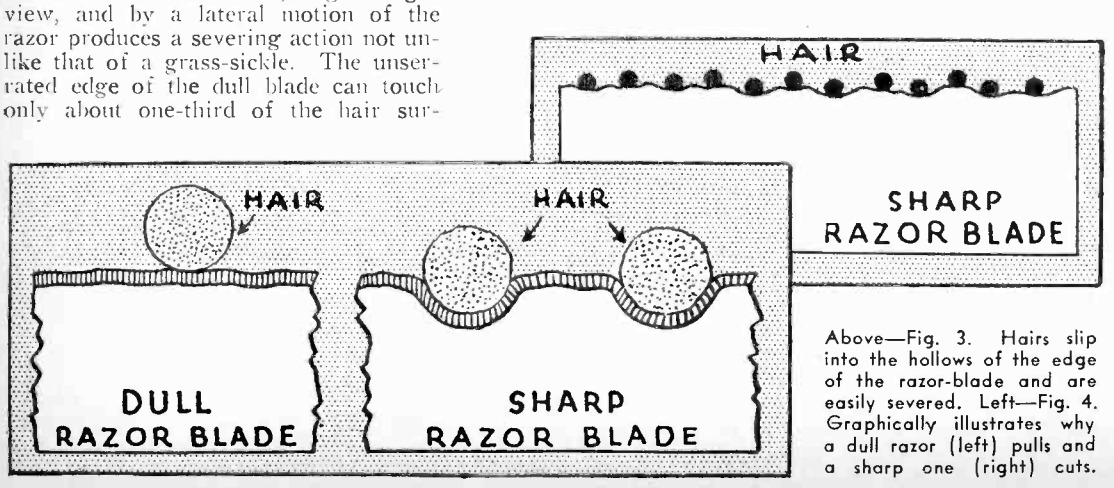
Fig. 1—Photomicrograph of a sharp safety-razor blade. The saw-tooth cutting edge as prepared by the manufacturers is plainly shown. Below—Fig. 2. Blade after it has been dulled.

AN office calendar once bore the printed challenge "There is always a job for the man who knows *how*, but the man who knows *why* will always be his boss." Many men know how most of the shop tools work, but when the tools get dull and need reconditioning, too often there is confusion and lowered efficiency of the action of the tools, due to a lack of understanding of *why* they did the cutting so satisfactorily when new.

Almost anyone would know that a cutting tool should be kept sharp, and the man who is most interested in such a tool probably is the fellow who shaves his own beard. The razor must cut *smoothly*, even though the original meaning of the word *shave*, from its Russian-Latin derivatives, *Kopate* and *Scabere*, indicates that the tool was only intended *to dig, to scratch, to scrape*.

A glance at the photomicrographs of two safety-razor blades, Figs. 1 and 2, reveals why such a tool cuts. The edge of the blade shown in Fig. 1 with its hills and hollows, is in the sharpest condition and ready for use, as prepared by the razor manufacturer, and Fig. 2 shows the same edge after it has been worn dull. As the sharp blade is drawn against the hairs they slip into the hollows, so that at least half the contour of each hair is in contact with the keen edges of these teeth-like serrations, Fig. 3. This increases the amount of cutting edge which touches each hair, Fig. 4 right view, and by a lateral motion of the razor produces a severing action not unlike that of a grass-sickle. The unserrated edge of the dull blade can touch only about one-third of the hair surface contacted by the hollows of the sharp razor, and therefore requires a proportional increase of pressure per square inch of blade against the hair. Furthermore, practically no lateral severing action is obtained. Hence a dull razor *pulls*.

To one interested enough to wonder how the serrations came in the cutting edge of the razor, it might be explained that the steel of the blade is composed of grains having from five to eight flat sides. They are held together by cohesion, which in this tool is so powerful that it would require a force equal to at least 100,000 pounds per square inch to pull them apart. However, when the edge of the razor is ground, the blows struck its grains of steel by the revolving grains of abrasive, forming the grinding wheel, loosen and force out some of the grains of steel, which leaves the hollows seem in the photomicrograph of the razor edge. Sharpening a razor on the canvas side of a strop will continue to pull out any loose grains of the steel edge, and so long as this continues the razor remains sharp. Some of the grains on the edge of the razor may have been partly disarranged by the grinding, honing, stropping, and may lie somewhat askew. When the blade is passed over the leather side of a strop these misplaced grains are caught in the soft leather and pulled out, giving the razor the fine edge often desired for a finish shave, but which is not so efficient for a stiff beard as the rougher edge. A dull razor is one which has no more grains at its edge loose enough to be pulled out by a strop, and it must go to the honing stone for such degraining. Should this fail, the grinding wheel must do the work. Quite a discussion just for a razor edge, one might conclude, but the fact is that the same principle of action holds good for all edge tools.



Above—Fig. 3. Hairs slip into the hollows of the edge of the razor-blade and are easily severed. Left—Fig. 4. Graphically illustrates why a dull razor (left) pulls and a sharp one (right) cuts.

So, possibly this homely description of why one of the best known tools cuts may arouse a greater interest in the cutting action of other com-

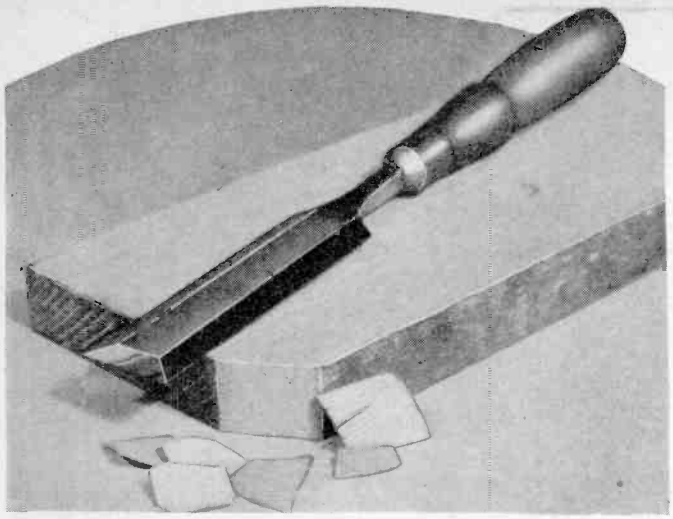


Fig. 6. Paring wood chisel. The two coarse grain chips on the right were made by a straight downward stroke. The smooth ones at the left were produced by a combined downward and sideways stroke.

mon tools. Over in the shop may be found a familiar tool which operates much like the magnified razor blade edge—the wood handsaw, Fig. 5. It is of carefully studied design and construction, and when in good order does remarkably clever work. Take the cross-cut saw. It is a combination of knife and chisel, for to operate properly it must sever the fibers of the wood first on one side and then on the other as each tooth is brought in action, and then the beveled top of each tooth chisels off the intervening wood. The alternate bending of the top of each tooth to the side provides for a saw slot, *kerf*, of sufficient width to let the blade pass through without binding on the sides. Hence a cross-cut saw cuts because 1—its teeth are filed to the right angle to sever the fiber with the least amount of effort; 2—the teeth are given sufficient set to clear the blade from any binding action of the sawdust, and 3—the *gum* of the blade, bottom of the teeth, is of rounded shape and not a sharp vee, so that the sawdust will not become wedged there. This fine combination for efficiency may all be upset, when the saw becomes dull, by refiling the teeth at the wrong angle, making the set uneven, and giving the gum a sharp vee form. A good saw blade is of the finest quality steel, heat-treated according to the best metallurgical knowledge, often hand-smithed, hand-blocked, hand-ground, hand-filed, and hand set. In some cases machinery does most of the work. By either practice, the thought and skill embodied in an ordinary handsaw call for the workman to keep the original design unchanged and its operating parts in good order. That cross-cut saw lying upon the bench came a long journey from the iron ore mine, by way of the steel mill and the factory, and had to pass more than 20 tests by its makers before being released for its many years of service. It never was intended to be used to make sawdust.

Again, another tool from the carpenter's set is worth at least a short study—the wood chisel, Fig. 6. The chips on the left show the tool performing at its best, severing the cross-grain fibers by a combined downward and sideward motion, not unlike the razor cut. The surface is left smooth. The chips on the right show a coarse grain, the fiber somewhat torn, and the surface of the wood is quite rough. Why this tool cuts efficiently when given the double-motion stroke is chiefly due to the fact that its 25 degree beveled edge has fine teeth like the razor blade and the saw which cut the wood fiber by a severing action. The quality of steel which is most suitable has been determined by many years of study of the tool's requirements, and its hardening and tempering are accomplished by the best heat-treatment methods. To give a tool of this character the proper amount of tough-hardness, it must be heated slowly to exactly that point at which the carbon in the steel changes its position between the grain surfaces and locates itself between the crystals of each grain, thus forming the desired iron-carbide condition. Then in order to retain the carbon in this state, quick cooling of the metal is necessary, and it is usually quenched in oil. Now the tool is too hard. It is again heated—but only to the moderate temperature of about 500 degrees Fahrenheit, instead of the former transformation temperature of about 1400 degrees, again quickly quenched in oil, and then given its final grinding. The steel has become a fine-edge tool, simple of shape, but embodying the finest science of design and metallurgical conditioning. And then all that one must do to ruin this fine bit of mechanical ingenuity is to resharpen it by pressing it too hard against a dry grinding wheel and guess at its cutting angle.

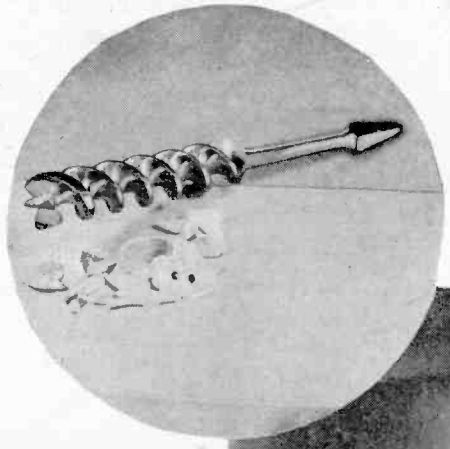


Fig. 7. The wood auger bit. At least forty operations are required to produce this combination of a revolving knife and chisel.

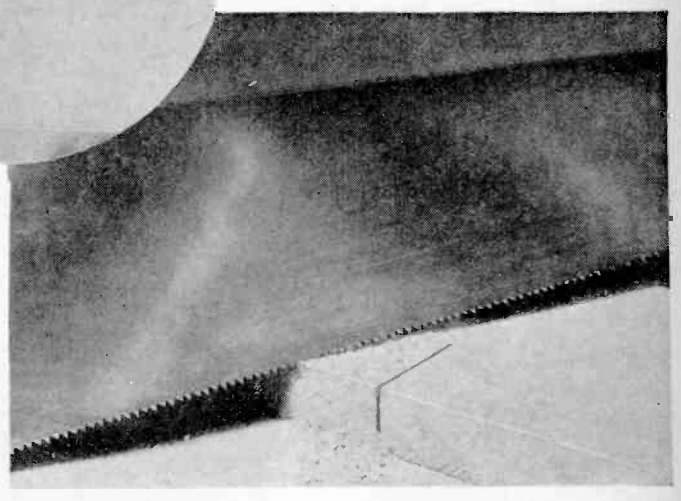


Fig. 5. Cross-cut hand saw. The teeth are sharpened, beveled, set and gummed to effect a combined chisel and knife action on the fibres of the wood.

One of the most interesting tools of the woodshop is the auger bit, Fig. 7. Why it cuts as it passes through the hole it makes is worth considering. This tool consists of a screw point, spurs, cutting lips, a throat, and a shank. It is not necessary to push the point into the wood to start the bit, for the thread on the point will pull it gradually down till the spurs and cutters are engaged. If it should happen to be a No. 16 screw point, it means that the bit will advance into the wood at the rate of 1/16 inch per turn. Some of the points have a single thread and some have two threads. The single thread is for bits being used in pitchy wood where the tendency would be to fill up the thread. Double-threaded points are best for small bits where the amount of metal will not allow a deep single thread to be used. The spurs at the side are for severing the fibers preparatory to the chip-lifting action of the cutting lips. If the spurs are worn or ground too short the cutting action is at once impaired. When the spurs have cut deeply through the fibers, the cutters at the bottom of the point are drawn into the wood at a rate of feed equal to the pitch of the threads on the tapered point. This explains why a heavy pressure on the bit is unnecessary, provided the bit is in good condition. The edges of the cutting lips must be level, or one will do more cutting than the other, which may give chip trouble in the throat. The throat of the bit is necessary to provide a way to get the chips out of the hole. It is a miniature spiral conveyor. The accuracy of operation of an auger bit is made more sure by its *hang*—the proper balancing of its metal around a center line passing through its full length from shank to screw point. This will (*Continued on page* 249)

Clouds that you cannot see can be photographed by infra-red light. This is an example taken on an Eastman Extreme Red Sensitive plate exposed through a No. 70 Wratten filter for 1/5 sec. at f/4.5.

The World of Black Light

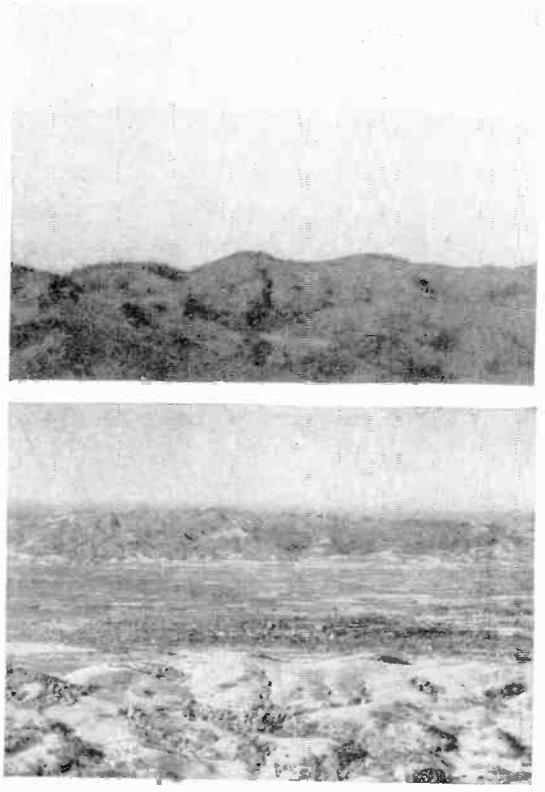
The Ready Availability of New Films and Filters Opens Up New Possibilities for the Amateur Photographer, Who May Now Make Pictures Very Simply by Ultra-Violet and Infra-Red Rays

By Walter E. Burton

SCIENCE and industry are peeking around the corner into an invisible world, finding new tools with which to work and discovering how to do things that a short time ago would have been considered impossible.

This new region which looks so promising is the world of black light. Our eyes see only a very small portion of all the light that there is. The short-wave ultra-violet and long-wave infra-red do not register. It is exactly as if you were standing in a street in a dense fog. You could see a few feet ahead of you and a few feet behind. Beyond that would be invisibility. Then, if someone were to place a magic glass in front of your eyes, you could see far down the street into the infra-red region; another magic glass and, turning, you could see just as far in the opposite direction—into the ultra-violet realm.

Because the human eye is limited in its abilities, science has adopted the camera as a companion in exploring beyond the edges of sight. Captain A. W. Stevens of the U. S. Army Air Service, flying recently in an airplane high above a bit of South America, took pictures of the Andes Mountains nearly 350 miles away. The resulting photographs showed distinctly the mountain ranges with their blanket of snow; but when Captain Stevens examined the prints, he saw something else: the curvature of the earth was distinctly visible! This was the first time that the roundness of the earth had been proved by photographic means. When making the pictures, Captain Stevens could not see the mountains because of the miles of atmospheric haze. But his camera carried a special film and had a magic red glass over its one eye. Thus, while the photographer saw only the atmosphere by visible light, the camera, by invisible infra-red rays, saw the mountains and the curving earth between them and the plane.



San José, California, as photographed from Mount Hamilton; top picture, with violet light; lower picture, with infra-red light. The obliteration in the upper picture is due to the hazy atmosphere. San José (in middle distance) is 13½ miles from the camera.

High-speed photography by infra-red light has been possible for only a relatively short time. R. W. Wood, Professor of Experimental Physics at Johns Hopkins University, and regarded as one of the foremost authorities on invisible light, found that by using color-sensitive plates and dense red filters, he could make pictures of landscapes that were totally different from the ordinary kind. On a bright, sunny day, the sky photographs black while green grass and tree leaves reproduce white, as if covered with snow. Also, there is an almost total absence of atmospheric haze.

Professor Wood explains that the black sky results from the failure of the atmosphere to scatter long rays of red light, while green leaves reflect them very powerfully or, rather, transmit them, because it is a matter of pigment or transmission color. Also, shadows

appear a deep black, because most of the light comes from the sun and none from the sky. It is exactly as if the picture were made on the moon where there is no atmosphere.

It was several years ago that Professor Wood made his first infra-red picture. He had to expose it for a long time; and when he made the picture, there was not an immediate possibility that the process would be of very great commercial value.

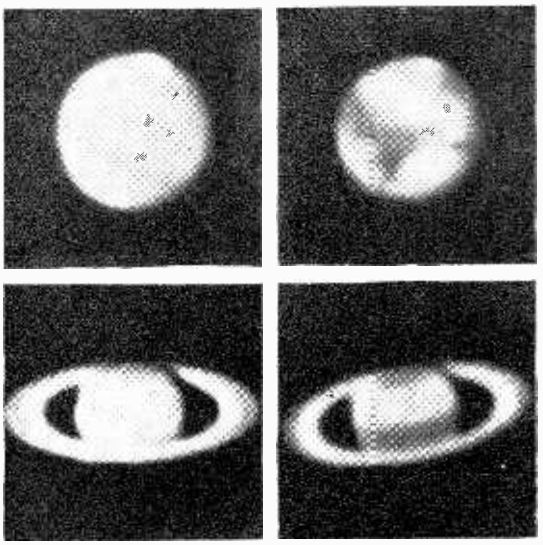
Not long ago, however, motion picture producers decided that it would be both economical and convenient if "night" pictures could be made in the daytime. Professor Wood's black light landscapes were recalled, and the method he used was applied to the motion picture camera.

Now, when it becomes necessary for the hero of a thriller to gallop wildly across a moonlit desert in time to rescue the heroine, the motion picture cameraman loads his magazines with color-sensitive film, puts a dense red filter over the lens, and grinds away, perhaps sweating profusely under the noonday sun. When the audience sees the picture, the sky is dark, the shadows are dense, shrubbery stands out with striking radiance . . . in short, the moonlight effect is perfect.

Architects frequently experience difficulty in obtaining satisfactory photographs of building details where lighting conditions, as judged by ordinary standards, are unfavorable. If you have ever tried to photograph a white marble building against a brilliant summer sky, you will understand this.

But by using infra-red light, architectural photographers can work magic with their cameras. White marble ruins of ancient temples can be photographed against a black sky. Details of weathered inscriptions and sculptural work almost invisible to the unaided eye sometimes can be reproduced clearly. Only a beginning in this field has been made. The possibilities are endless.

Of a similar nature is the photographing of oil paintings by invisible light, both infra-red and ultra-violet. A skillful photographer can prove beyond a doubt whether or not an old master is really as old as it appears, or whether it is a picture that has been altered since it first was painted. In many instances it has been found that there was beneath the visible picture another and wholly different one; or it has been revealed that the artist changed his mind several times in making the picture, and painted over an arm or a leg in order to alter its position or shape.



Above—Mars photographed by (left) ultra-violet and (right) infra-red light. The comparison between these two pictures and those of San José on the opposite page is suggestive of the presence of an atmosphere of considerable density on Mars. Below—Saturn photographed (left) by yellow light, showing light belt at the equator, and (right) by ultra-violet light, showing dark belt at equator, indicating that something at the equatorial region, or between it and the earth, is absorbing ultra-violet light.

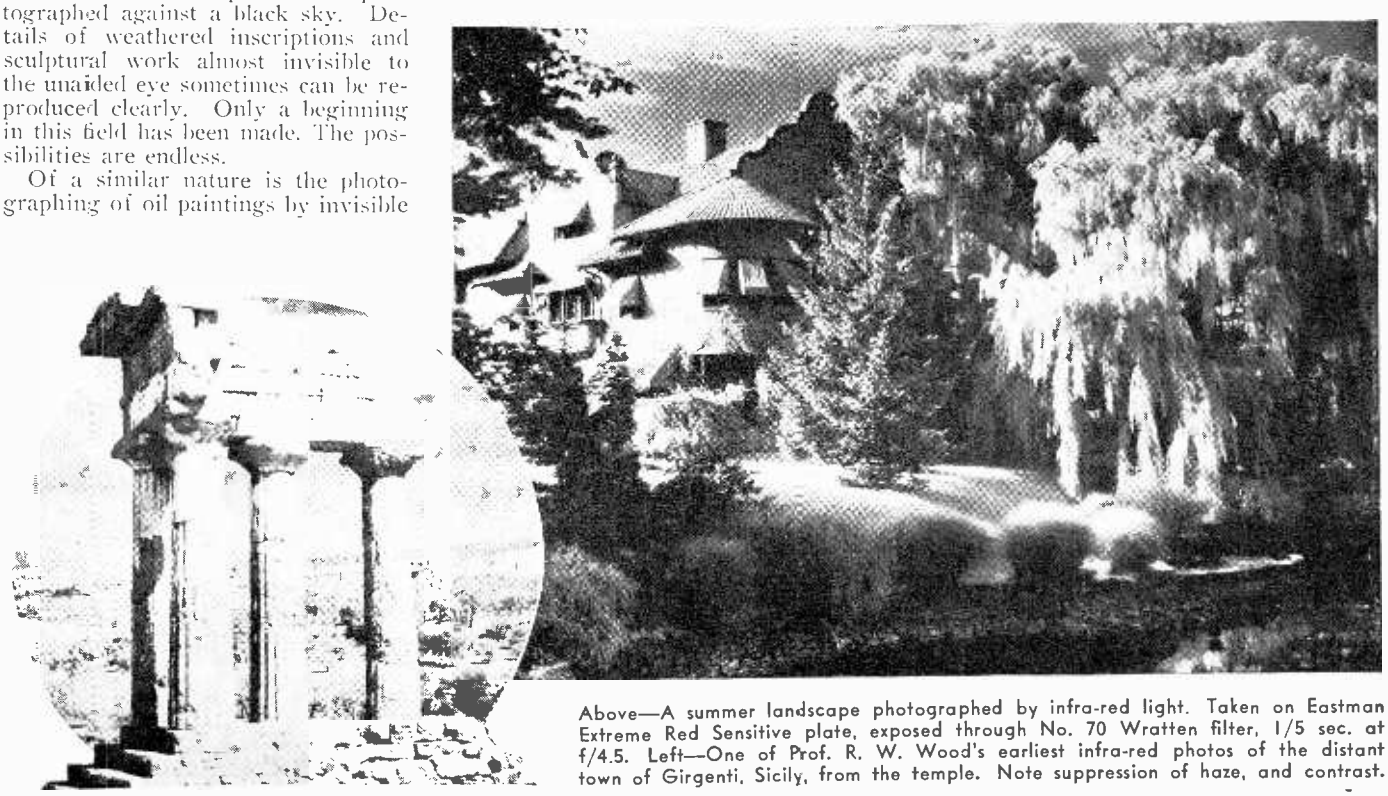
The human skin reflects red light strongly. For that reason, portraits made by infra-red illumination have an appearance that is "different," to say the least. Blue eyes, black eyes, and bluish-gray ones photograph jet black, like holes in the head. Shadows are jet black, the hair usually reproduces the same way, facial wrinkles are accentuated, and the face appears a ghostly white. The portrait as a whole is totally different from the everyday kind.

Because an infra-red portrait usually warps the sitter's features to such an extent that he is almost unrecognizable, this form of picture-taking probably will not become widely popular. However, it may prove of value in the field of criminal photography, or in medical research.

It is under the influence of ultra-violet light that the skin acts in the most unusual manner. It gives off light! That is not strange, when it is remembered that ultra-violet light makes nearly every other substance fluoresce—give off visible light of one color or another. One material will shine with a brilliant green when bombarded by invisible ultra-violet rays, another will appear violet, and a third a deep blue, and so on.

The skin of a blond shines with a different light than that of a brunette. This suggests at once a means of distinguishing synthetic blonds from the genuine article, something that may some day serve to determine the outcome of a criminal trial.

But it is the physician who is among those most likely to find ultra-violet light of great aid. The office of the skin specialist of the future probably will contain a camera, a dark room, and accessory (*Continued on page 260*)



Above—A summer landscape photographed by infra-red light. Taken on Eastman Extreme Red Sensitive plate, exposed through No. 70 Wratten filter, 1/5 sec. at f/4.5. Left—One of Prof. R. W. Wood's earliest infra-red photos of the distant town of Girgenti, Sicily, from the temple. Note suppression of haze, and contrast.

Breeding Butterflies For a Livelihood

There Are All Kinds of Ways of Making a Living and All Kinds of Farming, But This Article Describes the Unique "Butterfly Farm" of an Englishman Who Makes a Living by Breeding Butterflies

By L. Hugh Newman

Mr. L. W. Newman's butterfly farm at Bexley, Kent, near London, has many novel features, one being the large muslin bags which are placed over the numerous trees to protect the feeding caterpillars from birds.

IN the quiet little village of Bexley, in Kent, only a few miles from the roar and bustle of London, is a most unusual business, namely, the raising of butterflies. Over thirty years ago Mr. L. W. Newman conceived the idea of turning his hobby, which was breeding butterflies and moths, into a commercial enterprise. In that time the business has grown to such an extent that every year thousands of live eggs, caterpillars and chrysalides, not to mention the set specimens, are sent by post to all parts of the world. Museums are supplied, schools and colleges are catered to, and art classes use many of these beautiful butterflies for decorative studies. So, too, is the butterfly house of the Zoological Society of London supplied with live specimens during the summer months.

Life on the butterfly farm is extremely strenuous for Mr. Newman and his staff in the summertime. Every day, Sundays and holidays included, there are thousands of hungry little caterpillars to be fed, and there is no respite for the one who throws in his lot with a butterfly farmer from June to September. During the winter months, when all the lepidoptera world is sleeping, either in the form of ova, which are the eggs of the insects, hybernating larvae, known as caterpillars, chrysalides, or, in a few cases, the perfect insect, then the specimens bred the preceding season are mounted and the stock is arranged for the busy days that come in the Spring.

A Poplar Hawk moth, showing the peculiar sitting attitude.

Mr. Newman inspecting the cages in which his butterflies lay their eggs.

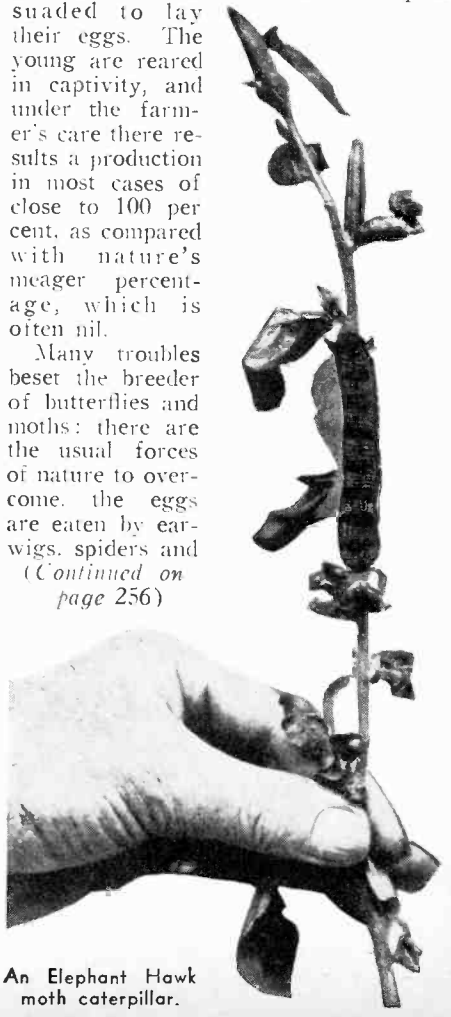
The first spring-like day in March, when the air is warm and green appears in the hedgerows, the butterfly farmer sets out collecting. Equipped with a satchel of pill boxes and a butterfly net, he mounts his bicycle and rides to the little lonely lane he knows about, where tiny larvae of the garden, and cream spot tiger, lappet moth, oak eggar, and many others, can be found basking in the sun or feeding on the tender leaves of weeds which grow along the banks of the lane.

These hibernated larvae after their long dreary winter of exile and fasting are quite easy to find, although they occur only in certain localities, and can generally be found in the same lanes every year. If civilization should intrude and the lane is asphalted, all caterpillar life is at once destroyed. This is due to the fact that the dust, contaminated with tar, settles on the leaves of the weeds and other food plants and poisons the larvae.

Another branch of the butterfly farmer's activities on these collecting trips consists of catching wild females for stock. These butterflies are taken home and under ideal conditions are persuaded to lay their eggs. The young are reared in captivity, and under the farmer's care there results a production in most cases of close to 100 per cent, as compared with nature's meager percentage, which is often nil.

Many troubles beset the breeder of butterflies and moths: there are the usual forces of nature to overcome, the eggs are eaten by earwigs, spiders and

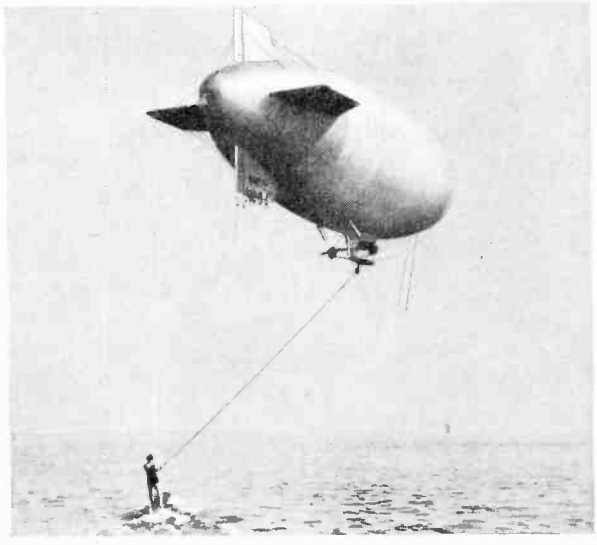
(Continued on page 256)



An Elephant Hawk moth caterpillar.

IN THE SPOTLIGHT OF SCIENCE

For Aquatic Sport—Blimp Aquaplaning



THERE'S something new for water sport enthusiasts. We've all been thrilled time and again—by the breath-taking stunts of Malcolm and Dick Pope, Jack Kerr and Harrison Fraser. These dare-devils originated the famous jumping boats that fly through the air, leap walls of fire, smash paper hoops; races in swimming pools with tiny speedy outboard motor boats; craft with wings which actually rise above water, aquaplanes that fly up and over slanting platforms, carrying the skillful jockey for a 30 foot air journey. Aquaplaning, aquaskiing and now—blimp aquaplaning.

This latest sport for the thrill seekers was introduced recently at Long Beach, Calif. by Elmer Beck, holder of the world's aquaplane endurance record of 24 hours. He stood smilingly upon his aquaplane and was towed by the blimp "Volunteer" as it flew over the waves at the rate of 45 miles per hour! Here's a good action shot of the champion as he sped behind his gigantic aerial tug.

Conquering Snowbound Mountain-Barriers

HIGH up in the Caucasian Mountains, surrounded by towering peaks that have defied mankind for centuries, lies Swanetea. This region is inhabited by romantic tribes that live in medieval stone houses, each crowned with a tower. They are autonomous, having preserved their independence because the rest of the world is unable to penetrate to their mountain fastness in the winter, and there is but one route, through the Latpar Pass, by which they can be reached in summer. This trail is beset with danger; should a man or pony slip on a loose stone along the narrow mountain path, he would fall to certain death on the rocks 500 feet below. In winter, the snow is waist deep. Recently a group of Young Communists made the perilous trip across the peak in the dead of winter.

New Amphibian Motor Car

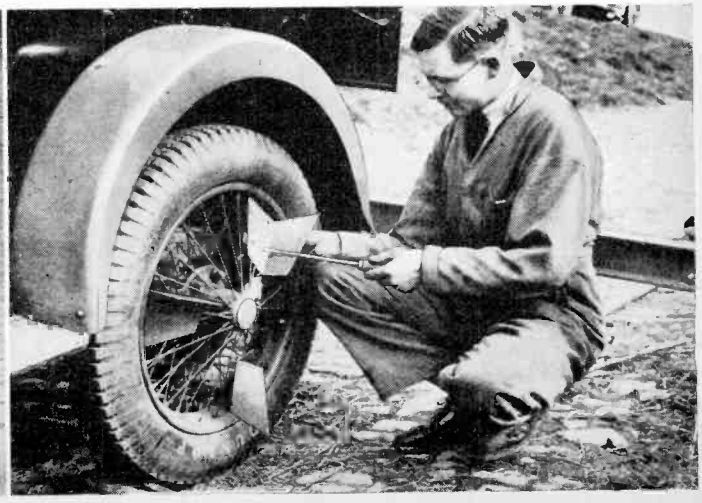
LAST month, in our *Spotlight of Science*, we featured a motorcycle-motorboat combination that made traveling over land and water easy. On land, the motorcycle towed the boat which was carried on a trailer; on water, the boat did the work.

The English automobile pictured is a very great improvement over this makeshift. This original car, designed to cross the deepest river without use of boat or raft, was constructed by Riley, and launched and tested on the river Severn, near Worcester, England.

When it is necessary to cross a body of water steel plates are fastened to the rear wheels so that they act as a pair of paddle wheels. A detachable frame which carries four large air bags floats the machine at such height that the water does not reach the engine.

The photograph to the left shows the amphibian car in the water directly after it was launched. The one to the right shows the driver attaching the paddles to the wheels of the car, prior to the launching.

This model is one of two which will leave shortly on a 12,000 mile trade promotion tour of Europe and Africa. The expedition is headed by Captain Geoffrey Malins, explorer and moving picture photographer, who, with a few expert salesmen will demonstrate to Europe and Africa that British goods, particularly vehicles, can hold their own.



Barrel Boat Puts to Sea

WE certainly hope that Richard Bartell, who was in training with the Phillies at Winter Haven, Florida, knows how to swim. Because if he doesn't we have an idea that this National League Club will be in the market for another shortstop soon.

His favorite sport seems to be riding the waves of Lake Howard in this novel contraption, consisting of some old planks, a barrel cut out on top, and the inevitable outboard motor.

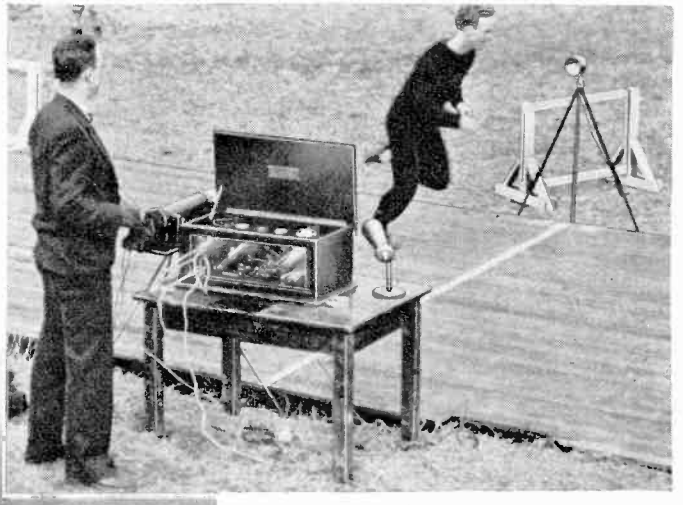
Photo-Electric Eye Accurately Times Races to One One-Hundredth of a Second

WE'LL soon have photo-electric cells installed in every nook and cranny. They are already being used to open garage doors automatically at the approach of an automobile, to noiselessly and efficiently move the swing panels in restaurants so that the hurrying waitress need not be afraid of upsetting her tray, to sound burglar alarms and for a multitude of other things. It will be remembered that a photo-electric cell was used to guard the Shah of Persia's treasures at the recent exhibitions at the London Museum.

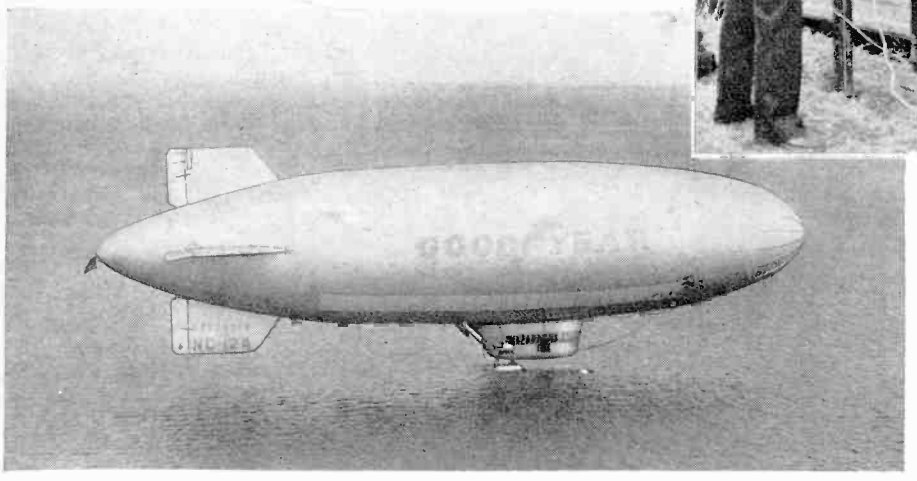
Now the electric eyes are finding a most welcome place on race tracks. There will be no question of whether any particular contest is finished in 2 minutes 6 seconds or 2 minutes 6 1/100 seconds, because this new application of the photo-electric cell will enable the officials to accurately register the time to one one-hundredth of a second.

The one we see here is called a "racing ray," and is installed on the cinder track at Haverford College, Pa. It projects a beam of light across the course, and, as the sprinter flashes past, the shadow of his body intercepts the beam and the time is instantly recorded.

The shadow of the runner's body intercepts the beam of this "racing ray" machine and the exact instant of time is recorded.



Landing a blimp at sea is no simple task. the Goodyear "Defender" landed a short while ago off the Bay of Biscayne, and rose again.



Dreams Cost Millions

SOME people live all their lives in a dream. This substitution of make-believe for reality may make their lives bearable, but it costs the United States a million dollars a day. So says Dr. R. G. Hoskins, of the Worcester, Mass., State Hospital.

The dream state is a mental disease called *dementia praecox* or *schizophrenia*. Chronic sufferers continuously occupy approximately one-fifth of all the hospital beds in this country; untold numbers are cared for by friends.

The chief cause of the disease is a loss of the patient's self-respect, usually due to his failure to measure up to the standards he has set for himself. To escape from the unbearable thoughts of his own worthlessness he retires into a dream state, which ousts altogether his normal, common sense appreciation of the world as he must face it. The proper treatment, Dr. Hoskins suggests, is to restore the victim's self-respect.

Blimp Lands Successfully at Sea

THE Goodyear blimp "Defender" was the subject of an unusual experiment that turned out very successfully, fortunately, for the crew of the ship. She was landed in Biscayne Bay, off Miami Beach. The "Defender" was specially equipped with two pontoons and used a large inflated canvas bag as a sea anchor for the test.

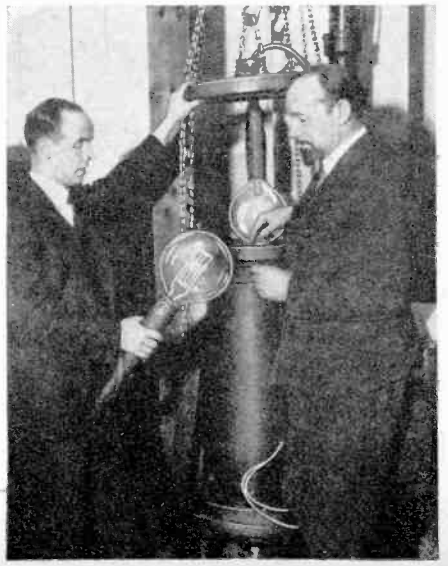
This is not the first time that a blimp has been successfully landed at sea. The United States Army blimps have made some landings on water, as have the Navy blimps.

In time of war, should it be necessary, a properly equipped blimp will be able to rest on the ocean without damaging either the boat or the occupants of its car. In fact, the craft could rest on a calm sea indefinitely were it not for the fact that it loses buoyancy because of the leakage of the lifting gas.

Arctic Sea Searchlights

HERE we see Captain Sloan Danenhower (left) and Commander Sir Hubert Wilkins (center), of the North Pole Submarine *Nautilus*, inspecting the 5,000-watt lamp for the *Nautilus*, at the Westinghouse Lamp Company, Bloomfield, New Jersey.

This particular bulb has just been subjected to a pressure test, which proved it capable of withstanding a pressure of over 100 pounds per square inch, more than the boat is expected to experience on its trip to the North Pole.

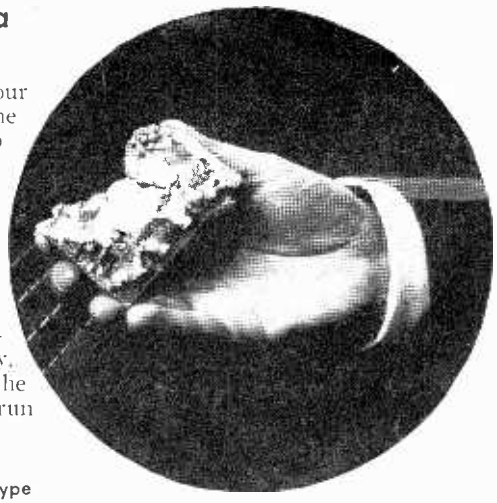


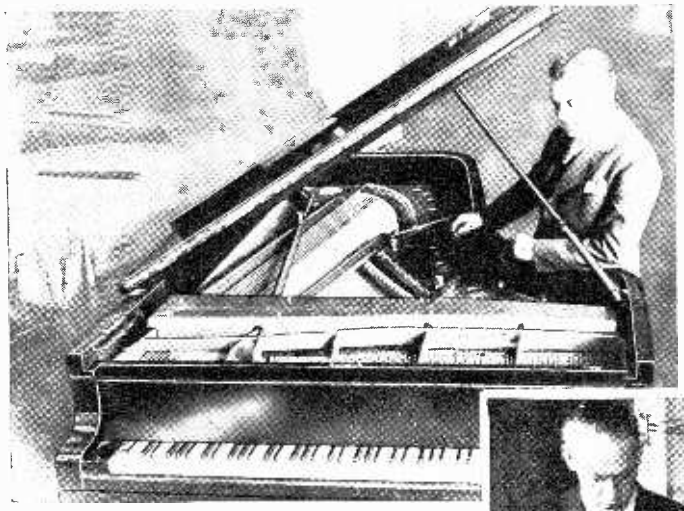
This Piano Eliminates the Mike

MICROPHONES scattered here and yon are taboo in the studio used for transmitting piano selections at the Berlin Broadcasting Station. A new baby grand piano (illustrated) has been installed which requires no microphones to broadcast melodies played upon it. About two-thirds of an inch above the strings of the piano a series of microphonic devices are fastened. Each one is adjusted to serve for a few strings. A player strikes a note, the oscillating steel string generates an alternating current which is intensified in the customary manner by huge amplifiers.

101,000 Miles Without a Repair Tie-up

AN ocean liner would have to sail four times around the world in one year without laying up for repairs to equal the record recently established by the car-ferry, "City of Flint," on Lake Michigan. This boat, owned by the Pere Marquette Railroad, made 1,010 trips in 363 days without a lay-up for repairs. The length of each trip is just 100 miles, making a total of 101,000 miles covered in all. It operated continuously. Only about two hours was spent by the "City of Flint" at the end of each run to load or unload its cargo.





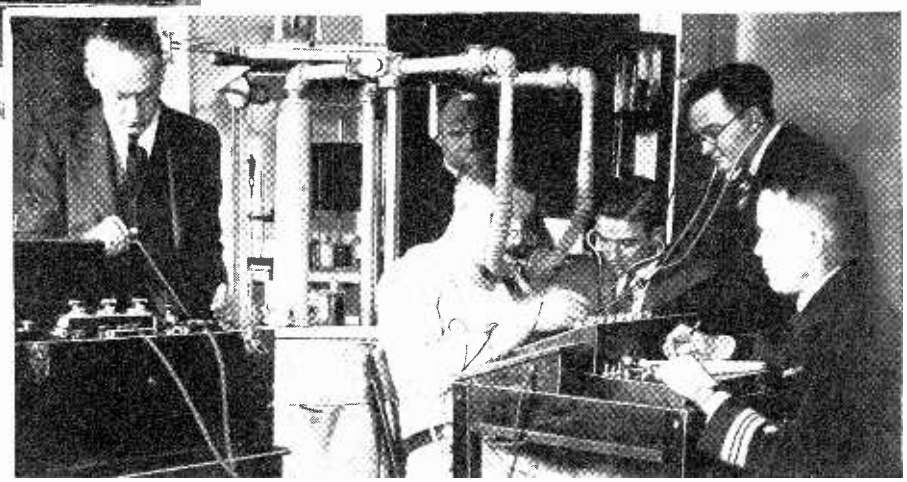
This is the new type baby grand piano which the Berlin Broadcasting Station has bought. No microphone is required for broadcasting.

Aviators being put through the "rebreather" test at the Naval Hospital to ascertain the altitude they can reach safely without artificial oxygen.

World's First Specimen of Distilled Chromium

THIS is the first specimen of chromium ever distilled, held in the hand of L. W. Chubb, director of the Westinghouse Research Laboratories. It was distilled at a temperature about twenty times that of boiling water, in a high vacuum of one-ten-thousandth of a millimeter of mercury.

Metallic chromium is used on a large scale in stainless and alloy steels.

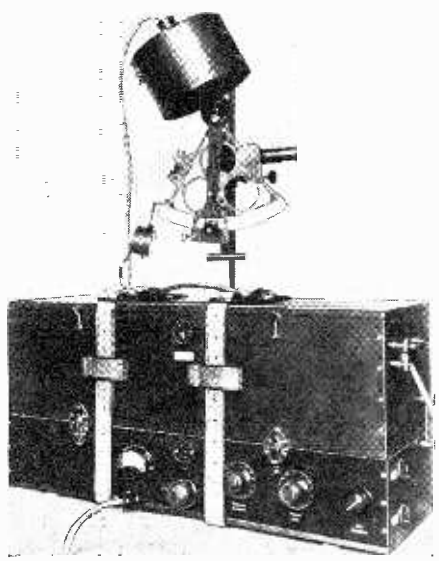


A Guide Through Dense Fog

THAT is exactly what this new fog eye, which Paul Humphrey MacNeil invented, is supposed to be.

Perhaps all-weather sextant is a better name for the instrument. The inventor claims that this apparatus will find the sun under any conditions—fog, snow, hail, rain, sleet—provided the sun is above the horizon.

During a cloudy crossing to New York from Europe it proved its value as a guide to the navigating officers of the *S. S. Mauretania*. Mr. MacNeil made the trip across with his machine.



Giving Navy Fliers a "Rebreathing" Test

PHYSICIANS at the Naval Hospital in Washington, D. C., accord all navy fliers a "rebreathing" test to ascertain the altitude a flier can reach without the aid of an artificial supply of oxygen, and still retain consciousness. They put a clamp over the subject's nose and a tube in his mouth. As he breathes through his mouth, he inhales air from a sealed tank. As the air is withdrawn from the tank the pressure within falls and the air assumes the consistency and characteristics of air found at high levels such as a plane would reach. Finally the air becomes so "thin" that successive lungfuls prove inadequate and the flier loses consciousness. He is then classed according to the amount of time he has had control of his senses.

The ill effects of altitudes, of course, call for special consideration. In addition to diminishing the oxygen supply, the extreme cold and the lowered air pressure are important factors. High altitudes dull the pilot's judgment, bring on drowsiness, breathlessness and muscular weakness, followed by great bodily fatigue. In war time it has been observed that there is a slacking of morale and loss of offensive spirit.

High altitudes and correspondingly low pressures cause the body to deepen respiration in order to secure enough oxygen to maintain its various functions. Simultaneously the heart action quickens, increasing the amount of work to be done by that organ. This entails added oxygen consumption just at the time when the supply is getting lower and lower.

As not all planes are equipped with oxygen tanks, and as quite often pilots must fly high, it is essential to know just how high they can go without losing control of their planes.

Of course, fliers are subjected to many other tests.

Broadcasting From An Automatically Controlled Plane

A TRI-MOTORED Fokker Transport, powered with Wright Whirlwind engines, and equipped with devices to make automatic navigation possible, was used by Lieut. Albert F. Hegenberger to stage an interview in the air.

Two newspapermen were in the cabin with him. They asked questions, which he answered; both were audible to the large radio audience. In addition, a conversation was carried on with General Electric engineers on the ground.

It was merely necessary for the pilot to set his instruments to their proper course and then, while the plane steered itself, devote his attention to the interview. A magneto compass, radio beams to control the course of flight and the position of the plane with reference to all three axes, and a sonic altimeter were used.

This is Berlin's "House of Broadcasting," most modern of all Europe's radio stations.

Granting an interview to the radio audience while a mile up in the air, in an automatically controlled plane.

The "House of Broadcasting" in Berlin

DIRECTLY above is an exterior view of Berlin's showplace—a radio broadcast station that opened this year. It was built from the plans of Professor Hans Poelzig, one of the leading architects of Germany.

The building was erected under the shadow of the 453 foot radio tower on the Berlin exposition grounds in the western part of the city. It houses the offices, broadcasting rooms and experimental rooms.

The main sending room is 131 feet long, 69 feet wide and nearly 48 feet high, the biggest and most modern room of its kind in Europe.

Straight lines and unadorned form which are associated with German style architecture are exemplified in this building. The building is shaped like a triangle.

Its interior has been made as soundproof as possible. Walls, ceiling, and floors are isolated from the outside world and each other. One transmitting room has a movable wall, which can be adjusted as resonance requires. The director of the performance transmits orders from his cell which has soundproof glass walls.

Organ Type Console Controls Lighting Effects

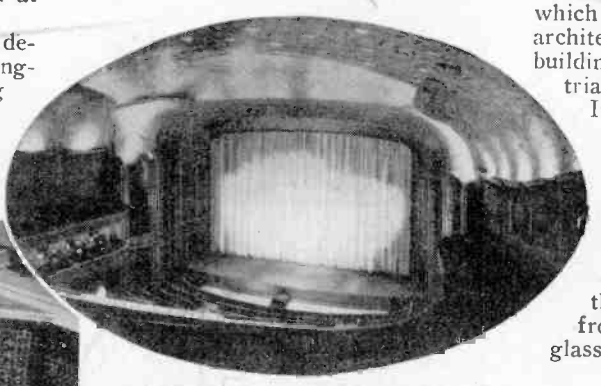
BY means of vacuum tubes a light artist at the color console of the Severance Memorial Hall, Cleveland, Ohio, has the hue and intensity of auditorium and stage lighting at his finger and toe tips, just as a pipe organist finds pitch and volume of sound at his command.

The unique lighting switchboard, designed and manufactured by Westinghouse Electric and Manufacturing Company, is built into an ordinary organ console. It provides for four complete scenes to be called forth at the will of the operator by throwing a switch. The different scenes may form a continuous program, one merging into the other at a predetermined time.

The vacuum tube control scheme is the means of reaching the long-sought goal of proportional dimming, that is, previously set intensities of various groups of lamps keep their same relative brilliance while being dimmed. The light organist at his console is ever the master mind; every circuit remains subject to his will.

Thirty-six main control drums project three-quarters of an inch above the face of its keyboard panel. They control the 110 lighting circuits as the operator fingers them.

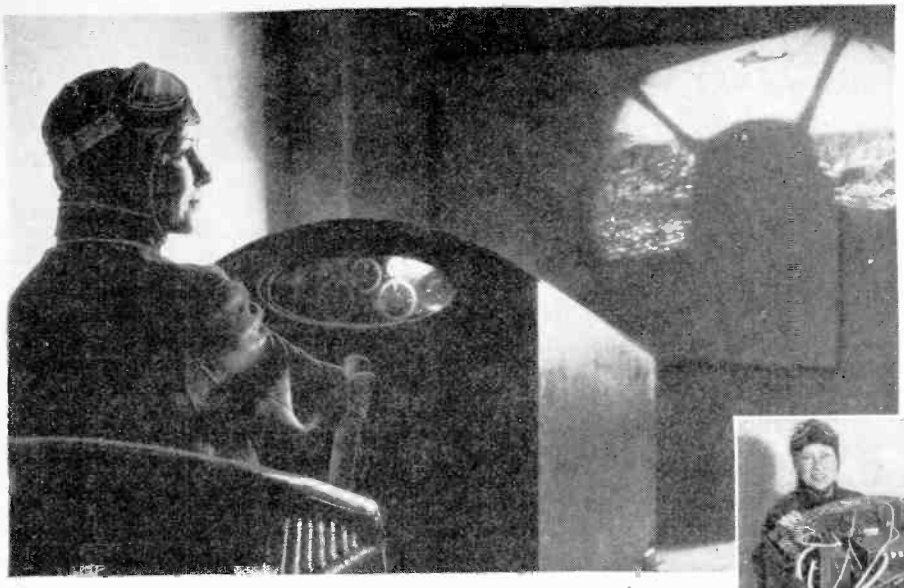
Our photographs give the console in use and the interior of the Cleveland Memorial Severance Hall.

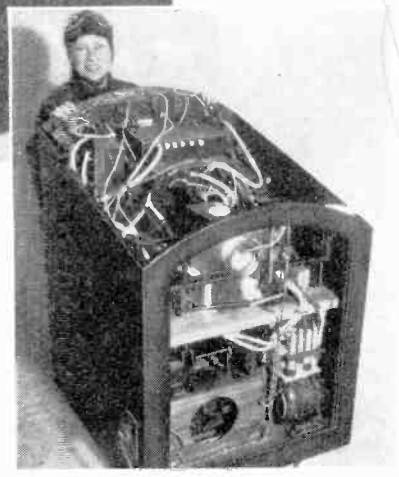


Feel as If You Were Dying?

IF you do, says Dr. J. A. Ryle, you are not. People who actually are dying almost never have the "Angor animi" or "anguish of the soul," which is a mingled feeling of distress and terror, quite unlike any other human experience. Persons who have never felt it can have no conception of its character.

In all probability it means that you are suffering from certain kinds of vertigo, heart disorders like angina pectoris and other diseases. The true cause is a disturbance of specific nerve centers in the lower part of the brain or medulla oblongata, where the brain and the spinal cord are joined.





Robot Teaches Flying in Two Hours on the Ground

"AFTER two hours practice with this equipment it is safe to say that the average student will be able to take a ship out and fly it away—and, what's more, land it safely." So says George D. Besson, the inventor of this robot instructor which takes the place of both teacher and airplane.

By using the machine, it is the inventor's claim you can learn to fly on the ground. It operates automatically under electrical and pneumatic power. The fledgling pilot sits at a standard set of airplane controls—a fast manipulated rudder bar and a "joy" stick. Before him is a full-sized instrument board, containing "blind flying" and motor control instruments. He opens the throttle for a take-off and on the screen before his eyes flashes the picture of a horizon with the silhouette of the plane engine and wing struts in the foreground a duplicate of an actual scene, with a miniature propeller whirling its blades through the line of vision. Manipulation of the controls causes the horizon to shift exactly as it does in flight—dropping if the student pulls the stick back to climb, and moving toward the top of the screen in a dive. The horizon tips to right or left as the case may be as the controls are moved for a turn and bank.

How Mothers Carried Babies

THE evolutionary mystery of how, when and why monkey mothers began to carry their infants in their arms with the child's arms around the mother's neck, as human mothers do, has been revived by observation of a mother lemur and her baby, recently born in the London Zoo.

The lemurs are remote relatives to monkeys. This lemur mother carries her offspring on her stomach, partly held by her arm and hand, the baby lemur clings to the mother's fur by its own tiny hands.

All monkeys, on the other hand, carry their babies exactly as human mothers do. At some critical time in the evolution of the monkey family, the tribe split from the lemur and this change was affected. A plausible suggestion is that the change must have occurred when monkeys began to leap from branch to branch instead of merely crawling along the ground.

Art of the Future

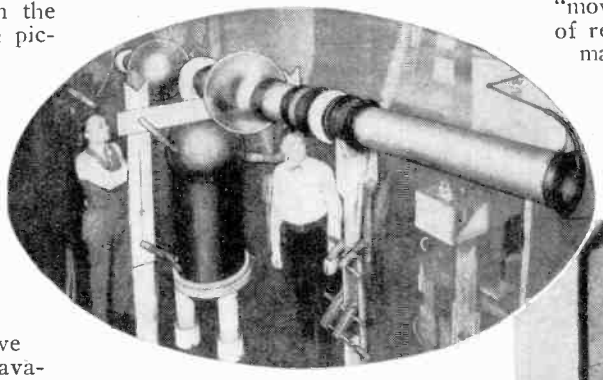
AN invention which may portend a new era in the plastic field of art has recently been developed by Alexander Archipenko, noted exponent of the modernistic motif in sculpture and painting.

The invention is one of the first "moving paintings" made. It is capable of revealing on one of its two faces as many as 32 designs and paintings, constantly moving. Each one is a complete and perfect image. They constantly change as a score of canvas belts move on a turnstile-like piece of machinery.

Snake Worship in Ancient Crete

TRACES of a forgotten snake religion evidently practised by the ancient inhabitants of the island of Crete in the Mediterranean Sea and perhaps the beginning of the many myths of serpent wisdom, "snake mothers," and so on which still survive, have been discovered during recent excavations in ruins of the ancient Cretan city of Knossos by Sir Arthur Evans.

In the ruins of the private house of a well-to-do family of three thousand years ago or more, there was found a room, perhaps held secret and inviolate, in which were many utensils evidently belonging to a snake cult. Among these were "snake tubes" made of baked clay evidently intended to contain snakes so that the reptiles could be handled in safety. Sir Arthur believes that the snake cult may have begun with some imagined good fortune, when snakes crept into the Cretan houses accidentally through the drain pipes. Later on the snake cult took on terrible characteristics, poisonous snakes were used, and probably exacted human sacrifices.



900,000-Volt X-Ray Tube for Medical Use

X-RAYS at 900,000 volts—by far the highest voltage ever attained in a tube built for continuous operation—will be produced in the giant two-section X-ray tube being constructed in the research laboratory of the General Electric Company, at Schenectady, New York, by Dr. W. D. Coolidge, associate director of the laboratory. The tube is to be installed in the New York Memorial Hospital. Two of Dr. Coolidge's assistants, L. E. Dempster, left, and H. E. Tanis, Jr., right, appear.

How Important Is Coal?

"SCIENCE is just beginning to reveal coal as destined to become the foundation for vast industrial chemical operations," says Chaplin Tyler, research supervisor of the du Pont Ammonia Corporation, Wilmington, Delaware. "Of the 600,000,000 tons produced yearly in the United States, five-sixths is still used raw.

"Far from being a simple substance, coal is a complex mixture of chemical compounds, largely hydrocarbons, together with such impurities as ash, moisture, and sulphur. Very little carbon as such exists in coal. A comprehension of this complex nature makes it easier to understand the transformations that occur when coal is distilled in coke ovens, such distillation being historically the second important step in the utilization of coal.

"When distilled, coal yields coke, an essential raw material in blast furnace operations and in the production of water-gas; coal gas or coke oven gas, valuable as a fuel and as a source of hydrogen for the synthesis of ammonia; ammonia, recovered as a water solution or combined with sulphuric acid to form sulphate of ammonium, the second most important nitrogenous fertilizer; benzol, raw material for various organic syntheses, also a motor fuel of valuable anti-knock properties; and coal tars, well known as raw material for synthetic organic chemical manufacture.

"There are under development uses for coal, certain to be of vast importance to civilization, since they will assure indefinitely certain essential commodities, the chief being gasoline and lubricating oils, heretofore obtained solely from petroleum."

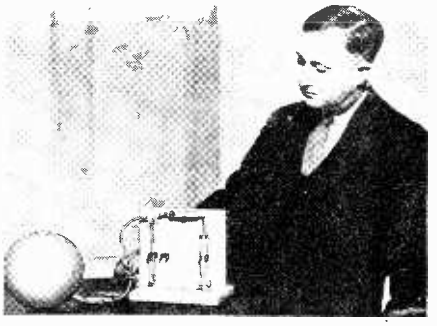
Tubbing Across the Thames

LITTLE Miss Madeleine Waeldin, it seems, is an ardent feminist already. She's not going to allow all the laurels for pioneering to be awarded to folk on this side of the Atlantic. Young as she is, Amelia Earhart's flight over the Atlantic Ocean and Gertrude Ederle's swim across the English Channel have left their mark on her mind.

She, too, wants to do something to bring honor to her sex, or so it would seem. Crossing the Thames is her idea of a spectacular feat, and when you consider her means of transportation, you'll agree with her that she's quite right. Mother's washtub, to which an outboard motor was attached, comprises her *de luxe* liner. Alas, a large wave upset her boat. The young lady had to swim back to shore.

Breath Tester Counts Your Drinks

Blow into this balloon, and there will be no doubt concerning your state of sobriety or drunkenness.



A VOTE of thanks is due Dr. Rollo N. Harger, Toxicologist of the Medical School of the University of Indiana, from all prohibitionists. He claims that the equipment with which we see him will determine one's exact degree of inebriation.

If your husband has visited a neighboring speakeasy, and denies it, just ask him to blow up this toy balloon. His exhaled breath will pass through the tube and bubble through a red liquid consisting of a solution of potassium permanganate and sulphuric acid. The degree of the suspect's intoxication is determined by the length of time it takes the liquid to change color and turn white. Dr. Harger says the test is infallible.

The only question that arises in our mind is what is to be done if the subject refuses to blow up the balloon?

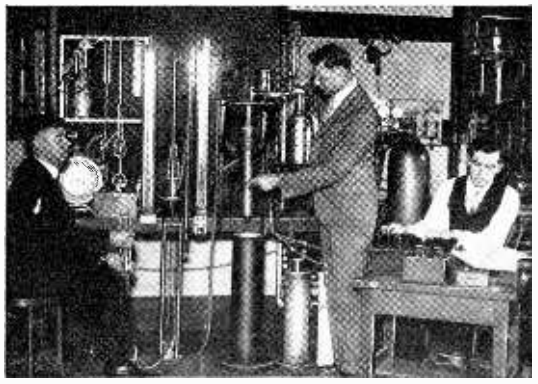
Helium Liquefied in U. S. for First Time

HELIUM, the lightest gas extant, with the exception of hydrogen, has proved ideal for aeronautic purposes. For, though hydrogen is lighter, it is inflammable, whereas helium is not.

As a substitute for atmospheric nitrogen helium serves admirably for deep diving operations when mixed with oxygen. Because of its low solubility in the fluids of the body, divers can work at greater depths for longer periods without danger of contracting the bends. This is the common name for the condition which ensues, when the nitrogen which has been dissolved by the blood forms bubbles when pressure is reduced.

Many other technical applications of helium have been suggested, but the relatively small amount available for industrial use has hindered developments.

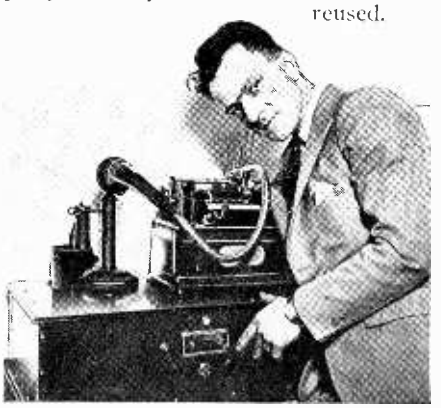
For the first time it has been liquefied in the United States at the Bureau of Standards Laboratories, Washington, D. C. A temperature of minus 456 degrees F., only 3.4 degrees above absolute zero, was reached during the course of the experiments. In the photograph we see (from left to right) J. W. Cook, Dr. F. G. Brickweede and R. B. Scott, the men who have worked to manufacture this liquid, and the apparatus they employed.

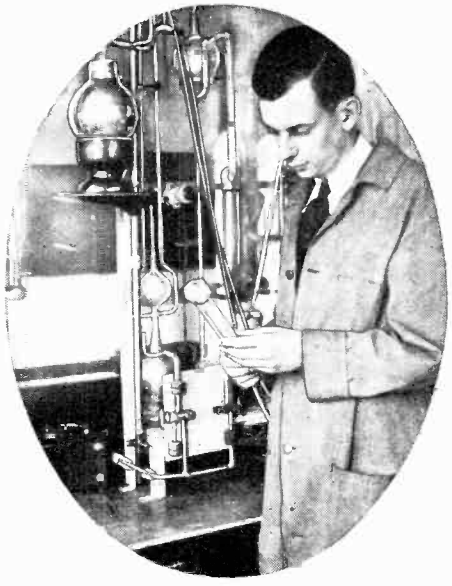


Robot Phone Operator

A NEWLY invented device which automatically tends to the telephone, in the absence of the person for whom the call is intended, has been perfected by William Schergens of St. Louis, pictured with the machine.

The ringing of the telephone bell starts its action. Whatever message has been recorded on the wax cylinder of the apparatus (which resembles a dictaphone) is transmitted to the calling party. The cylinders can be shaved and reused.





Glass Bubble Is Lenard Ray Tube Window

DR. C. M. SLACK, research engineer of the Westinghouse Lamp Company, recently was awarded $500.00 by his firm for the development of a glass bubble window for the Lenard Ray Tube.

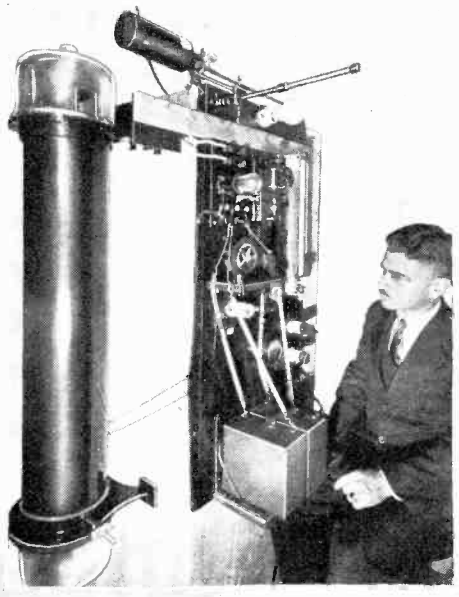
Lenard Ray Tubes are used to produce high-speed electrons outside the generating tube for experimenting in the fields of chemistry, biology and luminescence. The rays are being used for the treatment of cancer and to destroy tissue in treating certain skin diseases; equally as interesting is the discovery that various minerals placed under Lenard Rays assume colors never known before to scientists in the particular minerals.

These glass bubbles, which form the end of the tube, can be made as thin as 2/10,000 of an inch or about the thickness of a soap bubble.

World's Most Accurate Clock

THE most accurate clock in the world, which is expected to be correct to within 1/10,000 of a second per day, is being set up at the Bureau of Standards in Washington, D. C. It comprises a pendulum carrying a small mirror which swings in a vacuum; the mirror reflects light on a photo-electric cell generating a tiny current. This current is amplified until it is capable of operating many repeating clocks at various points in the bureau. Our photograph shows Dr. R. E. Gould, chief of the Time Section, with the apparatus.

In the April *Spotlight of Science* we featured the three Shortt clocks which were being checked against a vibrating quartz crystal in the Bell Telephone Laboratory to determine their accuracy. It was noticed that their accuracy was affected by the gravitational pull of the moon.



800-Horsepower Oil Electric Locomotive

THE locomotive which has been shipped to the Erie Railroad Company at Akron, Ohio, is the first of its type to utilize the full engine output at locomotive speeds of from 2 to 30 miles per hour. The locomotive, built by the General Electric and Ingersoll Rand companies, was given a complete set of tests before delivery and was demonstrated to a group of railroad officials on the test track at Erie, Pennsylvania.

Completely equipped, the new equipment weighs 230,000 lbs. It is designed for switching and transfer service and is capable of a maximum speed of forty miles per hour. The main generator, directly connected to the oil engine, drives four railway motors, each geared to one of the driving axles. An auxiliary generator is connected to the main driving unit. Fans for forced ventilation of the traction motors and for cooling the water in the radiators are provided as in a motor car.

Robot Pilot Warns

FIVE thimble-size robots, a series of Knowles grid-glow tubes, and some dry cell batteries are combined in an instrument which will warn the pilot of an airplane when danger threatens. With a robot on each wing tip, a robot with a grid-glow tube in the cockpit, a red light on the instrument board will warn the pilot when he is approaching too close to the ground at night. As soon as the pilot sees the red light he knows that the safe thing to do is to land.

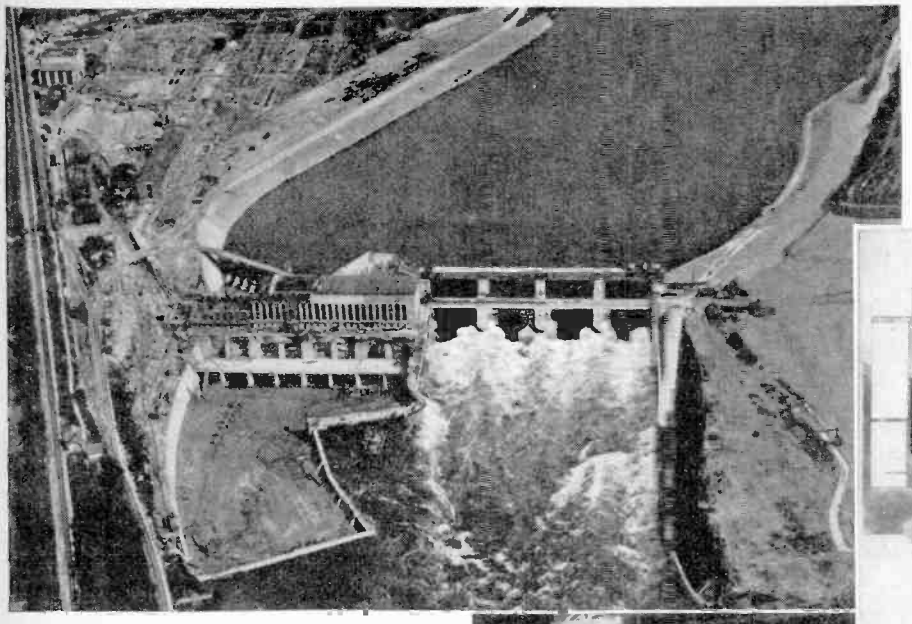
Electric Carillon

A NEW musical device which can bring out tones of bells louder than the largest bells extant, or produce them as the mere tinkle of a boudoir clock, was demonstrated by Dr. Alfred N. Goldsmith, vice-president and general manager of the Radio Corporation of America. It consists of a series of small chimes similar to those of a household clock. The chimes are struck by tiny electric hammers attached to a keyboard like that of a piano. The vibrations of the steel chimes create electric currents in a mechanism similar to the pick-up used on electric phonographs. These feeble currents are amplified millions of times by a vacuum tube amplifier and are then fed into a giant loudspeaker.

Letters Embossed in Aluminum Enable Blind to Read

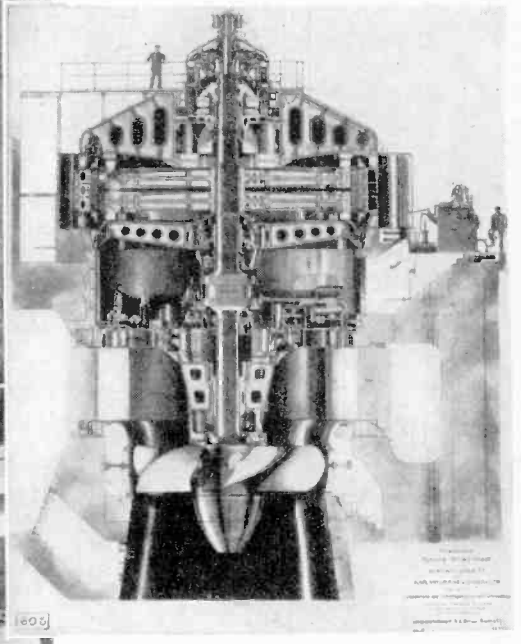
A NEW machine that produces enlarged, embossed letters on a wide roll of thin aluminum foil enables a blind person to read regular type. This machine, which has been named the *Visagraph*, has been developed by Robert E. Naumberg of Cambridge, Mass. It was demonstrated at the world conference for the blind in New York City on April 13. The blind person "reads" by feeling the letters in the same way as Braille is read.

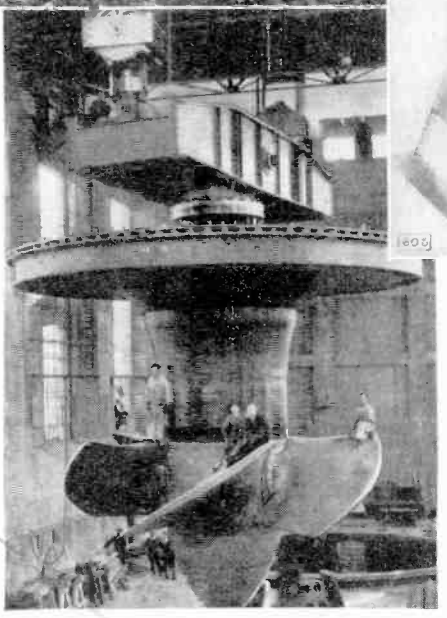
L. R. Quarles with the apparatus to be used in operating an airplane.



An aerial view of the dam. In the lower left we see the building which will serve as a center of distribution.

Below — Cross sectional view of the complete turbine above which is mounted a generator which will revolve at the speed of 75 r.p.m.





World's Largest Turbines for Swiss Power Station

THE installation of the hydro-electric station at Rybourg-Schworstadt on the Rhine will soon be completed. This enormous power house for producing electric power to drive machinery for the industries located in the surrounding cantons of Switzerland will be equipped with four Kaplan turbines. One has already been in use for a short time. These turbines, when completed, will be the largest water turbines in the world.

Directly above is an aerial view of the dam. The construction seen at the left of the picture will, when finished, house the motors. By referring to the lower photo an idea of the enormous mass of the installation can be gained by noting the comparative size of the men and the fly wheel of one turbine which, with its axle, weighs about 280 tons. In the rear is the opening into which the turbine wheel will be fitted.

The third illustration represents the cross section of the complete turbine with a built-in generator. 40,000 horse power which the turbine is capable of delivering will rotate the wheel at about 75 r.p.m. The capacity of absorption of each turbine varies from 10,700 to 300,000 litres of water per second. The four turbines were constructed by three firms working together under the name of "Arbeitsgemeinschaft Turbinenbau."

Why the Ocean Seems to Boil

QUITE often the sailors have reported that they have seen the ocean waters boiling and bubbling away. So vigorous was the action, according to the stories they tell, that the surface at times was hidden by puffs and clouds of steam.

M. Albert Noden, who observed a similar occurrence at Biarritz recently, has found what he considers a satisfactory explanation of this phenomenon. It is attributable to weather conditions. During the previous night the temperature of the air had dropped suddenly to a degree or two below freezing. The change was too sudden for the ocean water to follow suit. In the morning when the sea seemed to be boiling, the ocean was 15 or 20 degrees warmer than the air immediately above it. Water vapor was given off by the relatively warm water. It condensed immediately in the colder air and formed a layer of steam.

Radio Message Received Simultaneously with Sending by New Typewriter

THE Watsongraph is an instrument which permits the reception of a written message simultaneously with its transmission by a "wireless typewriter." A regular typewriter is employed as a transmitter to which radio equipment is attached. The operator merely depresses the keys as in ordinary typing, thereby sending the impulse to the receiver at the same time as the message is printed.

At the receiving end, an ordinary short wave receiver transmits the impulses through tubes to the typewriter, which automatically prints the messages without any human aid. The receiver picks up the impulses, one dot for each letter, and prints the message, character for character, simultaneously with the sending machine.

In utilizing this instrument it will be possible to send messages in absolute secrecy as only the individual for whom the message is intended can interpret it. His typewriter alone will print the letters in their true sense, other sets will merely receive a series of meaningless letters. The machine accomplishes this by the synchronization of letter positions.

Spectacular Harmless Fireworks

Celebrate the Fourth of July As You Should with Plenty of Fun and Fireworks. But Manufacture the Pyrotechnics Yourself and Insure a Glorious Display Which Is Absolutely Harmless

By Raymond B. Wailes

This novel battery of home-made fireworks will give four dazzling white flashes in rapid succession.

SOONER, or later, the amateur chemist usually turns his attention towards pyrotechny, or fireworks making. Often his product will be worthless, and sometimes highly dangerous. Lack of proper instructions causes failure, and the use of potassium chlorate and sulphur compositions which have appeared in print will sometimes cause premature explosions which may be very serious. The formulas contained in this article, if followed, will give the home experimenter a very satisfactory product. In no instance will potassium chlorate and sulphur be found to be used together. As is well known, these two substances rubbed together explode; the use of potassium perchlorate or other oxidizing and combustible substances such as potassium nitrate, barium nitrate or barium chlorate, rosin and shellac, precludes any possibility of a dangerous explosion by friction.

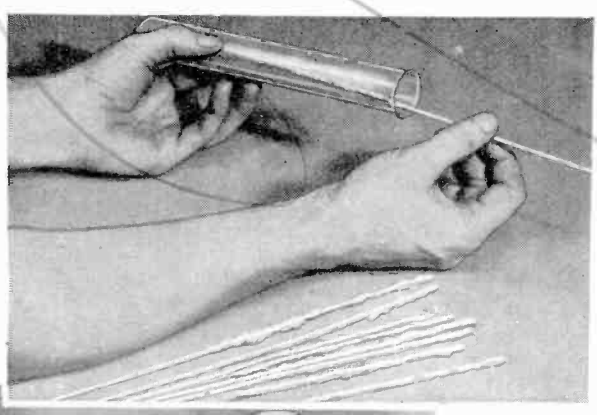
Colored fires which are *safe* and inexpensive to make are the easiest pieces of firework to prepare. The composition for making a beautiful, slow-burning green light is made up of powdered barium chlorate, 9 parts, powdered orange shellac, 1 part. The substances used are weighed out (say 9 ounces of powdered barium chlorate and 1 ounce of the shellac) and thoroughly mixed on paper. Another formula, used commercially, is: Barium nitrate, 3 parts; potassium chlorate 4 parts, and powdered red gum (gum kauri), 1¼ parts.

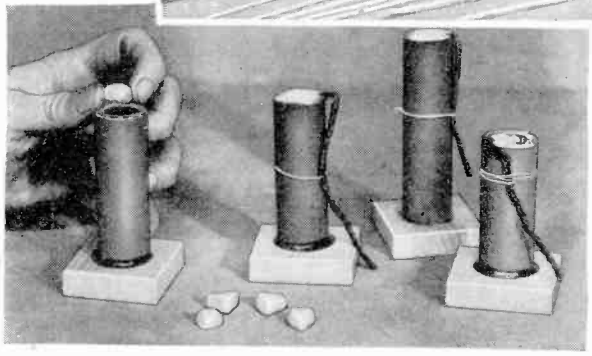
A good red fire is composed of 29 parts by weight of potassium chlorate, 6 parts of strontium carbonate, and 5 parts of powdered orange shellac. A mixture of 4 parts of strontium nitrate and 1 of shellac can be used.

For an inexpensive blue fire, the following mix is suitable: potassium chlorate 40 parts, powdered copper sulphate 8 parts, and rosin, 6 parts.

An excellent white light is made by burning a mixture of 24 parts of potassium nitrate (saltpeter), 7 of sulphur and 1 of charcoal (not lampblack).

After the above mixes are made, they should be poured into cardboard cases which have been glued to small wooden blocks. Tamping with a pencil tends to prevent mixing the contents, if the colors are stratified in the case. The accepted order of charging cases are: white, blue, green, red, white. When burned, the colors appear white, which changes to red, then to green, and then blue, ending up with white. For perfect effects, don't place green next to white, or allow the green color to follow red.





Above—Brilliant sparklers are easily made by coating wooden splints with the sparkler mix. Aluminum pellets inserted in "fire pots" produce beautiful silver showers.

This is the way your home-made sparklers would work.

A fuse for your colored light case is easily made by smearing the following composition, made into a paste with a teaspoonful of dextrine dissolved in a cup of hot water, on soft cotton string and allowing it to dry: Potassium nitrate, 16 parts; willow (or other wood) charcoal, 3 parts; sulphur, 1 part. The following composition, which is also used in making a silvery fountain effect can be used: potassium perchlorate, 9 parts; charcoal, 2 parts; sulphur, 2 parts. The latter burns very fast. The fuse is inserted into the top half inch of the filled case, bent over the side, and tied with thread to the case. A gummed paper cap or a drop or two of alcohol placed on top of the cases containing shellac or rosin will cement the particles together and keep the composition from spilling out.

A very novel effect can be produced with any of the colored light cases by inserting little pellets the size of a pea into the case. The pellets are made of barium nitrate, 5 parts; iron borings or filings, 2 parts, and aluminum powder (aluminum dust, or "bronze"), 1 part, all of course by weight. The mixture is dampened with dilute liquid (alcohol) shellac and rolled between the fingers to make pellets. No matter what color or composition is contained within the semi-filled case, a quarter inch layer of the potassium perchlorate-charcoal-sulphur fuse com- (*Continued on page* 265)

Would You Believe It?

The Rare and Unusual Happens Every Day Right Under Your Nose—So You Will Conclude from Perusing These Pictures, Authentic Reproductions of Daily Occurrences

Fish-Eating Fish

IT'S quite common for a fish to prey on a smaller fish. Sharks eat the comparatively small flounder that in turn feeds on the tiny minnow. But it is very rare indeed to come across a fish that will tackle fish larger than itself. The rapacious dogfish, a species of shark, found in the waters off the coast of southern California, tackled a tom-cod which was bigger than he. The cod came out second best.

Going through a keyhole is easy —if you know how.

Crawling Through a Keyhole

KING BRAVERMAN is a contortionist. There's no doubt of that. At a demonstration recently staged by SCIENCE AND INVENTION, at Union Square, New York City, he showed you just how to crawl through a regulation sized tennis racket, and, believe it or not, a keyhole. Here we see him going through the keyhole. Of course, it is larger than that in the average door. Its dimensions are 4½ inches wide and 8½ inches high. Even at that, it is quite a feat. Mr. Braverman is 5 feet 5 inches tall and weighs 150 pounds. His bones were intact after the performance.

A Double-Barreled Cannon

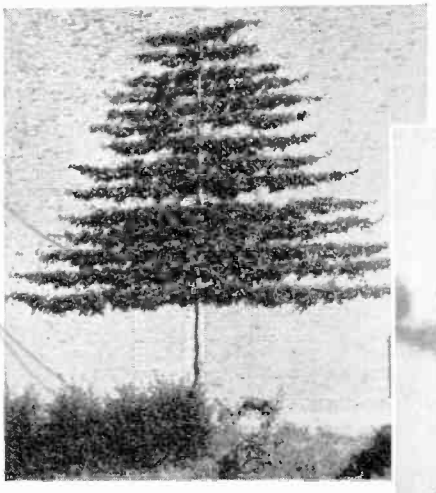
THIS unusual twin cannon made its appearance during the American Civil War. It was invented by a Confederate soldier, who thought that by firing simultaneously two cannon balls that had been chained together, it would be possible to mow down the enemy twice as quickly as otherwise. Experience showed that two cannon balls could not be discharged at the same speed, and the cannon proved useless.

Barge to Keep Her Balance

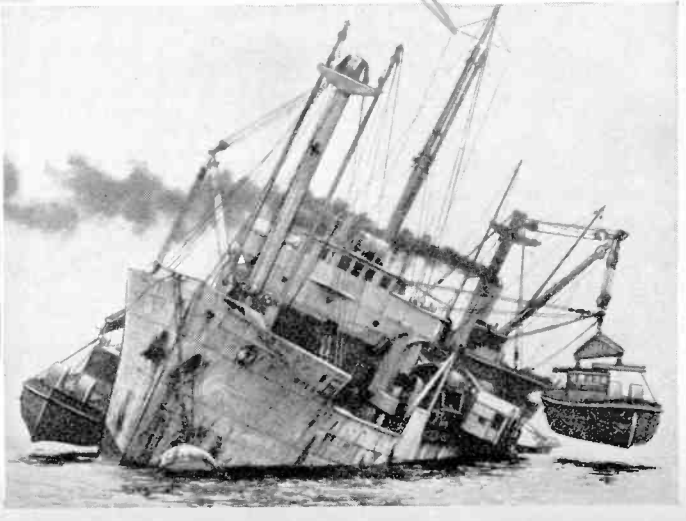
ONE barge to balance another—that's the stunt employed to keep the steamer *Belnor* from toppling over. This freighter loads barges of steel; when getting them aboard, it topples over at such an alarming angle that another barge is kept on the other side as a counter-balance.

Mural Decoration for the Farm

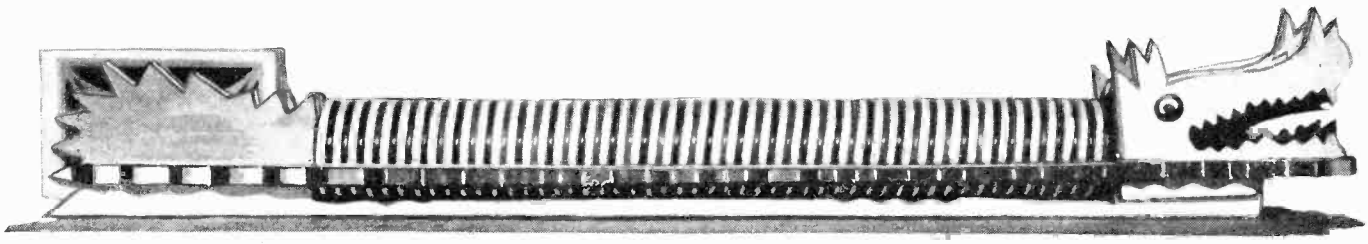
A PEAR tree trained as a vine is one way of making your farmhouse more attractive. In Belgium, near the Dutch border, some of the brick farmhouses utilize the southern exposure of their walls to raise these oddly shaped pear trees. The tree's smooth, shining very finely - toothed green leaves, and pure white flowers lend a holiday touch to the otherwise bare wall space.



One barge is attached to another to help maintain equilibrum.



Have you any WOULD YOU BELIEVE IT photographs? We will pay five dollars for every photograph accepted and published on this page. Send them in to the Editor.



A Poker-Chip Dragon

This Decorative Set to Hold Your Cards and Poker Chips Can Be Completed In a Very Short Time—the Cost of Materials Is Trifling

By Charles H. Alder

OF all the card games, poker is one of the most popular. Its great popularity makes it hard to understand why so few poker sets have been made that are decorative and ornamental as well as useful.

Most poker sets are just large round blocks of wood with some holes bored in them. They do what they are made to do but that's about all. Having noticed this, I set to work to turn out one that would be a little different than the ordinary run of poker sets. And here it is. A Poker-Chip Dragon!

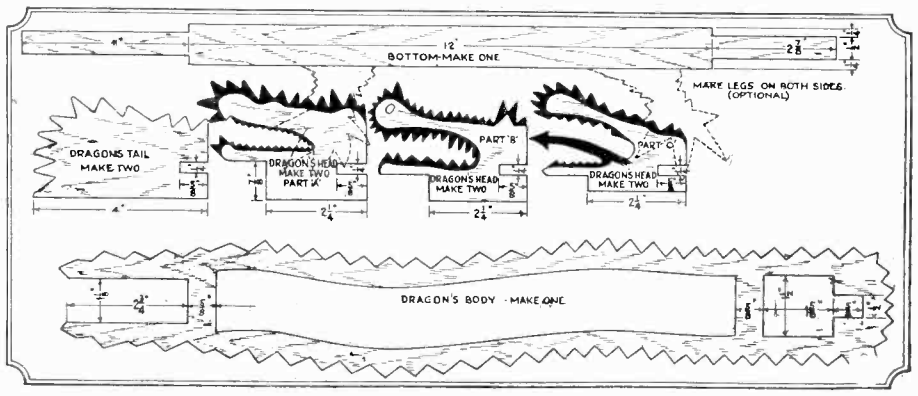
If you have the material on hand the cost of the dragon will come to about 25c. And the least expensive poker set on the market costs many times 25c. A similar set can not be bought, but you'll enjoy making it. In construction it is very simple and can be made complete in a very short time.

The materials required consist of 3 ply veneer, ¼" thick; Gold bronze; Green bronze; Red bronze; Bronzing liquid; 2 thumb tacks; ½" or ¾" wire brads.

The tools you will have occasion to use are: Fret saw; Hammer; Brushes for bronzing. (One will do if you clean it.) Sandpaper.

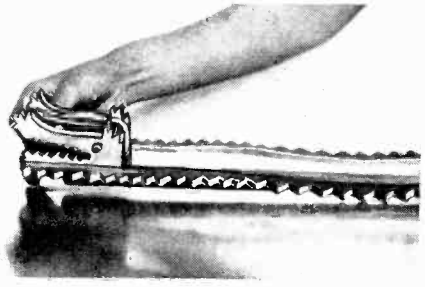
The first thing to do is to enlarge the drawings to full size on a sheet of paper. Then trace the different pieces on your plywood with the use of carbon paper. Now cut out the pieces. Note that the drawings show the bottom piece with legs. If you do not want legs on your dragon just leave them off. I didn't put the legs on mine as it would have been a little too large for the table it was intended for. But you may have more room. If so you'll want legs on your dragon; they will improve its appearance and make it more realistic.

Sawing out the body of the poker chip dragon. The author is showing you how.



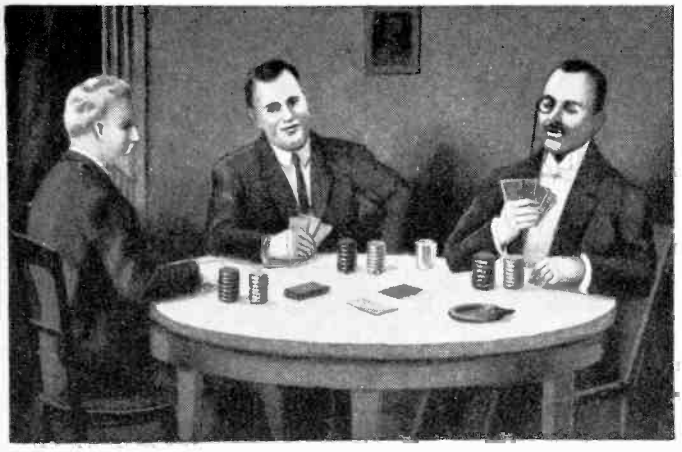
After you have the pieces cut out, sandpaper them and assemble. The two pieces for the tail are just slipped on the body of the dragon and the bottom fits in between the two tail pieces. There are six pieces to the dragon's head, A, B and C. "A" and "B" are interchangeable and either may be put on the outside of the dragon's head. If you wish to do so you can make a dragon's head after your own design.

Draw the head the way you want it, being sure not to change the bottoms of the six pieces, and then saw them out as before. The two middle pieces are fitted into the body of the dragon last, the bottom of the dragon fitting between the two middle pieces of the head. Then hammer some wire brads into the tail and head to hold the dragon together. If the pieces fit together closely glue them and use no brads. Push a thumb tack in either side of the dragon's head and bronze them red. These are the dragon's eyes. Now bronze the rest of it. The dragon's mouth is red, his eyes are red and the rest of him is green and gold. Now put the chips in your dragon and set it on the living room table or wherever you wish to keep it.



The dragon without the chips. Left—Construction details of the holder.

The same idea may be incorporated in other figures such as camels, horses, and lions. Just cut out whatever figure you desire in the form of silhouettes, one for each side and put the chips between the sides. The animals must be made long enough to accommodate 100 poker chips, or about 12" long. Then paint them to resemble the animals they depict, and they are ready for the next poker game.



Prize Puzzles to Polish Your Wits

By Sam Loyd

THE Puzzle King presents the nineteenth of a series of problems, the solving of which will show if your mathematical ability is bolstered up by logical reasoning. Prize winners of the April puzzles and solutions will be found on page 247.

TWENTY-FIVE DOLLARS IN PRIZES

A FIRST PRIZE of $10 will be awarded to the person sending correct answers to the three puzzles accompanied by the best expressed analyses of all three.

A SECOND PRIZE of $5 will be awarded for the next best analyses and correct answers to the three puzzles.

TEN PRIZES of $1 each will be awarded to the ten persons who send the next best analyses of all three puzzles, together with correct answers to the three puzzles.

Answers must be received not later than noon, July 16, addressed to "Puzzle Editor," SCIENCE AND INVENTION, 381 Fourth Avenue, New York City.

All contestants must abide by the decisions of Sam Loyd, who will examine all papers and award the prizes.

Papers of identical merit, tying for any one of the prizes, will each receive the full amount of the prize tied for.

An Initiation Fee

SPEAKING of the nobility, recalls an experience with two jovial gentlemen whom I met in the card room of the *S. S. Manitoba* some years ago.

They initiated me into a new game called 'Squeeze," which I found to be a jolly pastime. I lost the first game of "Squeeze," and Baron D. and Count C. each won enough from me to double the stack of chips with which he started.

The Baron and I scored the second game, thereby doubling our respective table assets.

Then in the final skirmish, the Count and I scored, which victory doubled the chips which he and I had at the opening of the third game.

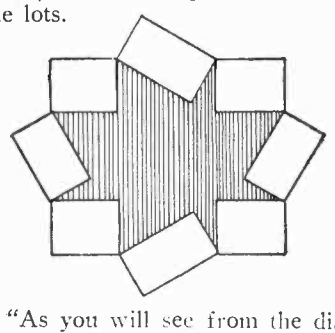
A mysterious feature of the sitting was, that while each player had won twice and lost but once, the Baron and Count quit winners, and I was a loser to the extent of four dollars.

After that third game, our three stacks of chips were alike, from which fact I will ask you to figure out just how much money I put on the table when I started to sport with my titled acquaintances.

Dressing Up Real Estate

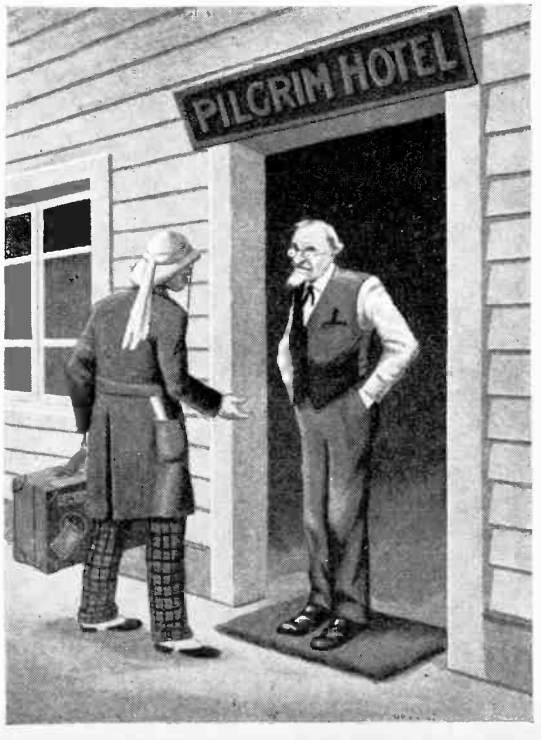
"IN these dull days," remarked an enterprising Long Island real estate dealer, "a fellow has to think up new ways of attracting buyers.

"For example: I had a choice parcel of land that wouldn't move, so I cut it up and tried the plan of a novel layout of the lots.



"As you will see from the diagram, the eight plots are so laid out that each owner shall have his own individual fence completely around his plot. Now, these plots are of uniform size, the width of each being three-quarters of its length. Well, they went off like hot cakes at $6,000 each, and I have an understanding with the eight buyers that they shall collectively pay me for that inner shaded section at three-quarters of the square-foot price I received for the lots. What I must now figure out is the amount of my bill for that community park in the center."

How much should the speculator receive for his star-like park?



Taxing the Nobility

WHEN Lord Wopping, on his tour of the West, arrived at Mud Springs, he inquired for a hotel conducted on the European plan.

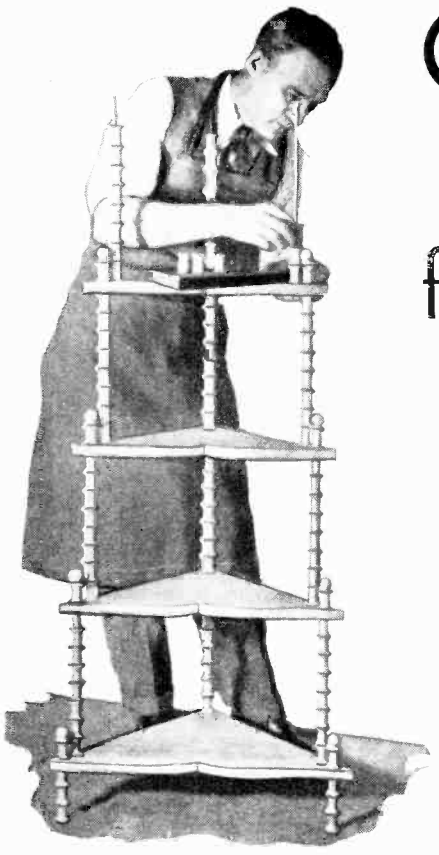
"There's the Pilgrim House, right across the road," replied the station agent. "That shack is run by a Dutchman, the clerk is a Swede and the cooking is done by a Frenchman; so, you see, everything is strictly European."

Lord Wopping found that three meals at the Pilgrim House cost $1.05 more than a night's lodging, but His Lordship sat down to four meals per diem. At the end of the week, he received a bill for $46.55, which the nobleman protested as "preposterously exorbitant." He had to pay it nevertheless, so we will ask our puzzlers to figure out how much the Pilgrim House host charged his aristocratic guest for meals, which were of uniform price.

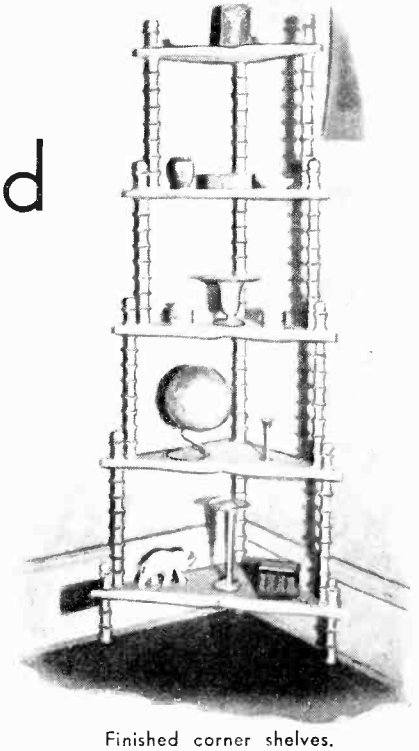
Ornamental Furniture from Discarded Spools

By H. L. Weatherby

Director of Manual Training, Montgomery County Schools



Building up the spool sections.



Finished corner shelves.

SPOOLS, spools, spools! What can we do with them? Are they just so much waste wood, or can they be used to advantage in some manner? There are so many places that use thread in quantity and the spools can be had for the asking. There are small and large spools, fat and skinny, long and short ones. They can be fastened together very securely with long rods and be made into legs or rounds. Where can we get them? Dressmaking establishments, tailoring shops, hemstitching places, sewing machine agencies, shirt and overall factories, shoe shops, and drapery houses, to name a few sources.

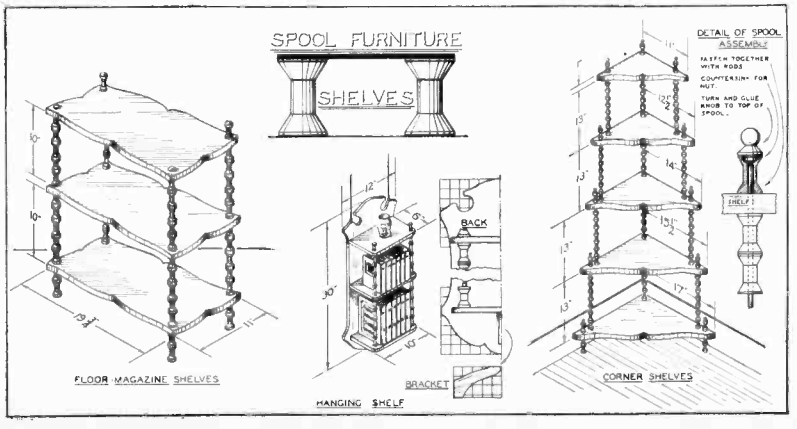
Now with spools available, and almost any establishment will save them for the asking, just what can we do with them?

It is extremely interesting to note the varied manner in which they can be worked up into truly useful, beautiful and sturdy articles of furniture, and if you do not believe they are sturdy just build one according to directions and then use it for a step-ladder.

The use of spools is in the nature of a revival of a method used in our grandparents' days. One finds many old corner whatnots and hanging shelves similar in design to the ones illustrated herewith, that were built by home craftsmen of a by-gone generation.

The method of construction is simple. Spools should be all of the same size and kind, or else they should be uniformly varied. For example, two short spools and one long one at regular intervals may be used, or any other combination desired. The bottom and top spools should be countersunk to accomodate the nuts at each end of the rod. The rods can be purchased at any machine shop or other place selling iron and steel. One-quarter inch round iron rods cost only about one cent per foot. Five and ten cent stores sell dies and die stocks for threading the rod, and with a hack saw for cutting, no other equipment is needed excepting the usual woodworker's tools.

Above—the finished magazine stand. Below—Dimensioned diagrams and details.



This month we have gone in for shelves and have illustrated three types. The method of assembly of each is identically the same as that of the others. Long bolts or rods are used through the holes in the spools—holes are bored through the shelves—and a nut is tightened up at each end of the rod, binding the whole firmly together. General dimensions are given but will vary somewhat, depending upon the type of spool used. The finished result will have the appearance of beautifully turned work without the labor involved in turning.

To summarize briefly: Deep spools, or spools containing more thread, work up better than those containing a smaller amount.

Have the spools uniform, or uniformly varied. Countersink them at both ends to receive the nuts. Cut the rod about ⅛ inch shorter than the actual length of the leg, or round to be built up, and thread it at each end. Where several shelves are to be used, bore squarely through as many of them as possible with one operation to insure getting the hole centered up correctly. Tighten the nuts securely with a wrench in assembling and then cover the top exposed countersunk spool with a turned or whittled wooden knob, or button, glued in place.

The finish should be a walnut or mahogany stain, covered by shellac and varnish.

Ike Osborn, age 13, and his "Pumpkin Seed" boat which he built from plans published in the February issue of SCIENCE AND INVENTION, and with which he set up a record speed for Junior "A" class boats of 30.444 M.P.M., at Winter Haven, Fla.

Preparing Your Outboard Boat For Racing

By J. Phillips Dykes

Vice Commodore and Secretary, American Outboard Association.

OUTBOARD racing will be all the more popular this season due to several factors. First, the simplification of the racing rules. Second, the abolition of all divisions except two, amateur and professional, thus making the winner in either division the clear-cut champion in that division instead of champion in some class or other of one of the thirty different divisions of the past.

Third, classes have been cut from eight to four, "E," "F," "G" and "H" classes having been entirely abolished and replaced with "A," "B," "C" and "D." These four classes of 16, 20, 30 and 45 cubic inches of piston displacement respectively, will allow outboard fans to concentrate on one class, and will, by enabling manufacturers to concentrate on fewer models, tend to give us cheaper and better motors. The free-for-all race has been left optional with local officials, thus affording amateurs and professionals an opportunity to race each other at every regatta.

Another great factor in the increase in popularity of the outboard is the rapid development of the smaller motors. For example, the little "A" class motors weighing from forty to fifty-five pounds, are showing speeds of over thirty-five miles per hour, rapidly approaching records held by last year's motors of twice the size and power!

In this connection, it may interest readers of SCIENCE AND INVENTION to know that the fastest speed turned in by an "A" class motor during the Florida racing season just passed, was accomplished at St. Petersburg with a Caille motor on the "Pumpkin Seed" boat described in the February issue of SCIENCE AND INVENTION for the home builder.

Last season's outfit will still be in the running in most parts of the country, however, so here are a few of the things to bear in mind when you haul the old outfit out of the boat house for your first tryout of the new season.

Before you win any races, your hull must be in tip-top shape. The motor has been taken care of if you followed our advice in the April number of SCIENCE AND INVENTION, so we will now busy ourselves with getting our hull and equipment into the best possible shape to stand the abuse it will get during coming races.

Examine the frames carefully; there are generally a few that are split or broken at the end of the season. If they are broken, take them out and insert new ones by all means. If, however, they are simply split and still

Malcolm Pope, well-known outboard racer, putting racing compound in the lower unit of his engine.

capable of supporting some of the weight of the boat, here is a simple way to remedy matters.

Cut two pieces of spruce, yellow pine, ash or oak so that they will fit over the split frame as is shown in Fig. 1. Using a 2-inch brass bolt, fasten securely, placing washers under the nut so as not to chew the surface of the wood, and your rib will be made as good as new with very little weight added to the boat. The braces can be screwed on from both sides using 1½-inch brass or copper screws if bolts are not handy. When using bolts, however, do not bore the holes more than 1/64th of an inch larger than the bolt diameter, which should be about 3/16ths of an inch.

Split planking should be replaced with new, being careful not to fit the new piece in too tightly as it will swell slightly, causing a bulge and spoiling the contour of a racing bottom. Allow 1/32nd of an inch for expansion on sides but not on ends, as there is no play except on the sides of the plank.

Examine your hull for loose screws, bolts and missing screws shaken out by vibration. In replacing these, it is always well to fill up the old hole with a wooden plug so as to assure the new screw or bolt of a clean grip on the sides of the hole and save many a ruined bottom later.

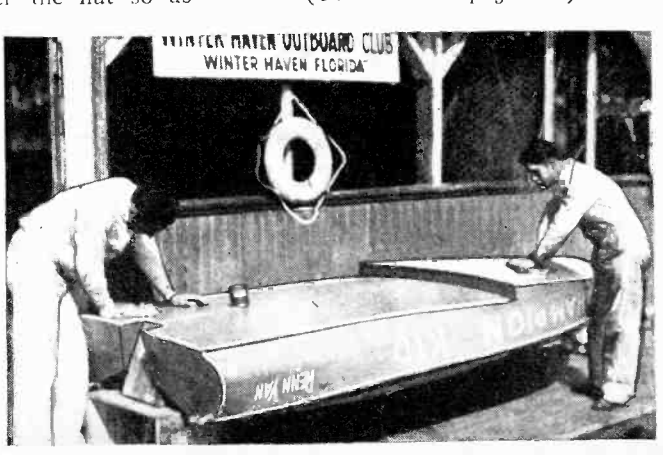
Examine carefully the screws holding the pulley plates in position on the guides to your steering ropes. Many a trophy has been lost by having one of these plates pull out during a hot race.

Sandpaper the entire hull and give it two or three coats of good spar varnish, sanding each coat slightly after it is dry.

There are many pet formulas for racing bottoms. A smooth bottom is important at all times and will help to win many a valuable trophy if kept in excellent shape. Here is a formula for a hard, smooth bottom finish, a formula that experience has taught me to be one of the very best.

After sanding the entire bottom to the smoothest possible texture, apply

(*Continued on page* 255)

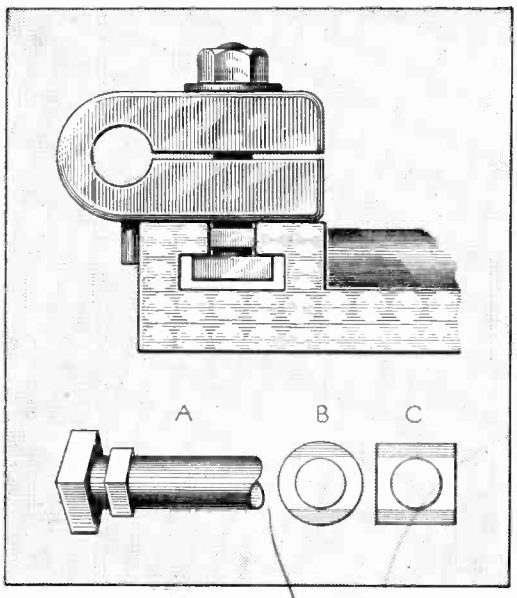


Malcolm Pope and Carl Ellis showing the right way to put a racing finish on the bottom of an outboard boat.

New Tools You Can Easily Make

To Finish That Unusual Job for Which There Is No Equipment Make These Tools in Your Own Home Workshop

By Joseph Pignone



The use of this boring bar holder is a certain guarantee against swiveling.

THE usual practice, in boring deep holes in metals, is to use the regular boring tool bit in the tool post of the lathe slide rest. For ordinary purposes this procedure is acceptable and effective, although several inefficient points are countenanced and overlooked.

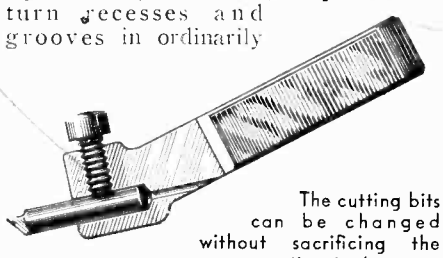
It must be remembered that in working deep holes the boring tool acts as a lever and tends to either spring or yield considerably or actually force the tool post around. Another vital factor to be considered is that the bottom of an ordinary tool post does not offer a surface of sufficient area to the tee slot in order to produce enough friction to hold the tool post rigidly for boring. The cross section of such a contact area is shown at "B" of the illustration above and it is clear that under excessive pressure or stress the slide rest tee slot will be damaged.

The improved device illustrated presents several advantages which are not instantly apparent to an observer. First of all, considerable contact area is obtained between the slide rest top and the bar holder. Secondly, the clamp bolt is so formed that a considerable surface area is gained as at "C," and, lastly, this bolt will not turn when being tightened. The bolt head is filled square as shown at "A." Another important feature is represented by the two pins screwed into the holder, which bear against the slide rest front and give further guarantee against swiveling. They may be removed when it is desired to hold the tool at an angle.

This boring bar is particularly suited for small jobs.

Construction of this boring tool holder is simple and should impress the builder with a decidedly improved performance. Square, soft steel stock is used, and its tool mounting hole should be reamed out after the whole unit is finished and mounted in place.

The boring bar illustrated is not only ideally adapted to the particular tool holder described, but it is of the most efficient type the author knows of for smaller work. Its principal advantage is that it will bore up to a shoulder and that its boring bits are easily made and inserted. By reversing the bit, it is possible to turn recesses and grooves in ordinarily inaccessible places very satisfactorily.



The cutting bits can be changed without sacrificing the entire tool.

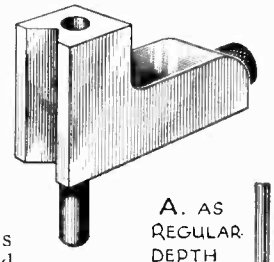
The equipment and layout in the home workshop of the real enthusiast these days are rather complete and adapted to adequately handle the average small machine project. When a job involving real accuracy is encountered, however, it is generally discovered that the precision measuring tools necessary are lacking, beyond an ordinary micrometer caliper or two. Since precision tools are decidedly expensive, and since each type of precision measuring device is limited to a special purpose, it is quite natural and sensible that the home machinist or even the small professional one prefers to invest first in a major unit such as a lathe, drill press, grinder and the like.

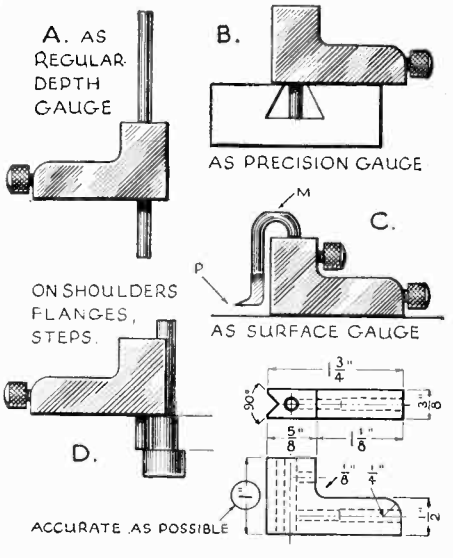
Ordinarily several micrometer calipers, *plus* a fair measure of individual skill and ingenuity, go far toward overcoming the lack of extended gauging facilities. Occasions do arise, however, when no end of improvising will help—the proper measuring or gauging tool suited to the purpose must be had or the job will suffer. One of these occasions is the measuring of shallow recesses, grooves, small projections, flanges or holes. It would require several commercial tools to be able to perform the measurement of the differences of surface levels mentioned. For real accuracy a vernier height gauge, micrometer depth gauge, inside micrometer caliper or perhaps a surface gauge equipped with dial indicator would be necessary.

It is possible, with an extended effort toward accuracy and with the aid of a fairly true bench lathe, to construct the small tool illustrated below, which was designed and constructed by the author, for many ordinarily difficult measurements. Within certain limits, as between 0 "and 2," this precision gauge will do the work of several commercial ones combined.

Only two surfaces of this tool must be machined very accurately, the bottom of the base and the top, and these two surfaces must be a standard distance apart, as one inch for instance. There is a hole bored vertically through the body in which the various attachments or depth rods are clamped. The principle of operation is simple. First measure the height of the tool with a two-inch micrometer caliper, apply the gauge to the work and permit the rod to drop to the surface to be measured and clamp it; then measure the total distance between bottom of the rod and the top surface of the tool. The differ-

(*Cont'd on page* 261)





A versatile precision depth gauge which combines the features of several instruments. A few of its uses are detailed here.

Scientific Aids to Your Comfort

By Mary Jacobs

Combining Illumination and Fresh Air

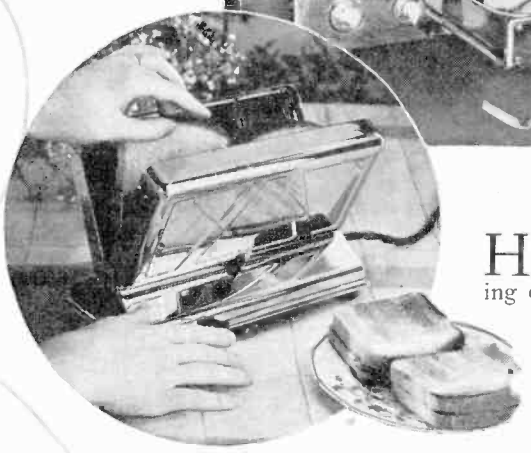
ON these hot nights it's a relief to sit in a softly lit room and relax while cool, refreshing air circulates around you. Why not buy one of these combination fans and lamps?

For the porch, for the sun-parlor, for the living room or reception hall—for the office or shop—it is extremely practical. Twin lights, covered with artistic shades, each to one side of the stand, shed a soft glow about the room. The fan brings you fresh air. The propeller blades of its fan are six in number instead of the usual four-bladed construction of the common fan; there is little noise while they are in motion. Five wind vanes have been fixed to the front of the fan to distribute the breeze evenly in all directions, and eliminate

drafts. There is no interference with radio reception during use.

This piece of furniture—it may be considered as one—is not only useful, but ornamental, as can be seen from the illustration. It may be obtained in either a 5 or 6 foot height. For alternating current, the finish may be had in Florentine Bronze, Napoli or Old Silver. For direct current, it is made only with the Florentine Bronze finish.

The lights and fan work independently of one another, or together. Tested and approved in our laboratory.



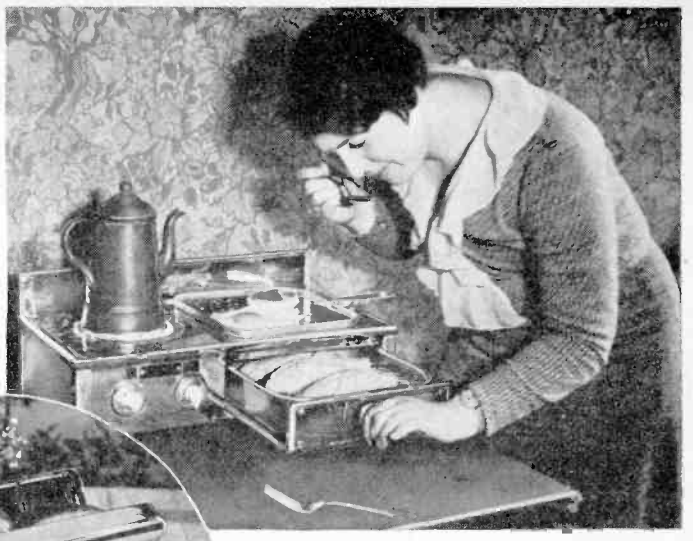
Toast as You Like It

IT'S quite difficult to get your toast done every time to just the proper crispness. Not with this automatic toaster—once you've made it to your satisfaction, the process may be repeated time and again with the same good results.

A timing mechanism is provided that may be set at any of six intervals for the exact tint of gold or brown desired. Two slices of bread are accommodated at the same time in the toasting rack; after you've put them in, just pull the lever, closing the toaster. Then forget it. When the toast is finished, the sides of the machine fall back automatically. The toast will be done on both sides, for there is a heating unit to either side of the rack.

Current is applied to the resistance wires when the toaster is in the open position, this keeps the bread warm until you eat it. But as soon as you are through toasting, operate the switch on the outlet cord to the "Off" position, and save current.

The base of the device, which is a very attractive chromium-plated appliance, has been provided with rubber feet; in addition, it remains cool even while the current is on. There is no danger of ruining the surface of your table. The movable sides are hot during use. Tested and approved in our laboratory.



Kitchenette Grill

HERE'S a handsome kitchenette grill that handles all the cooking except baking, for a small family. And if you buy an inexpensive portable oven for it, you can bake, too. You can broil steak, toast muffins, and percolate coffee or fry eggs simultaneously. Simply connect to the convenience outlet.

There is a seamless aluminum pan and a wire rack in the drawer for use when broiling or roasting. The handy aluminum griddle fits neatly over the square burner and is excellent for pan broiling or frying, for making pancakes, for warming plates, and keeping them so until the food is served.

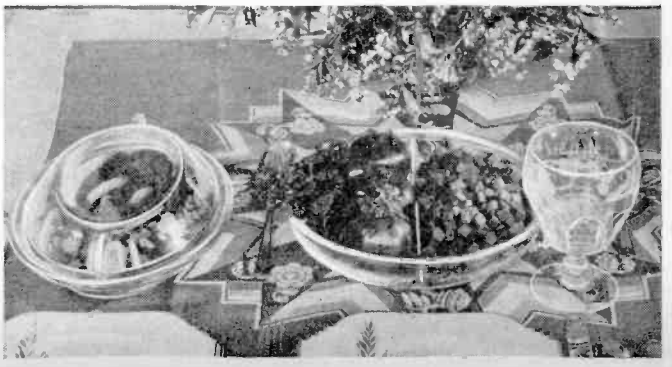
Each burner has three heats, high, medium and low, controlled by two switches. The grill itself is about 20×10×6 inches. The net weight is 14 pounds. The stove is chromium plated. Tested and approved in our laboratory.

Baking, Serving and Storing in the Same Dish

NOW that summer is here you'll appreciate these triple-service glass dishes. You can bake in them, serve in them, and then store the left-overs in the refrigerator without changing dishes.

As they are transparent, just open the oven door to see how far the cooking process has gone. There is little danger of scorching foods. And they look so well on the table that the trouble

(*Continued on page* 261)



Names and Addresses of Manufacturers Upon Request

Making a "Fill-in" Book and Magazine Case

By Burton E. Walters

THE odd corner or bit of wall space where nothing else seems to belong is the place where this simple but useful book and magazine case appears at its best. You will be surprised at the number of volumes you can store in it, even though it is little more than a foot wide.

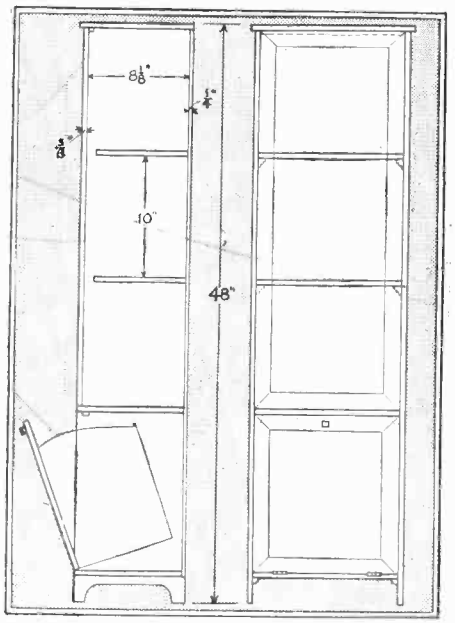
Of course, the lateral dimensions of the case will depend on the space to be occupied. The example illustrated was built to fit between two windows where the maximum free space was 13½ in. Cypress, given on the outside surfaces, a burned (sugi) finish, was used; but poplar, oak, walnut, or any other wood appropriately finished would have done just as well.

In building such a case, obtain ½ or ⅝ in. stock, preferably the latter. Cut the two side pieces to a length of 47⅜ in., and a width of 9 in. Rabbet the back and front to receive the doors and back panel respectively. The depth of the front-edge rabbet, measured from the board edge, is the same as the thickness of the door, and that of the rear rabbet is determined by the thickness of the back panel. Both are ¼ in. deep in the other direction. At the bottom end of the side pieces, saw out a curved center portion to form legs, the cut being to a depth of about 2 inches from the lower end.

The top is 9½ in. wide, and long enough so that it will project ½ in. over the sides. The two upper shelves measure 8 in. from front to back, and the lower ones measure the same as the side pieces less the thickness of the back panel. Upper shelves are spaced 10 in. between surfaces. The upper compartment is covered by a conventional door with a glass panel.

The most interesting part of the cabinet is the magazine or booklet container at the bottom. The two shelves above and below it extend so that their front edges are flush with the edges of the side pieces, there being projections into the rabbeted-out portions. From pieces similar to those for the upper door, build a frame and insert into it a plywood or building-board panel. Then, from plywood, construct a compartment extending back from the rear surface of the door, and filling the space as completely as possible. This is merely a box-like affair with a partition or two across it, so that there are convenient pockets for magazines, etc.

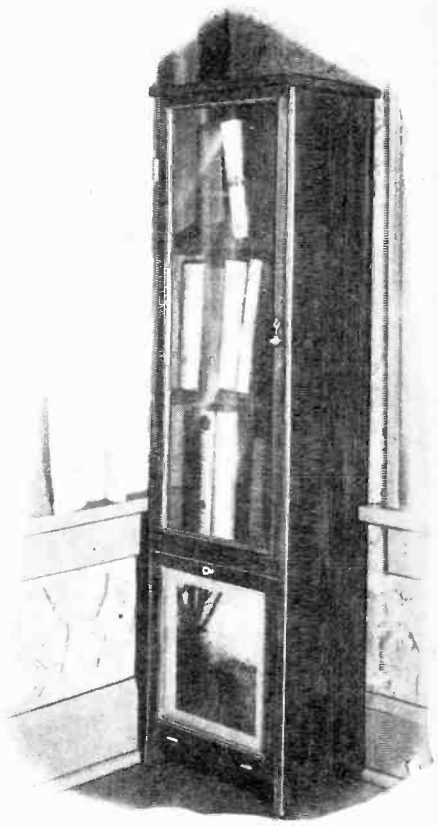
The door is hinged at the bottom, and the dimensions of the rack fastened to



Side and front elevations of the bookcase.

it are such that the rear edge strikes the lower surface of the shelf above it when the door is opened, preventing the container from swinging all the way out. This makes it necessary to use butt hinges that have removable pins. No catch is needed, as the weight of the container and its burden holds the door shut. A picture glued to the center panel completes the arrangement.

That is about all there is to the construction. Hinges for the glass-paneled door are similar to the butterfly variety—those employed on the model illustrated were made by hand from sheet brass. The handle is a well designed brass one, and the door is held shut by a friction catch. Inside, the wood is stained and waxed. It is well to wax the picture panel, too. Shelves rest on and are fastened to ½ × ½ inch strips screwed to the side pieces.

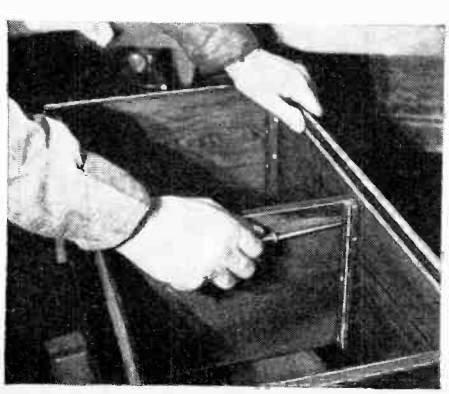


The completed bookcase. A glued-on picture adds to the attractiveness of the lower panel. The picture and panel are waxed.

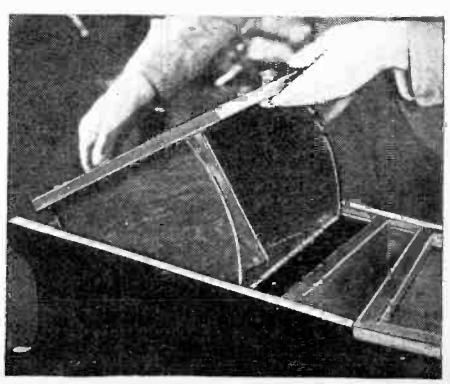
Before staining or painting a job like this, especially in cases where a soft wood has been employed in the construction, it is a good plan to try out the stain or paint on test pieces of the same wood. In this way it is possible to determine whether the particular shade chosen really will match other furniture in the room when it has dried. The effect of several coats may be tried, with a view to arriving at just the shade desired.

If the corner in which the bookcase is to stand is a little too bright, or if it is desired to relieve the tone of a too bright suite of furniture, a dark color may be chosen with advantage, and *vice versa*. Or if a modernistic effect is desired, brightly colored lacquers may be used. Also, instead of gluing on a picture, as suggested, transfers of various designs are readily available which can be applied where desired.

The shelves are supported by strips fastened with round-head screws. The strips also serve to prevent excessive warping of the sides.

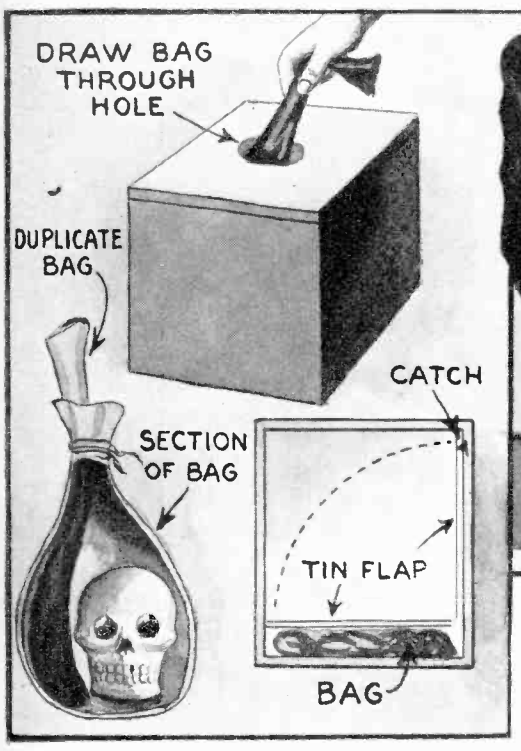


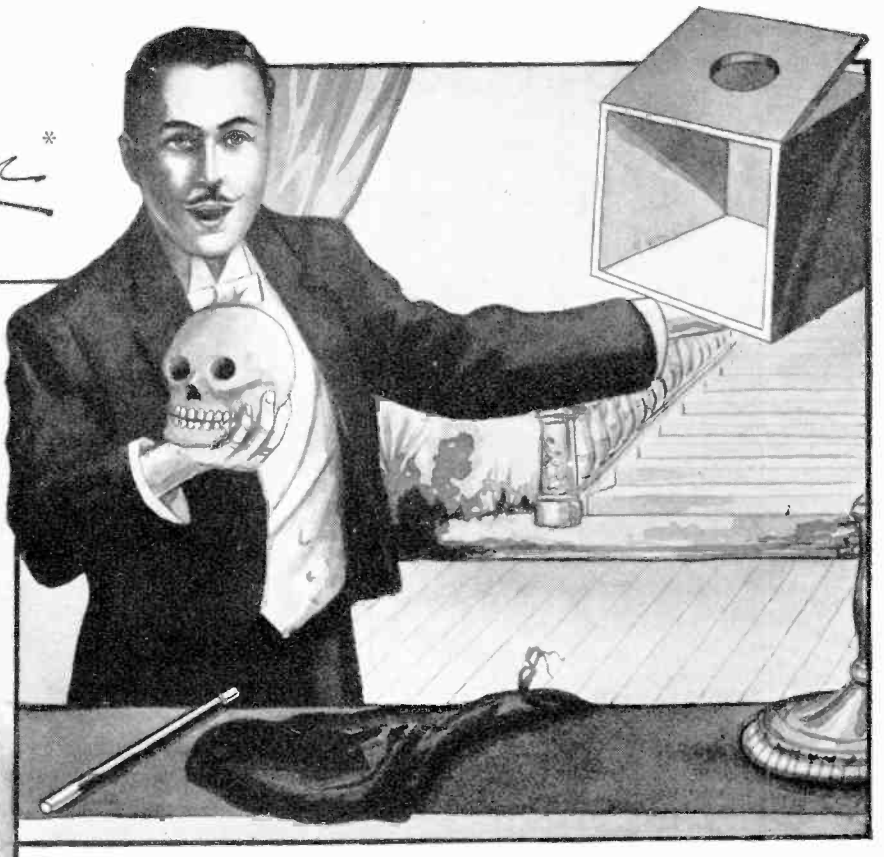
Hinges that are used on the magazine compartment at the bottom must be separable, so that the door with its attached plywood pieces can be inserted.



MAGIC

By Tunninger*

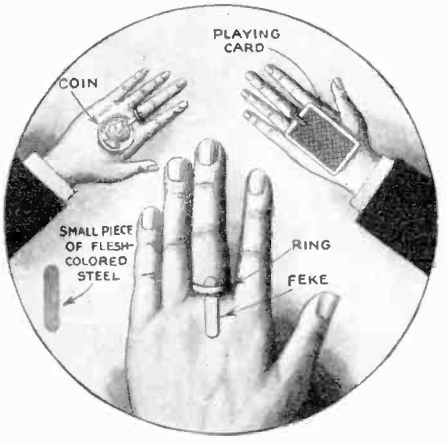




Skull Illusion

A LIFE size papier maché skull, after being examined, is put into a small sack, made of black silk, and the neck of the sack tied with a piece of tape. The sack and its contents are put into a box, and the neck of the bag adjusted to protrude through a small hole in the cover of the box. This hole is about an inch in diameter. Slowly and mysteriously, the magician draws the sack clearly through and out the hole in the cover of the casket, and tosses it to the spectators for immediate inspection. Careful examination proves that the sack has absolutely no opening, the sewn sides are intact, and the tape around its neck is quite secure. The skull is removed from the box, and the box shown empty.

Two sacks are used. The one is concealed inside the other. After the skull has been placed in the outer sack, the tape which binds the neck really binds the neck of the inner and concealed sack firmly. The outer bag, or the one in which the skull actually rests, is merely held firm and in place, by the lower edge of the tape, which is deliberately tied in this manner. Thus, it is the inner sack which is drawn out through the opening in the box, leaving the skull and the original sack upon the inside. After the presentation of the illusion, the box is opened, and the skull removed. A flap of tin or plywood hinged close to the lower corner of the box drops to the bottom, allowing sufficient space between the flap and the actual bottom to conceal the bag, which is still on the inside of the box. This enables the wonder worker to apparently show the casket empty.

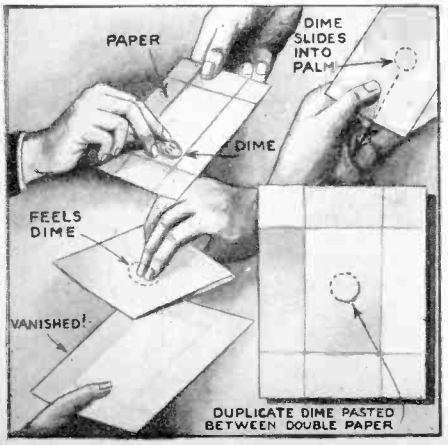


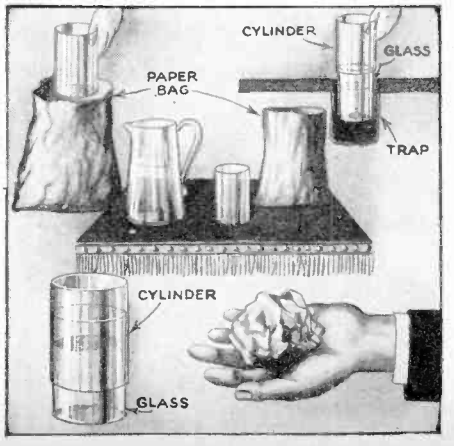
Enchanted Dime

HERE is an excellent pocket trick, easily constructed, that is unusually effective. The magician asks for the loan of a ten cent piece, which he places carefully in the center of a small piece of wrapping paper. The paper is folded several times, and is passed to some spectator, who is requested to feel the silver piece secreted safely within its folds. The paper is then carefully unfolded by the wizard, who has bared his arms to the elbow, and without any false moves or suspicious manipulations, is proven to be unquestionably empty.

The illusive dime may be magically produced elsewhere, if the conjurer so desires.

Explanation: A duplicate dime is pasted, beforehand, between two sheets of thin wrapping paper. When the original dime has been placed in the center of the paper, in the act of folding the paper over (*Continued on page* 263)





* No. 94 of a series of articles on magic appearing monthly

Overhauling the Car for Week-End Trips

Hot Summer Days Make Trips to Amusement Centers and Seashores Enjoyable Indeed, If Your Automobile Is Properly Equipped and Adjusted

By Arthur George
Consulting Engineer

THE pleasure of week-end excursions may be marred by an overcrowded car or lack of preparation. A little activity on your part will go a long way toward making your outings more enjoyable. It is possible to procure a small lean-to tent of the type shown in the illustration or make up one of canvas. These are excellent for seaside, lake shore or river bank and for changing clothes. The wet bathing suits are kept entirely out of the car.

A discarded, folding leg bridge table, varnished over, is handy at lunch time or is equally useful as a tent table to hold clothing.

If the tent is to be used for sleeping out, suitable mattresses for sleeping are required.

Such equipment as will be needed should be carried outside the car. Holders for strapping the tent, mattresses, bags and tables to the running boards and to the spare tire can be made up so as to be detachable. The illustration shows running board holders with a single clamp screw. Also shown in Fig. 1 is a hanger for baggage carried by the spare tire. These parts can be made easily from scrap iron. The handy man can easily provide such detachable baggage facilities for his car. In this the car will not be overcrowded with baggage and passengers can ride in comfort, free from cramped legs and aching bodies, which so often result from the lack of space occasioned by piling up the luggage inside the car.

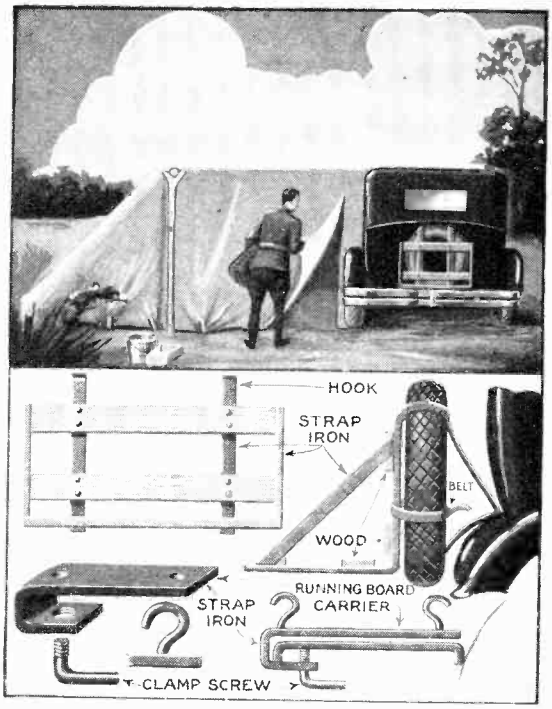


Fig. 1—A sleeping tent, holders for strapping mattresses and tables, and a hanger will add to your comfort on over-night trips.

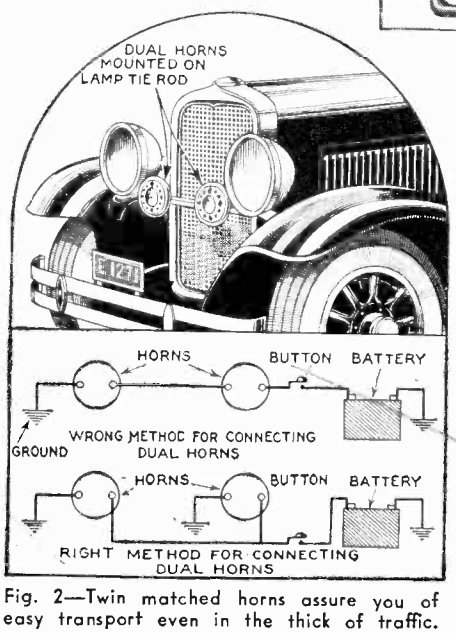


Fig. 2—Twin matched horns assure you of easy transport even in the thick of traffic.

The choice between under-hood mounting or lamp tie-rod mounting is only a matter of personal preference—either place has certain advantages. If mounted under the hood, the horns are protected from the elements. If mounted on the tie-rod, they sound a little louder possibly, but are affected by the weather. In winter, outside horns are sometimes deadened by sleet and snow. If sleet accumulates in the tubular part of a horn, it may cease to function.

The illustration, Fig. 2, shows the correct and wrong methods for connecting up the horn circuits. A study of the diagrams will make it clear how the extra horn should be connected to insure its operating at maximum efficiency. If connected, as was done by several owners in the method indicated as wrong, the horn tone will be much subdued, that is, both horns will blow together but faintly.

Twin horns and matched tone horns certainly do warn traffic and assure the owner right of way. If the car driver desires to supplement his present equipment with another horn, making a twin combination, it is not expensive to procure another of the exact type as the one on the car.

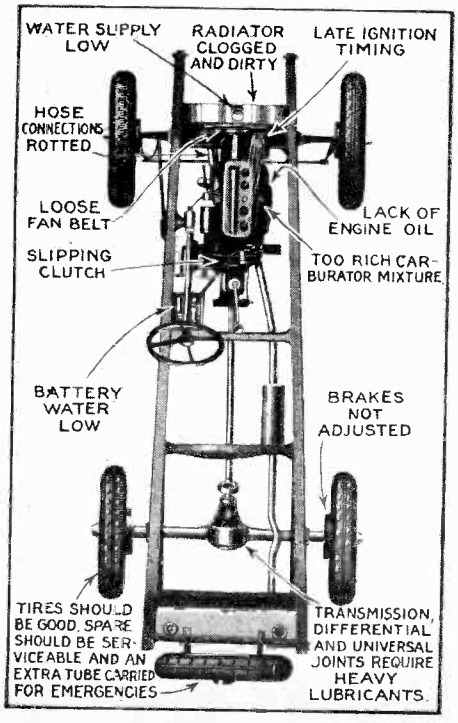


Fig. 3—Follow this chart in inspecting and adjusting your machine, prior to outings.

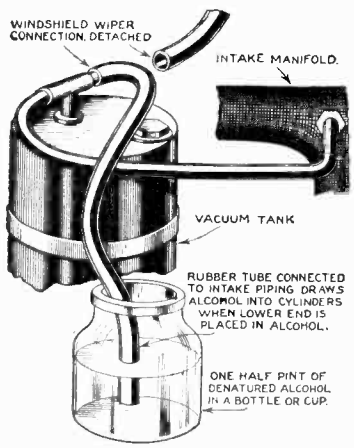


Fig. 4—Injecting denatured alcohol into the engine after you have removed the engine head.

If the car has not been overhauled for summer driving, you may expect trouble at any time, ranging from overheating to complete engine failure. It is desirable now to give special attention to the cooling system. Along with other essential details, Fig. 3 shows where attention may be required. A slipping clutch may occur in summer, especially where parts are not kept clean, as grease has a tendency to spread rapidly in hot weather. As engine oil goes fast on long drives in hot weather, see that an abundant (*Continued on page 245*)

For the Home Machinist

Spring Forming, How to Bend Pipes, Riveting Methods, and the Proper Use of the Hacksaw Are Discussed in Detail

By George A. Luers

Supervisor of Ordnance Design, Naval Gun Factory, Washington, D. C.

THE young man entering the machinists' trade will find no short road to success. Each job presents its own obstacles and even when aided by older machinists, the instruction which he will receive will not be easily absorbed.

Spring winding, in the machinists' trade, is an art infrequently mastered. Most of us know that it is possible to produce springs with a lathe, mandrel, tool post and a bar. Illustrated in Fig. 1 is a spring-making technique as practiced by some experienced men. The method is used when only short lengths of coiled wire are required, possibly a variety of sizes to work into some experimental job. A simple bending handle as shown is used jointly with a round bar and a vise. The mandrel bar is of the size needed for the spring. The mandrel and spring wire are all gripped in the vise. The end of the wire is passed through the bending handle and the wire is bent around the bar. After springs are made it is hard to hold them for shaping the ends, putting in eyes or hooks.

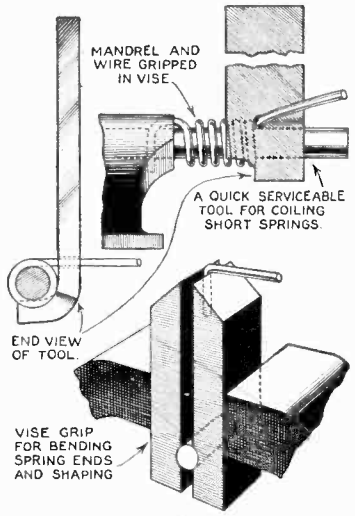


Fig. 1—Short springs can be very nicely formed in this way.

In the lower part of the illustration is shown a good tool for this service. Two pieces of flat stock, with a single pin as a fulcrum, form the tool. It is advisable if you expect to use it frequently, to fasten the two sides with a loose bolt and spring. This tool is used in the regular vise, in the manner illustrated. The writer asks any of the readers to try and find simpler tools for making springs.

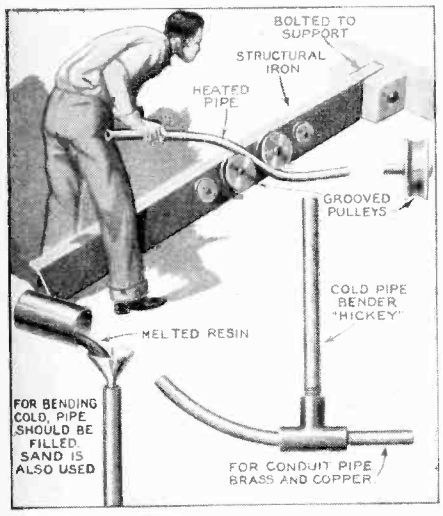


Fig. 2—This is the procedure to be followed in bending pipe without flattening it.

If you remember your first unguided attempt at bending a pipe, you will know how quickly the cold pipe will buckle and flatten at the bend. The most dependable way to bend pipe is to follow the method shown in Fig. 2 using grooved pulleys, mounted on a stiff piece of angle iron. To bend the pipe, it should be heated in the forge until it attains a red color, placed quickly between the pulleys and forced around the rolls with hand pressure. If the pipe cools it should be reheated and watched carefully while bending, to avoid flattening. With proper heat and by keeping the pipe well between the grooved rollers, intricate bends can be made in the pipe.

If pipe must be bent cold, pour in melted rosin, using a funnel, and plug the lower end of the pipe. When the rosin cools, the pipe can be bent quite sharply, while cold, without danger of collapsing. A tool for cold bending small conduit piping, copper and brass pipe, is shown also in Fig. 2. This tool sometimes called a "hickey" is a pipe to which is fastened another long piece of pipe which serves as a handle. To use this, the pipe is placed on the floor and the bender is used to force the pipe into a desired curve. The "hickey" will give excellent results, if not too sharp a bend is attempted.

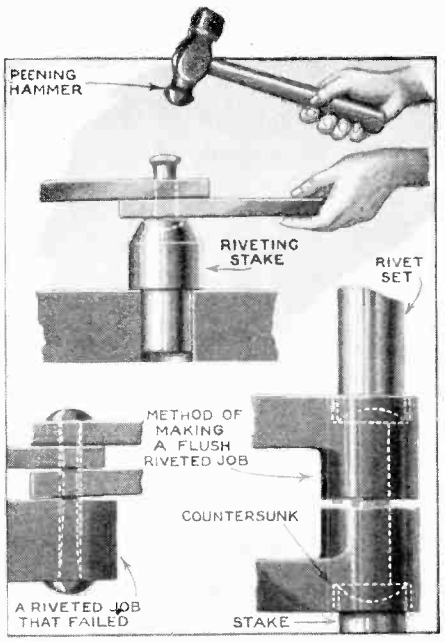
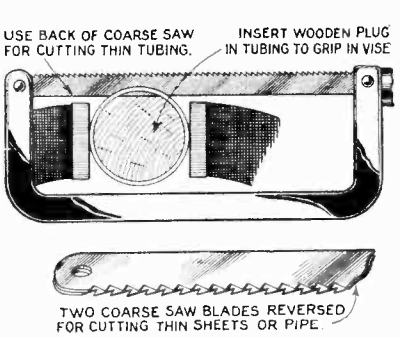


Fig. 3—In riveting, the success of the job depends a good deal upon the size of the rivet used. See text.

It is essential the young machinist should know the fundamentals of riveting; what can be riveted and what cannot be so treated. In placing hot rivets, the heading is done while hot. When the body of the rivet cools down, the distance between the heads shortens and the plates are thus gripped solidly together. Cold riveting is only permissible on thin plates and where the body of the rivet fits the holes in the plates. The heading of the rivet expands the body of the rivet, making a tight fit, provided the rivet is not too long.

An example of faulty riveting is shown at the bottom of Fig. 3. Here an attempt was made to rivet three plates and a casting jointly. The extra length rivet failed to expand before heading up and under load the plates shifted. In this instance it was necessary to sub-

(*Continued on page 247*)



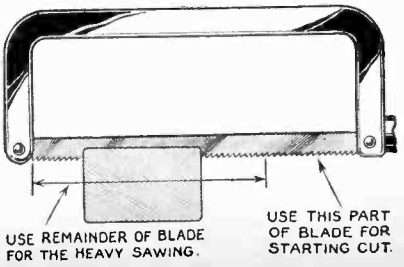
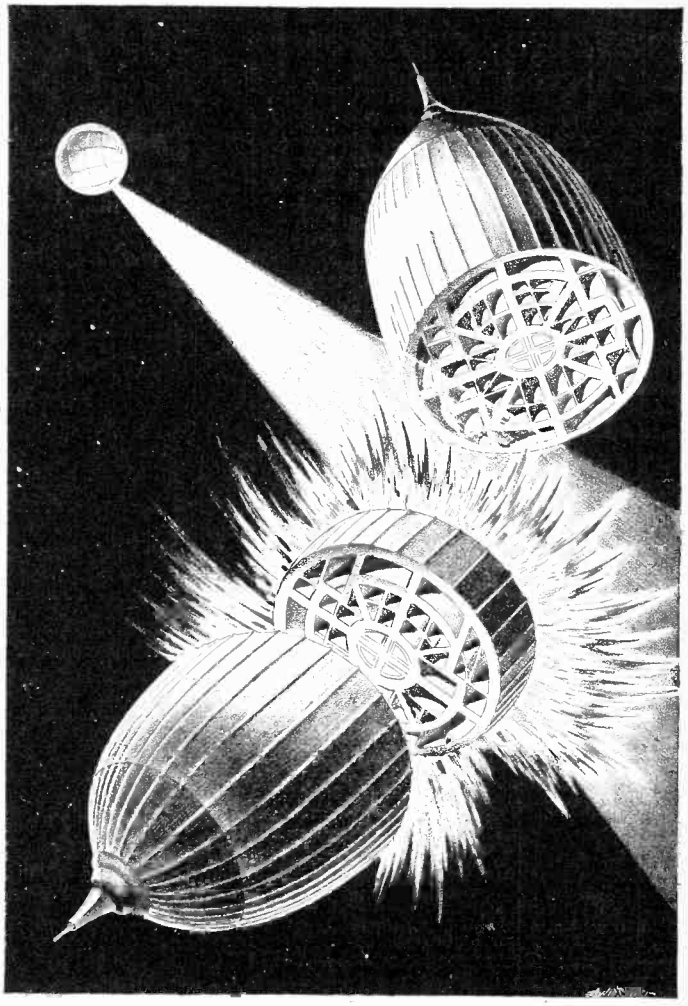


Fig. 4—Always keep one part of the blade sharp and in good condition.

Sliced by Infra-red and Ultra-Violet Rays!



MAJESTICALLY, smoothly, powerfully, the gigantic interplanetary vessel *Arcturus* leaves her dock on the earth for her regular trip to Mars. Built of the staunchest metal, protected by deadly projector rays, the *Arcturus* has no need to fear the cosmic bodies hurling through space to challenge her way! She can pass through treacherous meteoric swarms with ease.

Stevens, the crack computer of the interplanetary route and a scientist of no mean ability, is on the ship, and so is Nadia, daughter of the owner. It is while Stevens is showing Nadia the ship that the crash comes! A crash impossible to explain until Stevens investigates—only to find that their section has been neatly sliced from the rest of the ship by powerful rays! Infra-red and ultra-violet rays of a velocity and power unknown to the earth or Mars!

Who are these mysterious invaders? What do they want now with the castaways in space?

"SPACEHOUNDS," a new story by Dr. Edward E. Smith, of "Skylarks of Space" and "Skylark Three" fame, is the most thrilling story yet from the pen of this brilliant author. Although AMAZING STORIES published the first of these three years ago, and the second last year, every day still brings request upon request to the publishers for the copies in which these stories appeared.

AND NOW—this new serial "SPACEHOUNDS"—beginning in the July issue of AMAZING STORIES and by the same author, is the most fascinating and amazing of all! Be sure not to miss any issues containing these installments. Sign the coupon on the right, and we will enter your subscription for a special introductory period of 5 months for only $1.00—beginning with the July issue. Or

ASK YOUR NEWSDEALER TO RESERVE YOUR COPIES
JULY ISSUE ON SALE JUNE 5TH—PRICE 25c

"Stevens made out a relatively tiny ball of metal . . . at a distance of perhaps a mile. From this ball there shot a blinding plane of light,—and the Arcturus fell apart."

PATENT ADVICE

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.

Automobile Steering Mechanism

(1271) Mr. C. E. Ludolph, Freeport, Illinois, points out the advantages of a new form of steering for automobiles which he has devised and requests our opinion.

A. In addition to the advantages which you enumerate, there are many disadvantages, but if the system were properly designed and carefully developed with some sort of a safety so that in the event that the pressure drops in your system, the brake will automatically be applied, we are of the opinion that this idea presents something of concrete value. Your greatest difficulty would be in getting some automobile manufacturer to make use of this method and apply it to the cars which he makes. Unfortunately, you did not send a diagram with your description and therefore we cannot comment further.

There are two ways in which this apparatus can be built; one of them would be quite difficult to maintain in constant operation. We advise careful investigation, development work in the form of a model, and when the model proves practical you might proceed further, bearing in mind of course that there is no guarantee that the method will be accepted. If the patent is broad and basic, it will prevent anyone else from using a similar system during the life of the patent.

Aeroplane

(1272) Mr. Rudolph Schertz, Youngstown, Ohio, presents a copy of patent No. 1,725,481, issued on August 20, 1929, dealing with an airplane capable of landing on water and which supposedly has great sustaining power because of air pockets in the fuselage and wings and specially designed air outlets or escapes. The airplane is also adapted for ground landing. He claims that he has something people have been looking for.

A. We do not see how your device presents anything superior to existing types of machines. There are many details thereof which could not even be considered good engineering practice.

There is really only one way to prove the value of this invention and that is to make a workable flying model, man-carrying size. This should not be difficult nor extremely expensive. If the device does what you claim for it, there is a possibility of developing the suggestion in such a form that it will interest financial backers.

There are today hundreds of airplane patents, supposedly improvements on existing machines or radical departures from present styles of aircraft, which will never see the light of a successful market. As to whether or not yours will do so, depends entirely on its merits, on your own ability and on your method of securing finances.

Glass Dispensing Rod

(1273) Mr. Joseph X. Labovsky, Wilmington, Delaware, submits a suggestion of a capillary tube to be fitted to an iodine or mercurochrome bottle for applying the antiseptic directly to the wound. He requests our advice.

A. The capillary applicator which you have designed is not, in our opinion, a marketable product. The cost of construction of the capillary tube is quite high. The rubber stopper must be differently constructed so as to operate with this applicator and the capillary tube is easily clogged up by a slight evaporation and crystalization of the chemical from the solution. Should the capillary tube be clogged up, it becomes impossible for anyone to clean out the bore of the tube again. We do not believe that the product is a salable item.

Movie Advertising

(1274) Mr. A. L. Butcher, Maryville, Tenn., submits diagrams and descriptions of an invention for movie advertising operated by either a clock-work motor or an electrical motor, containing an automatic rewind or a long, endless film. He requests our opinion.

A. We do not see anything patentable in the method you have outlined. As a matter of fact there are movie advertising machines on the market today which are far superior in principle to either one of the methods you have projected and will take much more film, housing this in much smaller space. We certainly do not advise further action.

Drafting Triangle

(1275) I. L. Hull, Milwaukee, Wis., has submitted a new drafting triangle which contains an adjustable letter guide. He asks our opinion of the same.

A. We believe the idea that you have advanced is original and can probably be made into a worthwhile marketable item. We would advise that you have a patent search made to indicate the thoroughness of the protection which you can secure. We would also suggest that you use some form of locking means for securing the rotating disc so that the disc cannot possibly shift. We would also advise that the slant guide be made in an adjustable form.

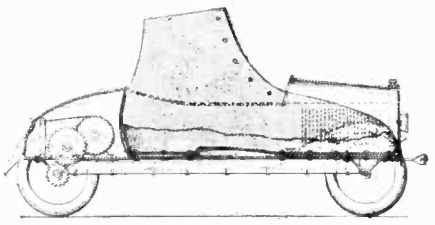
Among the Inventors

Notice to Readers:

AN appreciable period of time elapses between the filing of a patent and the date upon which the patent is granted. During this interval inventors frequently move. We regret that it is quite impossible for us to supply the correct addresses of persons whose inventions appear on this page, nor can we furnish information about when the product may appear on the market. Attorneys who prosecuted the patent cases can furnish the most reliable data. Copies of patents are available at ten cents each from the U. S. Patent Office, Washington, D. C.

Roller Skate Given Miniature-Automobile Appearance

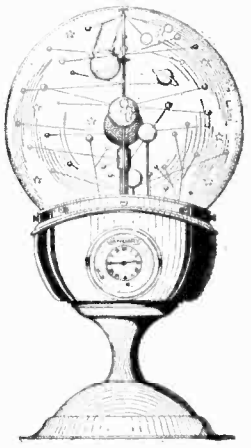
WE all like to embellish the playtoys that we use. The boy buys a shiny lamp for his bicycle and the girl a stiffly starched new dress for her



favorite doll. And more or less in the same spirit, so it seems to us, Mr. H. Dupuis has designed a roller skate that looks like a Liliputian motor car. He states that the extra metal parts that make up the body of the car will hold the foot of the wearer firmly to the skate and afford him considerable protection at the same time. A music box is so connected with the wheels that it sounds continually while the skate moves. Refer to patent 775,895.

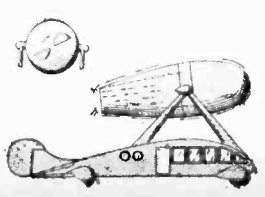
Planetarium-Clock

COUNTLESS students eager to observe the movements of the better known celestial bodies have built mechanisms which are working models of the solar system. Mr. Tomasevich following in their footsteps has constructed an all-embracing device. Included in his conception, as noted in patent number 1,770,820, are a regular timepiece and a calendar showing the months of the year, besides a most intricately arranged set of units representing the more familiar heavenly orbs and their motions. An electric lamp takes the place of the sun. The entire device is driven by clockwork.



Revolving Cylindroid Airplane Propeller

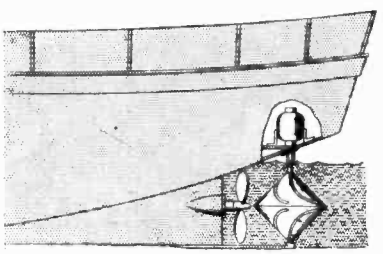
AIRCRAFT design undergoes so many changes, some radical, many merely slight modifications of existing constructions, that one is not at all surprised by the appearance of a new and revolutionary working plan. The airplane that is the subject of patent 1,790,162 assigned to Mr. P. Maiwurn is provided with a revolving hollow tube instead of a propeller. This tube has two scoops located at its front end which is closed except for slits leading from these scoops into the interior of the tube. The terminal end of the tube is open. In operation the scoops are expected to gather in the air immediately in front of them, thus creating an area of rarefication, and deliver this air to the interior of the tube. Thence it will be expelled through the rear aperture, causing the plane to move forward. The combination of the two effects is expected to provide motion.



The scoops which are expected to gather the air are plainly shown.

A Motor-Driven Rotary Rudder

RUDDERS have always been thought of as plane surfaces, and most improvements in their design have been at-



tempts at providing better means of controlling their movements. However, at least one inventor has departed from the usual form.

Mr. Eustis Corcoran, as noted in patent number 1,777,912, has designed a rudder which consists of two congruous cones, mounted base to base. These are provided with spiral grooves or helixes of identical pitch, one right-handed and the other left-handed. When the device is rotated by a motor the reaction of the water tends to turn the ship to right or left according to the direction in which the rudder is revolving.

Overhauling the Car for Week-End Trips

(*Continued from page 239*)

supply of oil is in the reservoir.

The battery water will evaporate more rapidly on long drives in warm weather; check this up. It is advisable to test for a loose timing chain, adjusting where needed and also to check the ignition timing, as a late spark will cause the engine to overheat. The carburetor mixture should be cut down as far as possible, for the engine will operate better if the fuel is burned up clean. The brakes are highly important on long trips and should be adjusted in view of traffic conditions. The lubricant in the transmission, differential and universal may thin and leak out on hot days, so it is advisable to check this, adding heavy grades of lubricant.

All tires should be good, the spare should be good, and an extra tube is worth dollars when miles from a garage.

When the engine knocks because it has accumulated carbon, only gasoline

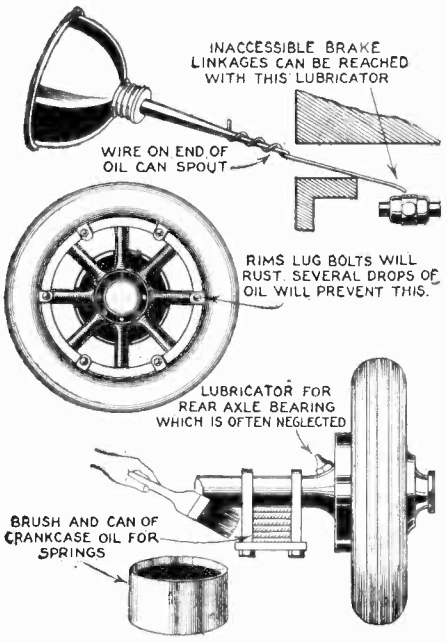


Fig. 5—Oiling points and how to reach them.

with non-knocking properties can be used with any satisfaction. The job of removing the engine head to scrape away carbon is one each motorist would avoid, but is the most dependable.

A method used by some motorists, with good results, is shown in Fig. 4, consisting of means for injecting denatured alcohol into the engine. In this the injections of alcohol loosen the carbon and it is blown out with the exhaust. The alcohol is sucked into the cylinders after the engine is speeded up. It is left for two or three hours and the engine is started. Incidentally alcohol is excellent to clean spark plugs.

So many places on the automobile are not oiled simply because it is not possible to easily reach them. Many joints and links in brake systems, spark and throttle connections are thus neglected. If the owner will provide a simple heavy wire extension for the oil can, as shown in Fig. 5, these and other inaccessible points can be reached.

What's New in Radio

New Pentode Tube

THE Arcturus Radio Tube Company has recently marketed a power output pentode, designated as the Type PZ. The purpose of the pentode, in comparison with triode power output tubes, is to provide a tube having a high mutual conductance and a high power sensitivity. Because of its high power sensitivity the pentode delivers an output of 2.5 watts with 11.7 volts input as compared to the -45 triode, which delivers a maximum output of only 1.6 with an input of 35.4 volts. This factor permits the operation of the pentode at maximum output directly from the detector tube. The amplification factor of the Type PZ pentode is 95 as compared to 3.8 with –45 power output triodes. Both of these factors increase the amplification sufficiently to obtain maximum power output with a single a. f. stage as compared to the usual two stages.

The characteristics of the Arcturus Type PZ pentode are:

Filament voltage.....	2.5 volts
Filament current.....	1.5 amperes
Plate voltage.....	250 volts
Plate current.....	32.5 milliamps.
Control grid bias.....	16.5 volts
Space charge grid potential	250 volts
Space charge grid current	7 milliamperes
Cathode grid potential	0*
Plate impedance.....	38,000 ohms
Transconductance ...	2,500 micromhos
Amplification factor..	95
Power output.....	2.5 watts

*As the space charge grid is connected to the center of the filament the potential is substantially zero.

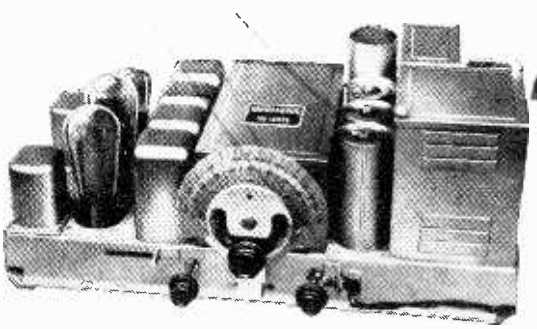
The pentode, it is stated, is four times as sensitive as the –45 power tube—a property of no small economic importance when considering output, detector overload and pre-amplification.

New Period Cabinets

MORE than ever before, radio sets have come to be regarded from a home decorative angle, and today a radio cabinet must be worthy of the same close inspection that might be bestowed upon any other fine piece of furniture. It is for this reason that Stewart-Warner have produced a line of cabinets designed to follow the lines of various "period" furnishings. Instead of reproducing the ornamentation with inexpensive "moulded carvings"—plastic composition that dries to brittle consistency and cracks or chips in use—the new cabinets are embellished with genuine wood carvings, cut deep into the surface of the solid wood.

An old English original provided the design for the "St. James" period model illustrated on this page. The cabinet front is solid walnut, carved deeply in Elizabethan *motif* and provided with sliding door. The overlays are redwood burl.

The Series 100 chassis installed in these cabinets has a sturdy, welded steel frame and uses an improved tuned radio frequency, 8-tube, screen-grid circuit that will not oscillate. New type resistances prevent trouble from this source. The switch knob has been eliminated from the panel, the switch turning "off" and "on" as the volume control is turned. The audio system is entirely new, extending perfect tone reproduction over a far wider range than heretofore has been considered possible.

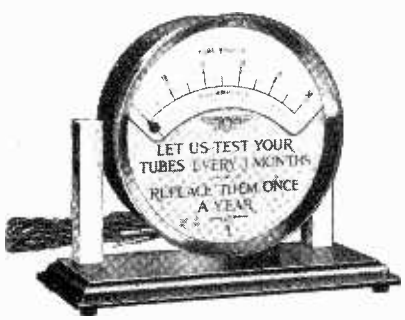


The new Stewart-Warner "St. James" period model, with sliding doors to close off the front when the set is not in use. Left—The chassis of the tuned radio frequency, 8-tube screen-grid receiver. The volume control (right-hand knob) operates the line switch.

Meter Promotes Tube Sales

THE new Tube-Seller just announced by the Jewell Electrical Instrument Company provides the radio dealer with a totally new method of merchandising radio tubes. These Tube-Sellers are "full vision" tube merchandisers. Tube values are read on two meters—a large easy-reading demonstration meter which faces the customer—a small meter on the test panel for the convenience of the salesman. Both meters read together and accurately indicate tube condition.

The big indicating meter wins customer confidence just as do the double scales on grocery and meat market weighing machines. Pattern 213 is claimed to be the finest tube merchandiser and the most convenient tube checker ever produced for the radio dealer. It is complete in every detail for rapid and accurate tube testing.



Pattern 213 Demanstration Meter

Pattern 219 Tube Seller

Such features as a pre-heater and short checker, rotary filament voltage switch, and a means for testing output pentode tubes are provided.

The Pattern 219 Tube-Seller offers the advantages of the large demonstration meter, Pattern 213, used in conjunction with a counter-type tube tester, the familiar Jewell Pattern 209. The demonstration meter is connected by a ten-foot cord. This instrument tests all standard types of tubes. Output pentodes may be tested.

Answers and Prize Awards in April Puzzle Contest

First Prize, of $10, is awarded to:
Frederick E. Loescher, Riverview Manor, Harrisburg, Pa.

Second Prize, of $5, is awarded to:
Ernest R. Churchill, 4846 Carrollton Ave., Indianapolis, Ind.

The ten prizes, of one dollar each, are awarded to the following:
W. B. Rasmussen, 600 Campus Ave., Pullman, Wash.
Thos. R. Lannon, 1816 Pearl St., Jacksonville, Fla.
A. Maxson Smith, 900 Title Insurance Building, Los Angeles, Cal.
W. Dungson, 143 Washington St., Newark, N. J.
Simon Nelson, 1321 Jefferson St., N. E., Minneapolis, Minn.
R. A. Powell, 2928 11th Ave., Columbus, Ga.
Paul E. Grof, Hooversville, Pa.
Alfred J. Corns, P. O. Box 217, Glen Morgan, W. Va.
P. C. Braendlein, 6561 Falcon Ave., North Long Beach, Cal.
Arra Steve Avakian. (Please send address.)

Solution to "Buffalo Bill's Ride"

LET us call the distance that the army marched during the time that Bill was making his way to the head, X miles. So the army moved X, and Bill moved 30 plus X miles. Then Bill, returning, must have gone back that distance X miles while the army moved forward 30 miles minus X. Thus we have the statement in proportion:

30 plus X is to X as X is to 30 minus X. The value of X squared proves to be 450; and X equals 21.21320343 plus.

Buffalo Bill traveled 30 miles and twice that distance X, a total of 72.42640686 plus miles.

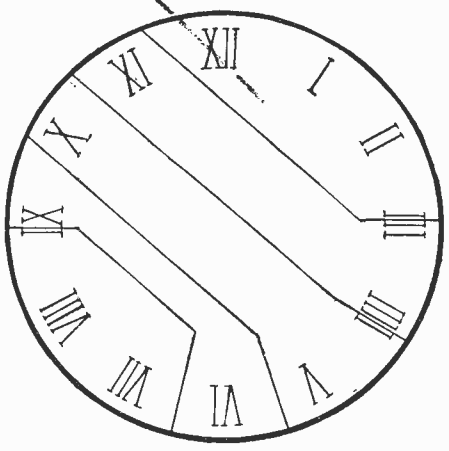
Solution to "The Clock Race"

IT was told that the alarm clock gained one minute per hour on regular time, while grandfather's clock lost two minutes per hour, as compared with correct time. Therefore, in every sixty-one minutes of its progress the alarm clock gained three minutes upon its rival.

At the end of the race the alarm clock was sixty minutes ahead, so we have but to divide sixty by three to learn how many sixty-one minute stretches the alarm clock had run in the race.

Twenty times 61 gives us 1,220 minutes as the dial distance covered by the winner. This equals twenty and one-third hours, which deducted from 8 o'clock takes us back to 11:40, as the standard time at which the race must have started the previous morning.

Solution to "Dissecting the Clock Dial"



THE accompanying diagram illustrates how the clock dial can be divided into five parts, each of which contains numbers totaling to 16. Either XI or III may be split in forming the upper groups.

For the Home Machinist

(*Continued from page* 240)

stitute body bound bolts. It is never advisable to make rivets too long, or the work will not hold securely.

Where rivet heads interfere with assembly, it is possible to counterbore and sink the heads below the surface of the parts, as illustrated in Fig. 3, lower right view. There is no set rule for the length of a rivet before driving, but it is safe to make the rivet one third longer than the thickness of the plates, especially if it fits loosely in the holes.

All mechanics know how to use a hacksaw, but not all know how to get best results. Fine hacksaw blades should be used to cut light sheet metal, thin tubing and hard steel. Fine blades should also be used for cutting brass, copper and wrought iron pipe. The saw blade should be strained or taut in the frame and worked at a speed of 50 strokes per minute for best results. Where thin tubing is to be cut and no fine blade saw is at hand, an emergency method is to cut this with the back of the blade. A wooden plug in the tubing will allow gripping in the vise, as shown in Fig. 4. Another method of using coarse saws on pipe is to use two blades in the frame, these being reversed. These methods avoid breaking the teeth out of the blades or breaking the blade in half.

For steady use of a saw, it is best to start the cut with the sharpest teeth in the blade. Many experienced mechanics reserve the rear end of the blade for starting cuts, and use the forward end for heavy cutting off. If this method is followed, there is always a sharp part of the saw available, to cut through the tough skin of a casting or forging.

Wrinkles and Recipes

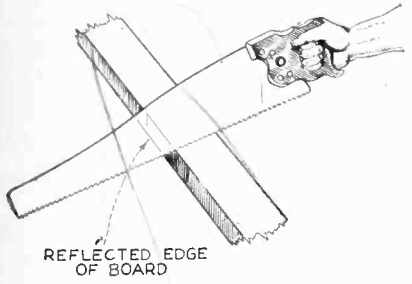
First Prize, $5.00

To Clean Soiled Walls

PREPARE a smooth cooked starch, a little thinner than for starching clothes, and apply this in a light coat over all walls and ceiling, using a brush to put it on or a clean cloth. In one-half hour you can wash off the starch with clean cloths, wrung out of warm, soft water. All smoke, grease and dirt will come off easily, without injuring the hands.
—*Maud Forbes Baker.*

Sawing Square

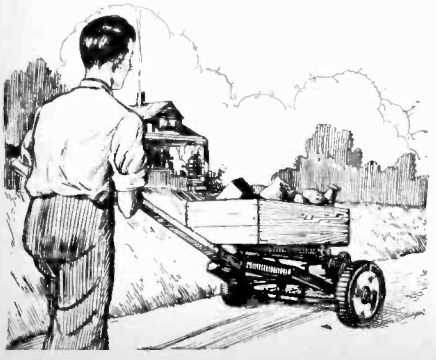
THE next time you saw a board, try this stunt. Place the saw upon the surface of the board. Now if you look into the saw blade you will see the reflection of the edge that the teeth strike.

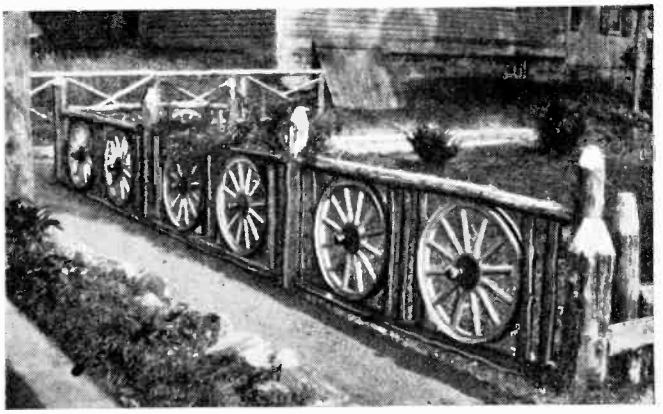


Set the saw until the board edge reflected in the saw appears to meet the same edge of the board on the opposite side of the saw. If you get this reflection in this manner you will be able to cut the board exactly square.—*E. Keyarts.*

"Lawnmower Wheelbarrow"

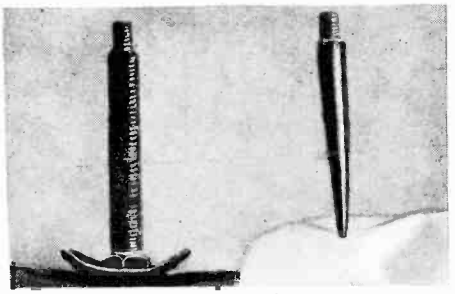
TAKE hold of the handle of the lawnmower and turn it over so that the roller is in the air. Place a suitable box on top of the handle flush with roller and tack with a couple of shingle nails. It is best to place the box lengthwise across the handle. The box can easily be pulled off for mowing. This will work excellently for hauling groceries and other articles.—*Herbert Fisk.*





Practical Use for Old Auto Wheels

OLD auto wheels, rustic cedar posts and rails were used to construct the fence pictured here. The completed fence attracted much attention because of its oddity; the contrast of the rustic cedar and symmetrical wheels had a touch of beauty.
—*Eugene Keyarts.*



To Inflate Beach Balls

TO inflate beach balls, footballs and volley balls having valveless stems is a difficult task when performed by mouth. An adapter which can be connected to a regular tire pump is very convenient as well as sanitary. This device can easily be made by anyone from an old inner tube valve, with a file. The first illustration shows the inner tube valve before being converted; the finished product is also shown.

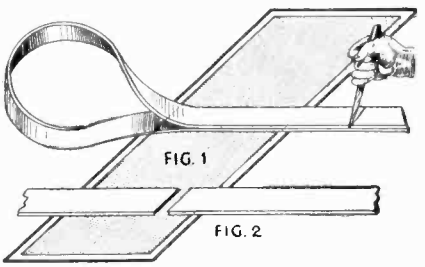
To make, just cut off the valve stem close to the locknut on the inner tube, then file to a taper as shown. It is ready for use. To use, screw the threaded end into the hose nut of the tire pump, then insert the pointed end into the stem of the ball you wish to inflate.—*P. C. Kangieser.*

$5.00 is paid each month for the best Wrinkle or Recipe accepted and published in these columns. All others used are paid for at regular rates. Address: Editor, Wrinkles and Recipes.

Belt Cutting

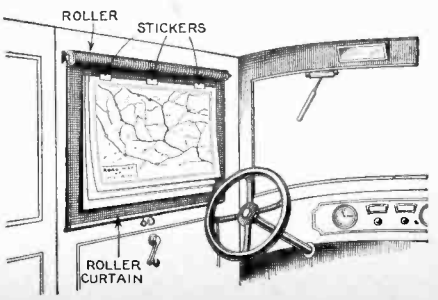
HERE is a good belt cutting kink that will insure straight running of the belt, although the joined edges are not cut square. The sketch shows methods clearly. In the top figure the belt is prepared for cutting and the lower one shows how the two ends will meet, after the operation is completed.

Twist the belt, place the two ends one on top of the other as shown, with both smooth surfaces either on the inside or on the outside, and the long edges lined up. Then cut through both pieces together. If cut square or at any angle, the edges will join perfectly.
—*R. C. Demary.*



Convenient Auto Road Map Arrangement

ROAD maps which must be unfolded and folded, and perhaps frequently referred to, are always troublesome to handle in traveling about in an automobile. The accompanying illustration, however, shows an arrangement by which reference to such maps is made especially easy and convenient. It consists of a simple roller device attached to the front framework of the enclosed car, beside the driver's seat, for bringing the map or maps into use and disposing of them afterwards. It is as easily operated as an ordinary window shade. The arrangement entails only the use of a window shade of the spring roller type, together with the map and a few stickers to hold it in place.



How and Why Tools Cut

(*Continued from page 217*)

prevent the boring head from swinging off center as the brace turns the tool. The resharpening of the spurs and cutters must follow the original angles and shapes, and as the tool is of the best quality high carbon steel, hardened and tempered, nothing should be done which would raise its temperature high enough to disturb this heat treatment. It takes from 40 to 50 different operations to produce this highly developed circular-cutting auger bit, once known by the Old English wagon builders as their *nau-ger, hub-gore*, and later by the Anglo-Saxons as a *nafe-gar*, or *nave-spear*, for *piercing* the hole in the nave, hub, of the wheels of their carts.

Of course cutting tools are not confined to wood-working, nor are they limited to those operated by hand-power. Some of the most remarkable actions of tools can be observed in the cutting of metal, and it is quite essential to understand why these tools cut. For example, a metal job revolving at high speed in a lathe and forcing over the edge of a tool a long spiral of metal is indicative of more than merely a reduction of diameter or change of form of the metal. There are at least three important essentials to be considered in such work, i.e., the *wear* of the tool, the quality of the cutting, the *cost* of power to drive the tool. These lead to a consideration of the three following actions of the tool as it removes the metal:

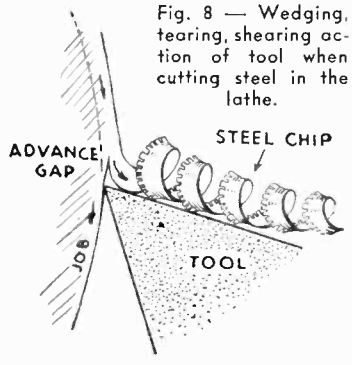


Fig. 8 — Wedging, tearing, shearing action of tool when cutting steel in the lathe.

(a) *Wedging.* This is not quite the same as the use of a wedge for splitting wood, where both sides of the wedge are in action. In metal cutting the wedging action is a single one, and it occurs between the cutting edge and the adjacent lip surface of the tool. Fig. 8. The important result is that the pressure necessary to accomplish the wedging action causes an *advance-gap* to be formed in the metal being cut just ahead of the cutting edge of the tool. The advancing edge of the cutting tool is, at least while a heavy cut is being taken, under less pressure than is the tool surface a short distance back of the cutting edge. This allows the tool to run at higher cutting speeds than would be possible if the cutting edge received the same pressure as does the lip surface close to it.

(b) *Tearing.* Following the wedging effect of the tool on the body metal, there is a *tearing* action which forces the masses of grains apart and forms the chips and shavings, which strike the tool just back of the cutting edge, flow on over the top of the tool, and are broken in short sections by a final shearing action. The cutting speed and feed partly determine the effect of the cutting action on the metal, whether the surface be left smooth or rough.

Fig. 9—Rough inside surface of the shavings shows the correct cutting action. Smooth outside is an indication of the burnishing effect produced by the rubbing of the metal upon the top of the tool back of the cutting edge.

(c) *Shearing.* If a good size shaving from a piece of steel is examined, it will be seen to have cross-lines closely formed along its entire length. Fig. 9. These indicate the shearing action on the metal after it has been torn loose by the wedging effect of the tool. The chip, instead of flowing away from the tool as a long *straight* piece, is by the shearing action regularly broken across its width, and thus takes the form of a *shaving*.

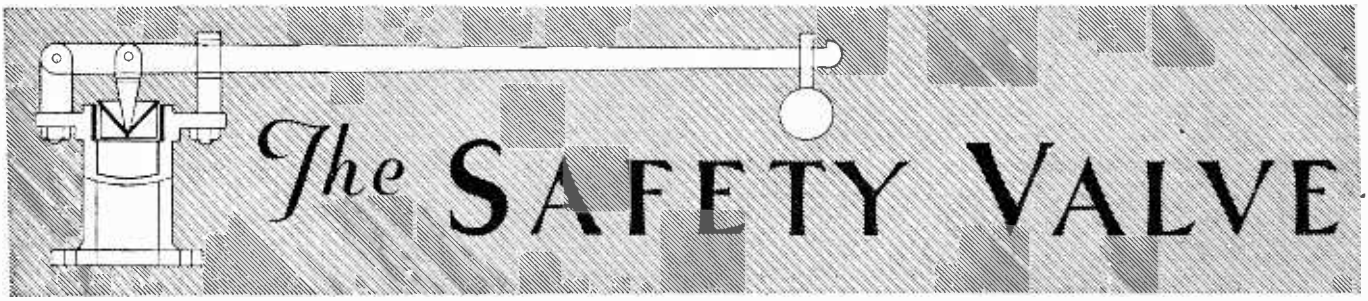
Hence, the action of such a cutting tool might be describing as that of *wedging* the edge of a tool into the metal, which causes one mass of grains to be torn loose from those of the body metal, followed by a *shearing* action which breaks the chip crosswise and forms it in a shaving.

(d) *Heat of cutting.* As the heat produced at the cutting tool is an undesirable element, its source should be considered. It is generally conceded that it is caused:

1. By the *release of the energy* required to hold the grains of metal together. That is, when one mass of grains is torn from the mass forming the body metal, the power of cohesion which held them together is released in the form of heat. This is called the *Atomic Heat*, and it makes itself felt at the most sensitive point, which is the cutting edge of the tool.

2. By the *friction of rubbing* of the chip on the tool at several places, particularly on the top where the chip strikes in its downward movement and is turned upward.

The total amount of heat from these sources will show itself at three principal points, i. e. in the *job being cut*, in the *metal removed*, and in the *tool*. The increase of temperature of the job and of the tool is in most instances of considerable importance, and particularly affects the cutting efficiency of the tool. Hence carefully prepared lubricants must be used, which are made to flow over the tool at its cutting edge and thereby keep its temperature as low as possible.



This Department Is Conducted By and For You. Expressions of Opinion or Comments Are Welcome. Please Address Them to Safety Valve Editor, in care of this publication.

Blindfold Trick

AS a reader of your fine magazine for years, I am writing this letter, which you may answer in your "Safety Valve" columns of SCIENCE & INVENTION.

Recently in a local theatre I witnessed so-called "Telepathy." I do not believe in that, nor in "Spiritualism." The séance took place as follows:

A lady was seated on the stage while a man proceeded to blindfold her: first he pasted paper stickers over her eyes, then put a wad of cotton over them, next he tied a cloth around her head, and another cloth triple-folded went over that.

The gentleman then announced that the young lady would describe and find any article shown to her by him.

Sitting in the ninth row from the front and fourth seat from the end, I offered a pencil to the man, which he took, and raised over his head, as though showing it to her, then gave it back to me. I put it in my vest pocket. He then motioned to her with his hand. In the meantime not a single word was spoken, the gentleman's lips did not even move, which, by the way, I was watching, thinking that through some sort of radio hookup, he managed to talk to her. He motioned to her, and she walked off the stage and out into the aisle, always in full view of the audience, the man was making motions as though directing her. Slowly and hesitatingly she walked over to me and took from my vest pocket that same pencil.

Can you explain this? I still say there is a trick to it.

ALEX MISLAV,
Cleveland, Ohio.

(We do not wish to expose any of those tricks that are used by theatrical performers and thus interfere with their trade of furnishing entertainment to the theatre-going populace.

In this case, we do not believe that the performance was given as a genuine telepathic demonstration. Our own Mr. Dunninger is capable of doing more than this, but he does not claim supernatural powers. He openly states that his system can be duplicated by anyone who is willing to put in the years of practice required to perfect the method he uses.

There are many ways in which stunts of this nature can be produced. It is simple to look down under paper stickers. Wads of cotton placed over the eyes aid the sight rather than impair it. The performer may merely look down along the bridge of the nose and see the feet of the assistant in the aisle. The feet signal the performer. In another method, the entire performance is pre-arranged. It is known that people who go to a theatre will hold up a ticket or card, pencil, pen, kerchief, ring or coin. The assistant will spot these various articles as any member of the audience holds them above his head and establish the pre-arrangement. Then he need merely await the foot signal which indicates into which aisle the performer is to travel for the secreted object. The third method is a signal given to the operator. In this method a person back of the back-drop spots the articles through a pair of glasses, and telephones the message to the performer; and the fourth is a code which may be delivered by a slight clicking sound heard in the receiver conveniently fitted into the ear of the performer and actuated by a key held in the pocket of the assistant.

We do not claim that any of these methods were used in the demonstration to which you allude, but we will go on record as saying that the demonstration was not genuine telepathy.—EDITOR.)

More About Archery

LOOKING through the March issue of SCIENCE AND INVENTION I was happy to find an article on archery, but as I read it I gradually cooled off and ended up wondering whether you are in the habit of accepting material on other subjects, without assuring yourselves that it is up to par. I believe, however, from long acquaintance with your magazine, that this must be an exception. Mr. C. H. Alder undoubtedly aroused the interest of a good many of your readers and so as not to disappoint them, may I suggest that you obtain, from an accomplished archer, an article that will set your readers right and tell them a little more about the use of the equipment.

SVEND A. HUEG,
Buffalo, N. Y.

(Of course the young lady who posed for the picture did not know a thing about archery. Her stance, pardon us, that word is a golf term, her position is not what it should be, but a little practice, and after checking up the many good works on archery, she will have no difficulty in mastering the principles. The article was intended to deal entirely with the construction. Perhaps in the near future, an accomplished archer will furnish the lacking details.—EDITOR.)

Wouldn't Miss It

I ENJOY your magazine very much and will never miss another copy as long as I can borrow two bits.

However, I do wish you had a mathematical department as has been suggested before. I greatly enjoy working out Sam Loyd's problems. Whatever you do, don't take his page away from him. There are thousands of fellows whose chief hobby is puzzling on a good problem.

CARLETON GAMAGE,
Skowhegan, Maine

Around a Tree

I HAVE been watching with interest, for some time, your Safety Valve Department and would like to have the answers to two questions.

The questions are: A squirrel is on a tree and a man is out from the tree going around the tree, but the squirrel stays opposite the man all the time. The man makes complete circles around the tree with the squirrel opposite him all the time. The question is—Does the man go around the squirrel?

The other question: If a gun (no matter how powerful) is shot in a perfectly level position and in a perfectly level place, so that the bullet will not hit anything until it comes to the ground and something is dropped from the same level of the gun (any height from the ground) exactly the same time the bullet leaves the end of the barrel, which body will hit the ground first?

RAYMOND MCLAIN,
Waldron, Ark.

(The answer to your first question is, that the man goes around the squirrel. The following will make the explanation clear. Let us assume that you constrict the diameter of the tree until this diameter approximates zero. The squirrel now turns around about itself with its face always toward the man.

The moon always presents the same face to the earth, yet it rotates. If observed from space, all sides of the moon can be seen. The moon, therefore, makes one complete rotation in a little less than 28 days, and at the same time it turns about the earth.

In reply to your second question, the bullet from the gun, shot in the manner you describe, will strike the earth at exactly the same moment another bullet of the same weight and dropped from the same height reaches the earth.—EDITOR.)

That Perpetual Motion Question

I HAVE been following with much interest your articles on perpetual motion, and it is really surprising to find that people sincerely believe such a thing can be accomplished. I was just wishing I had fifty thousand to take up the offer of Mr. Myers, up in Canada, as I could certainly use that ranch

and certified check he spoke of. It seems that a man who has lived over three score years would know he can't get something for nothing. I don't believe in man-made miracles, and like you, I'll have to be shown. After all, the world is better off without any perpetual motion, so long as the sun rises and sets on time, so why should we worry about it? Would like to hear more from Mr. Myers and his high-powered thought development.

Amazing Camels of the Plant Kingdom

(*Continued from page* 213)

The Oriental Pitcher Plant, Nepenthes, grows as an epiphyte in the same kind of forest as the Staghorn fern, and it solves its scanty food problem in a still more direct and effective way. The ends of its leaves are transformed into insect traps, bright colored bulbous affairs with open, gaping mouths at the top, which secrete nectar to attract ants and crawling insects. The unwary ones that eagerly crawl into the interior slide down into the digestive fluid at the bottom of each cup and are there drowned. These insect pitchers have all of the essential equipment of an animal stomach, being provided with digestive fluid and secreting and absorbing glands. This digestive fluid is so precious that the plant spreads an umbrella over the open mouth of the trap, to prevent rain water from diluting this liquid. These insect traps are so effective that even under the artificial conditions of a greenhouse the pitchers are always well stocked with captured ants.

While quite a different plant in all of its requirements, the water fern, Ceratopteris Thalictroides, which grows floating in the stagnant ponds and lagoons of tropical waters, because of its watery and rather poor environment, seldom produces any fruiting spores except at rare intervals when it finds anchorage in the rich, muddy bottom. Each leaf develops a new plant from a bud growing out of every notch of it, and these little baby plants are fully equipped with roots and leaves before they ever become detached from their parent.

These are just a few of the thousands of odd and curious adaptations that plants have developed to solve their own problems of food, shelter and livelihood.

The Romance of Glass

(*Continued from page 210*)

the bulbs past a row of girls who examine them for flaws, and finally pack them.

In all glass-work, immediately after the article has been formed, and before it has time to cool, it is submitted to the annealing process. This is necessary because, on coming in contact with the cool air the outer skin solidifies while the inner mass of glass is still in a fluid state. This action sets up stresses within the glass which, if not released by the annealing process, would probably cause fracture.

The ability of the interior of a mass of glass to retain heat after the outside skin is cooled was strikingly demonstrated to me at Corning when I observed a worker throw a mass of molten glass, weighing perhaps ten or fifteen pounds, into a tub of water. Five minutes later, although the outer cooled skin of glass was cracked and split into a thousand fragments, still adhering to one another, the interior was glowing a dull red.

The bulb-making machine described above may be classified as being semi-automatic, for it requires human attention to replace used up lengths of tubing. At the Wellsboro, Pa., plant of the Corning Glass Works bulbs are made at the rate of several hundred per minute by fully automatic machines. In these machines, molten glass flows in a steady stream and passes between two rollers which form it into a thin ribbon with biscuit-like projections on the upper surface. This ribbon, in turn, is picked up and carried along by a series of closely spaced and hinged iron plates which have a round hole in the centre. The operations are so timed that as each glass "biscuit" is placed over each hole, the plastic glass begins to sag through the opening, whereupon a plunger descends and pushes some more of the glass through the hole. Immediately on the withdrawal of the plunger, a puff of compressed air forms the glass projecting through the hole in the plate into a bubble, and just as this bubble is about to drop, a mould closes around it. A further sustained puff of air presses the bubble against the retaining walls of the mould, and holds it until it has cooled sufficiently for the mould to be opened, whereupon the newly formed bulb, still attached to the iron plate, moves forward into a cooling stream of air.

The inner surfaces of the moulds are coated with carbonized cork, and the moulds rotate about their vertical axes while the bulb is being formed within them, the coating and the rotation serving to produce polished, seamless bulbs. Just before leaving the machine, a nicely regulated tap of a hammer detaches the bulbs from the gathering plates, leaving them with necks having irregular edges. The bulbs are then dropped upon a conveyor which carries them past a group of burners which fuse or smooth over the rough edges and also anneal the bulb.

Operating at a speed of 250 bulbs per minute, one of these machines will produce 360,000 bulbs in the course of 24 hours, and work up in that time between 40 and 45 tons of glass.

Another fascinating section of the plant is that in which Pyrex heat-resisting glassware is made. Here a gatherer brings from the furnace a gather of glass which he holds over the lower half of an iron mould. A "gob" of glass slowly drops into the mould, and when just the right amount has been deposited, another worker literally cuts off the viscous flow from the gathering iron to the mould by means of an ordinary pair of shears. Then the upper half of the mould comes down under the action of compressed air, and slowly squeezes the gob of glass until it fills every interstice of the mould: After a few moments the upper half of the mould is withdrawn, and the newly formed article—perhaps an insulator or a baking dish—is lifted out, still glowing dull red, and carried to the lehr for annealing.

Here is a beautiful example of the cut-glass craftsman's skill.

In another section, that referred to in the opening paragraph of this article, molten glass flows continuously from a tank into the moulds, and is automatically cut off when the right amount has fallen into the mould. The filled mould then moves around one place in the circular machine to permit another empty mould to move into place under the falling stream of glass. Each mould, when filled, is closed under pressure, and a high pressure blast of cool air plays over it after the mould is closed, and at the same time the mould moves steadily around the machine in regular intermittent steps, each step being timed to synchronize with the time it takes to fill a mould. Workers are stationed at this machine to supervise its operation and remove the pressed ware after the moulds are opened.

I watched several of these machines, each attended by its busily engaged group of men, and I gradually became aware of the fact that there was no foreman in sight. Yet everything went on smoothly.

"No foreman is necessary," explained my guide. "Each man has his allotted task; each task must be performed with precision, and within a definitely limited period of time. If any man failed in his task, or even made a slight mistake, he would hold up all his fellows and perhaps necessitate the stopping of the machine and the cutting off of the continuous supply of molten glass from the tank furnace. Hence, the machine itself is the foreman."

Undoubtedly, the most spectacular and fascinating work of all is carried on at the Steuben plant, where colored art glass in the form of tumblers, vases, etc., is made. This work is all done by hand, and the individual craftsman is to be seen here at his best. He is an aristocrat, too, who will not deign to lower his dignity or soil his hands with menial tasks. He is waited upon by young gatherers, who bring from the furnace to him a gather of glass upon which he proceeds to exercise his skill; by other minions who take from him the partly completed work, reheat it in a huge, roaring furnace of gas flames, and bring it back to him; and by boys who circumspectly convey the finished work of the master and deposit it delicately in the lehr.

On receipt of a gather of "metal," the master craftsman first of all "marvers" or shapes the molten glass by rolling it to and fro across the surface of a flat steel table. Next follows the blowing process—a few puffs with the work held downwards to elongate the bubble; a few puffs with the work held above the head, to swell out the bubble; then a few spectacular swings in a circle to slightly cool off the work before giving it another puff—and now it is too cool and requires reheating, during which interval the master sits down upon his bench for a few moments of well deserved rest. The process naturally varies with every type of article, but the machine-like precision of every movement, the nonchalant manner in which it is carried out without an atom of wasted effort, is extremely impressive to watch. And surely only years and years of experience can make possible the fact that each article, when finally turned out, agrees exactly in dimensions, form and shape with the original model to which the craftsman works.

It may surprise many, as it did me, to learn that the essential process in the manufacture of any round glass vessel which is not solid, even a tumbler, is blowing. After the original bubble has been blown the final shape of the article is arrived at by various processes which necessarily vary according to the nature of the finished article. But at various stages of the work, some blowing will be resorted to. These remarks, of course, do not apply to cheap cast or machine-turned glass-ware.

The manufacture of railroad signal

lenses and colored lamp chimneys is another extensive activity at Corning. The discovery of methods of coloring glass so that the colors will remain unchanged under changing weather conditions, and of a glass which will not flake under extreme temperatures—these and a dozen other refinements are the results of years of patient scientific research and development.

It only remains now to describe briefly the process of producing cut glass, as carried out at the plant of T. G. Hawks & Company at Corning.

The first operation consists of outlining in waterproof ink on the "blank" the design which is to be followed by the cutters and engravers. If the job is a fairly bulky one with deep, wide cuts, it goes first to the operator of a steel wheel, between two and three feet in diameter and about one quarter of an inch thick. The edges of the wheel are beveled so that the cutting edge is V-shaped. The steel wheel itself does not do the cutting, however. As it revolves rapidly a mixture of water and fine carborundum powder flows continuously over the edge of the wheel, and the job is pressed against it. The result is a deep, V-shaped cut in the blank, the edges of the cut being roughened by the carborundum so that they look like frosted glass.

Finer work, of course, requires wheels which are smaller in diameter and thinner, and also a finer grade of carborundum is used. The rough edges of the cuts are next treated with wheels of a smooth stone similar to that used for razor hones. As these wheels are revolved, constantly wetted by a stream of water, the job is manipulated against the edge of the wheel until the roughness left by the carborundum is all smoothed off. Final polishing is done with the aid of rouge.

In the case of the finest work, such as delicate tracery or engraving, copper wheels, varying in diameter from two or three inches down to something like one eighth of an inch, and in thickness from about three-sixteenths of an inch down to visiting card thickness, are used in conjunction with extremely finely powdered stone.

One has only to examine a valuable piece of cut-glassware to realize the intricate and painstaking work involved, and a single goblet, extensively cut, may easily take weeks to complete. Good cut glass is extremely beautiful to behold—and so is the price ticket! But the price requires no great amount of justification after one has watched the long and tedious processes through which each piece has to go.

Of all the factories it has been my lot to visit I can truly say of the glass factories at Corning that although modern efficiency is evident in every department, its incidence has not robbed the industry of its ancient romance and fascination. The uncanny "intelligence" and precision of a machine inspire wonder and awe, but the deft competence of a skilled craftsman inspires a warmth of human feeling and admiration which I find indescribably refreshing after contemplating the innumerable and slightly sinister Frankenstein monsters of modern industry.

Fortunes in Plain Sight

(*Continued from page 207*)

from machining operations, cast scrap from automobile and other plants, old sheet and kitchen utensils, etc. New aluminum comes from bauxite ore, Saline County, Arkansas; about half is imported. The valuable alumina consists of rounded bodies, like pebbles, embedded in a pebbly fine-grained clay. The Bureau of Mines is developing a new sulphuric acid process of extracting aluminum from common clays and silicates, and reports that the cost is not far from that of the standard Bayer process. 225,000,000 pounds of aluminum are used annually, and the demand is steadily increasing, as many new alloys are being invented.

Beryllium is one of the most interesting of new metals. One-third lighter than aluminum, it is several times as strong, and at the same time almost as hard as quartz, so hard it will scratch glass. In 1922 it cost $5.000 a pound, today its cost is $4.00, and new processes will doubtless reduce this price still further. It is used for X-ray apparatus, and as electrodes in neon signs. Beryllium oxide makes harder glass and better spark plug porcelain. Soon it may displace duralumin and other aluminum alloys in aircraft and building materials.

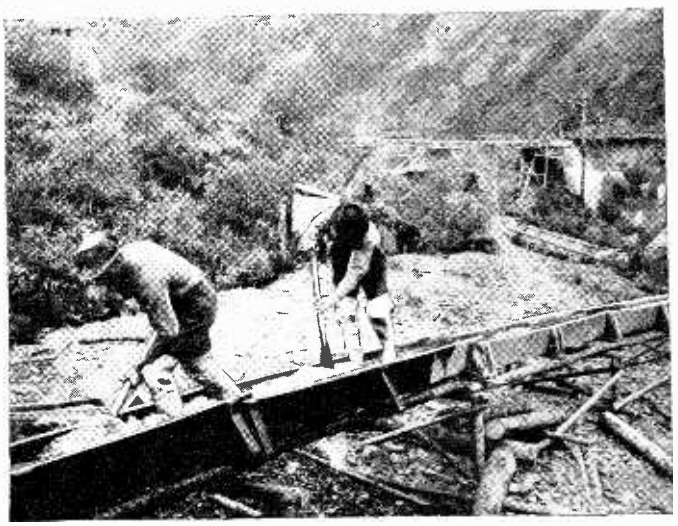
It comes from beryl ore, a waste product of feldspar and mica mining in New Hampshire, etc. In Africa are mountains of the ore, refuse from gem mining. Many new deposits are being found, such as the one in northern Winnipeg. The streets of Sverdlov, Siberia, are ballasted with beryl and semi-precious topaz, jasper and malachite. Maine has produced large beryl crystals, and one of four tons' weight is in New York's Museum of Natural History. Referring to the technical difficulty in extracting beryllium, "Product Engineering" said recently:

"We are literally walking over wealth we cannot extract. This time the solution may not be electrolytic reduction. More likely it will be by the application of the new methods of high temperatures and by vapor separation. Anyway, who will be the research genius to give industry this metal in quantity?"

One of the most useless products of early days in Utah was a black material that when burned gave off dense black smoke, and melted into a tarry substance. A settler named Gilson spent over forty years finding uses for what was found to be nearly pure bitumen. "Gilsonite" today is indispensable for telephone mouthpieces, paint, varnish, ink, and many other common products. A worthless deposit of former days is worth a vast fortune to those of today who have found its uses.

In northern Alberta are several thousand square miles of sands impregnated with bitumen, only a few feet below the surface. These "tar sands" have made perfect road-surfacing material, and yield petroleum, gasoline, etc. Natural gas is found nearby. The day is not far distant when this greatest body of bituminous material in the world will produce fortunes every year.

Slowly but surely our coal reserves are being reduced. Lower grades, such as lignite, will inevitably come into use —when better methods of processing are discovered. The next generation will be amazed at our extravagance in burning coal for heating and industrial uses, wasting highly valuable by-products. Henry Ford carefully distills all the coal that enters his huge plants,



Washing for gold, Spruce Creek, Alaska

recovering ammonium sulphate fertilizer, coal tar, motor benzol, gas and coke, over $6,000,000 a year that would otherwise be lost up the flues.

Many states and Canada have enormous areas of lignites, low grades of coal that average about one-half the heat units of ordinary coal. Various methods are being developed to burn lignites and extract their by-products. In Texas, which has over *thirty billion tons* of lignite lying only a few feet below the surface, steam plants are burning powdered lignite. In Montana and Colorado are vast deposits, while North Dakota has some 32,000 square miles that contain several hundred billion tons of this imperfect coal. Most of the state of Wyoming is underlaid with coal of varying grades.

Briquetted lignite "char" is comparable with anthracite coal in heating value and ease of handling. Such char is used regularly in some parts of Germany for household fuel, for which a special "grudekoks" stove has been devised, which holds heat when banked and is quickly started when cooking is to be done. Our Bureau of Mines reports after various tests that "the most desirable and most practical process for carbonizing lignite will be through distillation in closed, tight carbonizers, by which means the maximum yield of by-products can be obtained."

Perhaps a domestic carbonizer can be devised, which will automatically distill cheap coal, yield useful gas and "char," and pay for its upkeep in chemical by-products recovered.

Pennsylvania has produced in a century of mining over four billion tons of anthracite. From 10 per cent to 15 per cent of all this coal has been too fine to ship. The coarser particles have passed out through the "breaker," along with waste rock and slate. The finest coal is washed out with the washing water, and finally settles to the bottom of streams. Vast areas are today covered with this culm and silt.

The Pennsylvania Geological Survey estimates that "in the streams in the anthracite region and leading from it are accumulated at least 900 million tons of material which contains enough coal to make them profitable for future recovery." This coal is 20 per cent to 80 per cent combustible, and improved processes of handling and treating will no doubt be developed. Some briquetting is already done. Pulverized-fuel burning may open a great market for material that is worse than waste today.

Kane County, Utah, and Johnson County, Kentucky, have enormous beds of cannel coal, previously mentioned, that some day will yield up their valuable products. The lowest grade of coal-like material is peat, which when dried can be burned, distilled, made into fertilizer, and otherwise turned into profit.

Recently the recovery from oil wells has been increased by use of compressed air, water under pressure, "shooting" with nitroglycerine, etc. But vast reserves of oil remain for new and more effective methods. History proves that the abandoned "dumps" of this generation will be the working material for the next.

Industrial flue-gases are giving up their acids and solids. Marble-cutting chips make brick facings. The dust from plants processing precious metals yields up its gold and platinum. Waste paper, rags, household garbage and many other common wastes are valuable materials to those who know how to process them economically.

Because there are so many of these by-products still going to waste around modern cities and factories, your chances of making a fortune with them are far greater than those of finding a gold or diamond mine.

Preparing Your Outboard Boat for Racing

(*Continued from page 234*)

with a two-inch brush the following solution:

To one quart of spar varnish add ¼ pound of flaked graphite. You will have your hands full in keeping this mixture well stirred up, but it must be done, so get a smooth stick that will do the job. Now add about ½ pint of good drier and, using a fore and aft stroke, apply the mixture as evenly and as rapidly as possible. (See Fig. 2.)

Assuming that you have turned your boat upside down and that it is exposed to strong light or sunshine, allow it to dry for at least eight hours. Then with a handful of the finest steel wool obtainable, rub the entire surface, also with a fore and aft motion, until it takes on a polish and becomes smooth to the touch.

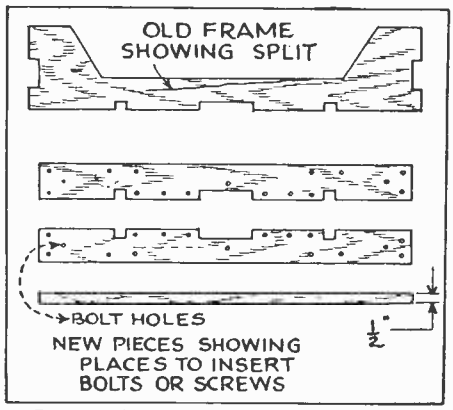


Fig. 1:—How to repair split frames.

Apply two or three more coats, buffing each one, until with the application of the third, the bottom will be so slippery that if you pour water on it the water will immediately run off, even though the bottom appears to be level.

A bottom finish applied in this manner will last at least half the season as it is only necessary to buff it up a bit after each race to keep it in shape.

Examine your tiller ropes for internal breaks. The metal core is almost always broken in one or more places after a hard season. In fact, I advocate buying new rope anyhow. The expense

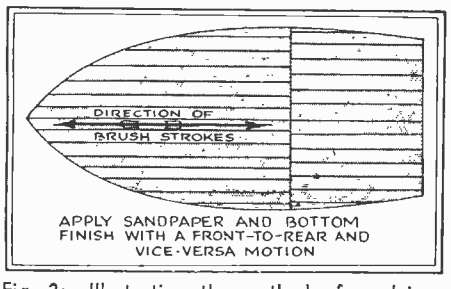


Fig. 2:—Illustrating the method of applying bottom finish to a racing hull.

is small and the insurance against accident by having a steering rope part at the wrong moment is adequate compensation for the trouble.

Examine the fin on the bottom and make sure that it is absolutely in line, for the slightest deviation when traveling at forty miles per hour will cause a constant pressure on one side of the tiller, hull and superstructure, and will cause your motor to slow down many revolutions. This last bit of information was discovered quite accidentally by the writer and has been a great help ever since.

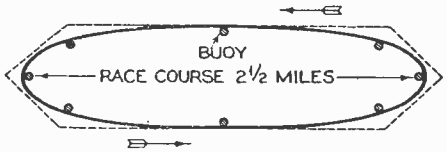


Fig. 3:—Oval line indicates fastest course. Dotted line shows wrong course to steer.

Contrary to many views on the subject, your boat should plane as nearly level as is possible when running at high speed. If your boat seems to hold her nose too high in the air, experiment with placing your body at different places in the hull until you have struck the right balance. This is mighty important in racing as a badly planing boat cuts its own speed, due to resistance.

Sometimes a boat is off balance due to the propeller being too high in the water or too low, experiments along this line have discovered many an extra mile per hour for the race driver who had the time and patience to observe the action of his boat with a transome of varying heights.

In racing, remember that in getting up to the line, in front, you have the added advantage of running your first lap in quiet water while the other fellow has to take your wash and fight it. Don't try to take the turns too sharply, as the effort expended in regaining speed lost through sharp turns and lost planing, will drop many valuable yards that the other chap is gaining on you by steering the slightly oval course shown in Fig. 3.

OUTBOARDERS, AHOY! Here is your chance to get a free membership in the American Outboard Association! Or, if you are already a member, you can get your membership renewed for another year without charge.

All you have to do is to send in a new wrinkle that can be used to good advantage by our readers in this department; and, if we publish it, you will receive your membership card, gold and silver lapel pin and official racing number in the A. O. A. on the 10th of the month of publication.

This membership is worth $5.00 and is a fully paid, voting membership entitling you to all the privileges of the Association.

Send in your new wrinkles for motors, hulls, novel stunts, racing ideas, fuels or what-have-you to J. Phillips Dykes, Marine Editor, and write on one side of the paper, placing your name and address in the upper left-hand corner. No outboard wrinkles will be returned unless postage accompanies your letter.

EDITOR.

The House of Tomorrow

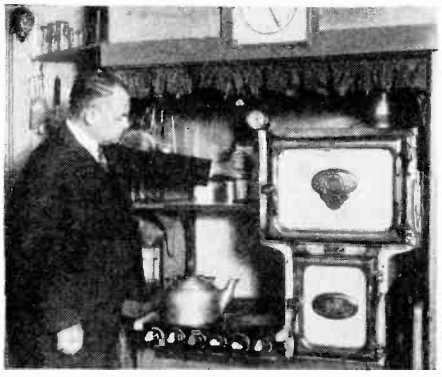
(*Continued from page* 214)

Ultra-violet bids fair to be the open sesame to our future more healthful living conditions. By its regulated use the period of useful adult life can be lengthened, not necessarily by altering the life span, but by reducing infant diseases and mortality; by influencing our nutrition: by a species of general tonic.

Again, ultra-violet will revolutionize the preparation of foods. Irradiating fruits, vegetables, raw oysters and the like increases their vitamin content, purifies them by killing germs, and aids body assimilation. Therefore eating irradiated foods will favorably affect our size, our weight, our bone growth, and strength. Science discloses, for example, that baby's milk is infinitely superior when it comes from cows that have grazed in natural sunlight or have been treated with ultra-violet, and have eaten naturally grown greens or irradiated produce. For this reason, according to Mr. Hibben, the kitchen of the future will have an irradiator under which fresh fruits and raw foods will be placed, prior to serving.

"The preparation of three meals a day need not faze the housewife then," he continued with a smile. "Pneumatic tubes may connect our homes with stores, which will be somewhat similar to our present day restaurants. These will both sell and prepare all kinds of food. If the housewife wants grapefruit, a three-pound steak well done, French fried potatoes, fresh peas, a tomato salad and apple pie and coffee for dinner at 6:30, on the dot, conveyers will deliver them."

If, on the other hand, she prefers to cook, all sorts of electric contrivances will be at her service. While it is comparatively easy to manufacture pots that



Automatic control of heating units will aid the housewife materially.

whistle when food is cooked and automatic indicators for seasoning foods, he feels that a more sensible practice is to improve our electric stoves so that automatic control of the various units will be had.

"Quite a good deal of time is wasted in thinking up devices which would prove more of a nuisance than a benefit. Why not concentrate on useful articles? A light electric blanket to cover us while we sleep would enable air to get to our skin as well as our lungs—no more cold feet, no heavy layers of covers, fewer moths! With the air we will condition, we will be able to sleep with sunshine pouring down upon us, and so get its beneficial effects always."

"If it is possible to create artificial sunshine for use indoors, don't you think that the time will come when night will be turned into day, and we'll have twenty-four hours of sunlight, indoors and outside?" he was asked.

"Decidedly not," was his answer. "In the first place, continuous sunshine will kill nearly all living greens—no vegetation could survive the combination of natural and man-made sunshine day and night. Then again, we would require three million times as much artificially made light as we have now throughout our country, to illuminate it at night. I estimate that all the incandescent lamps in existence in the United States, massed together under a single canopy, would furnish only enough light to illuminate one square mile of the earth's surface to sunshine brightness.

"This does not mean, of course, that we will not produce artificial light at night. Ten years from now, should you want to enjoy the beauties of your outdoor flower garden, or play night golf or baseball, or do a host of labors, artificial light will be more readily at your service. We may get our electricity from the tides or the heat of the earth's interior or the disintegration of mere atoms—who knows?"

Breeding Butterflies for a Livelihood

(*Continued from page* 220)

beetles; young larvae are stung by various species of parasites which lay their eggs on or inside the body of the young caterpillars—these hatch and live on the internals of it, slowly sapping its life until it eventually dies—and, often, unless extreme care be taken when breeding in quantities, disease comes upon the whole colony of larvae. One may contract dysentery and within forty-eight hours all will be dead.

Night work on the butterfly farm consists of treacling tree-trunks with a special strong-smelling preparation to attract the moths. This mixture contains alcohol, and the moths, after feeding on it for a short time, become quite intoxicated and can be placed in boxes with little difficulty. Another method of obtaining females of the required species, at night, is to visit the sallow thorn bushes, when in blossom, at which time many night-flying moths can be caught in nets while they gorge on the honey.

In a couple of months the butterfly farmer will have replenished his stock and from his spring collecting trips he will have thousands of larvae bred from his captive females. All the winter pupae are now emerging, and at dusk each day all on the farm are quite busy, as they watch the assembling of the different moths.

If in a good locality, as Mr. Newman's farm is, little trouble is experienced. That the females have the power to attract males for a distance of many miles has been proved by liberating marked males at different distances. Some form of wireless telegraphy or insect intelligence—call it what you will—is obviously in progress until the male is close enough to catch the scent of the female. That scent does play a part in the attraction is shown by the fact that a male moth will diligently search an empty box for hours, looking for a female previously placed there and then removed before the male's arrival.

The following evening the pairs must be watched, for as soon as they part the female at once begins to lay her eggs, anywhere and everywhere. But since the farmer does not want the eggs to be laid indiscriminately, the female is gently removed to a "laying box," where she has a chance to lay her eggs undisturbed. The box is labeled as to the date, locality, and species it contains.

When the period of incubation ends and the eggs are due to hatch, a bush or limb of a tree is enclosed in a muslin bag or "sleeve" which is tied at both ends. The box containing the eggs of the moth is fixed in the sleeve in such a manner that the young caterpillars will be able to crawl on the food. They now need no more attention until they have eaten all the leaves in the sleeve, at which time they are transferred to a larger bush and preparations are made for their pupation.

If their mode of pupation is in the earth, the full fed larvae must be collected each day and placed in special boxes for them to turn into pupae. Many pupate in moss or dead leaves; in this case the "sleeve" can be packed at the bottom with this material and thereafter it is allowed to remain undisturbed until all the larvae have turned into chrysalides. Life during the summer months on the farm is one continual changing of sleeves, and watching to see that the little caterpillars have an abundance of fresh green leaves with which to fill their hungry little bodies.

As the summer draws to a close and

the dropping leaves and the cooler evenings indicate the coming of Fall, the work on the farm lessens. All the huge hungry hawk larvae have changed into their last skin and have burrowed into the cages, filled with earth, which have been provided so that they may have a place in which to pupate. Then there are no other indications of their ever having existed except the fact that all bushes and trees have been stripped bare of leaves—even the bark showing signs of where the hungry little caterpillars have tried to find extra nourishment.

The last of the outdoor work of the season consists of "sleeving" bushes in sheltered corners where the hibernating larvae are to spend the Winter. A great many species spend the cold months in this state, lying dormant until the following Spring.

Are You Getting Enough Sleep?

(*Continued from page* 211)

Many of us are in the habit of warning children not to make grimaces, lest their faces stay that way. Yet we go about wearing a grouchy frown year after year, and our faces do indeed stay that way.

Sleep and relaxation smooth out the wrinkles of the face like an internal massage, we might say. Hence the expression "beauty sleep" is more than a slogan. It is a fact.

In the newspapers we occasionally read of people who are alleged to have passed weeks or months without sleeping and are nevertheless none the worse.

Physicians have investigated these alleged miracles on a number of occasions and found them to be what might be expected—frauds.

Few problems are more difficult to solve than that of insomnia. Why should we fall asleep one night the moment we touch the pillow, only to lie awake most of the next night fruitlessly trying to force ourselves into the sleep that will not come naturally?

Sometimes the fault lies not so much with the insomniac as with his surroundings. Often I have been asked to prescribe a hypnotic drug for wakefulness, only to find on close questioning that a removal of a nuisance was all that was required.

People who live in apartments are frequently annoyed by loud speakers, both radio and human. The whir of traffic on the street below, or the angry crying of a baby in an adjoining apartment may keep a perfectly healthy person awake for many hours. Oftentimes there is only one remedy—to move.

Light is another enemy of sleep. It may come through a transom or through the window. Sometimes, after sleeping soundly for several nights, you will toss around fitfully and then open your eyes to find the moon shining straight in your face. That is where the dark shade comes in handy.

My suggestion for anybody who has difficulty in sleeping is that he buy a new mattress and pay a millionaire's price for it. I know of nothing that is so conducive to sound, restful slumber as a soft, form-fitting mattress equipped with springs.

Without fear of contradiction I can say that coffee, taken with or after the evening meal, is the great Macbeth that murders sleep. The explanation is simple. Coffee stimulates the brain and stirs intellectual activity.

Do not get the impression that coffee is harmful, for it is a wholesome beverage if taken at the proper time. For breakfast I invariably drink coffee, and often for lunch; also, when it is necessary to work late in the evening a cup for dinner is most helpful. But, if you expect to enjoy a sound repose, let at least four hours elapse between coffee and bedtime.

Speaking of gastronomic habits, the effect of a Welsh rarebit in disturbing sleep is notorious. Any heavy meal too soon before retiring gives the same result. But to go to bed hungry is equally fatal. Often have I been kept awake by the iron grip of hunger squeezing my stomach and fallen asleep promptly after a raid on the Frigidaire.

A cup of hot milk or chocolate, particularly if sipped slowly, is one of the strongest incentives to sleep.

When we come to the neurotic type—the person who is a bundle of nerves—the problem of insomnia is more difficult. There is no external cause to remove. The fault lies in the wakeful person himself.

Fear, worry and anxiety are the great destroyers of sleep in neurotic people. They can be abated; if one can be taught by discipline to banish these disturbing emotions from the mind, sleep slides naturally into the soul. How to accomplish this is the great problem confronting the neurologist.

A number of simple devices to overcome wakefulness may be described. Some will succeed in one case; others in another.

Counting sheep may put you to sleep by sheer monotony. But if this turns into counting the dollars you lost on Wall Street, you may be sure there will be no sleep that night.

Many people cannot sleep simply because they do not get tired. For those who lead sedentary lives the convenient taxicab is often the cause of insomnia. Persons who work in offices will do well to take a brisk walk before going to bed, particularly on cool evenings.

In other cases, exercise proves a dismal failure as a cure for insomnia.

Reading to be bored is one of the most successful ways of coaxing sleep. The *Congressional Record* is said to be an absolute cure for all cases of insomnia.

Obviously, one would not expect to fall quietly to sleep after reading *All Quiet on the Western Front.*

King of Mediums Made Ghosts to Order

(*Continued from page 215*)

which he experienced during one of Pecoraro's séances, and which he states is an assurance of the existence of genuine spiritualistic forces. According to Pecoraro, Doyle believed that he (Doyle) shook hands with his son, when the ghostly fingers of the "spirit" emerged from between the black satin curtains.

I questioned Nino regarding this séance, and he cheerfully volunteered a description of the *modus operandi* that he employed. "How about the strong, cold breeze Sir Arthur felt during the séance?" I asked. "That breeze, according to the late British writer, was positive evidence of your real psychic power."

"I don't know anything about any breeze," Nino grinned. "I didn't feel any, although at times I grabbed the curtains, after freeing my hand, and by shaking them back and forth, I produced a breeze throughout the room."

"Did Doyle shake hands with an artificial hand which he imagined to be that of his son?" I continued.

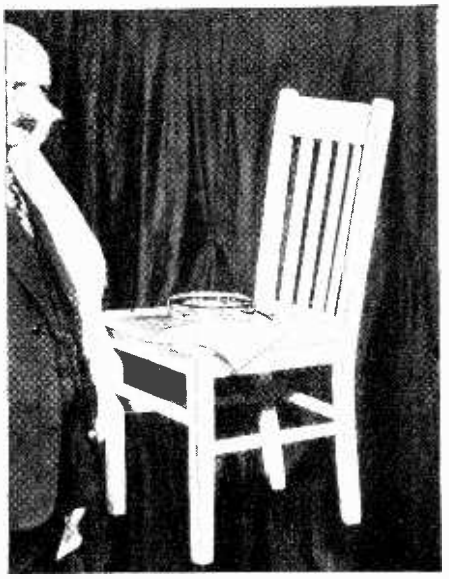
"No," shouted Nino, "I never used any apparatus of any kind. It was *my* hand that he shook. If he believed it to be the hand of his late son, I cannot help it."

Nino was greatly provoked upon reading the Associated Press story, cabled from London, in which Lady Doyle stated that she never heard of Nino, and did not believe that her late husband ever did. "Why, she was with Sir Arthur when he attended my séance," cried the excited ex-medium. "In fact, she offered me $300 in payment for my work, so impressed was she with my demonstration. I refused this money, however." Fame meant more to Nino than money. At least it did then—but not now. "For eleven years" continued Nino, "I have been using my ability and brains to popularize spiritualism, but I never got anything out of it, so why should I continue to let spiritualism take the credit for what is really my physical ability?"

Yet Nino has this interpretation in describing his ability. He prefers to call it "psychic." He frankly admits that he is fully conscious of the way he does these things, and that he never was in a genuine trance. Yet, he considers himself a superman, and thus believes himself entitled to use the term "psychic," inasmuch as he has developed the ability to get in and out of fastenings, which art he admits is quite exclusive.

Another who, unfortunately, has blown the trumpet of Nino's praises, is Hugh F. Munro, an investigator who has constantly communicated with us, and who offered challenge after challenge. So convinced was he of Nino's spiritualistic ability, that he has affixed his signature to numerous articles which have been published in various periodicals, describing Nino's super ability as a medium. Several times he placed Nino in a bag which was then securely tied and sealed. Then after being bound to a chair, the medium was placed within a cage consisting of a framework covered with chicken wire. This wire cage was then draped with cloth. An interlude filled with the ever-necessary spiritualistic hymns granted the time for the customary ghost hand to make its appearance. A table would be levitated, or a tambourine which had been placed directly in front of the cabinet would be hurtled into the air.

Nino smiled when questioned regarding these manifestations. "Well," he replied, "after getting my hands free, I have a way of getting them outside of a cage, and moving these things. Naturally, upon examination after the séance, I am back in my bindings again. Simply because Mr. Munro is unfamiliar with my method, he believes it is the work of spirits. Really, I have looked around my cabinet often, in hopes of seeing some of the ghosts that some of my believers thought they saw. If they were there, they were quite invisible to me. I think my audience had many hallucinations."



What is reported to be an authentic phenomenon in levitation, with Nino Pecoraro as the medium.

One might add here that in spite of the movie confession, the stories the newspapers ran, the reports of investigators who really investigated, and a verbal confession over a broadcast network, Mr. Munro has offered $100.00 to Pecoraro, if he will prove to Munro's satisfaction that the manifestations which Pecoraro produced were done by natural and not spiritual means. This logic reminds one of a murderer confessing to a crime and then being required to prove it by repeating the scene of it before the jury. Of course this analogy is far fetched in so far as, in this case, there is a definite injury to a person.

According to Mr. Pecoraro, he at one time so completely mystified a group of investigators from a scientific magazine, that Mr. Malcolm Bird, chairman of that committee, was in favor of paying the $2,500 prize which they were prepared to pay to any genuine medium.

Mr. Bird, on the other hand, emphatically denies this, and claims that Nino's system was at all times known. According to Bird, there was only one question raised. "Was Nino a conscious or subconscious fraud?"

"It was Harry Houdini's analysis of my work which prevented me from getting this money, and resulted in a verbal combat between the two investigators," says Nino.

Quoting the New York Times of December 1, 1923, Mr. Bird states: "We regard this case unusually interesting, and believe that the medium does not practise conscious fraud. The phenomena produced while the medium is sitting are of much scientific interest." Mr. Bird further states that Nino's case is far different from that of the Valentine and Stewart cases. Inasmuch as he was convinced that Valentine and Mrs. Stewart were conscious frauds, he had no further interest in them.

Nino insists that Dr. Prince and Dr. W. J. Powers were completely mystified by his work, and although they demanded future séances at the time of the investigation, they were completely convinced of the genuineness of his spiritualistic ability.

Dr. Walter Franklin Prince, of the Boston Society for Phychical Research, ridicules this statement. He proves by publications several years old that he was never fooled by Pecoraro.

Here is a letter which Dr. Prince wrote the editor of this magazine concerning his true opinion of Pecoraro:

Dear Mr. Kraus:

It appears from your note, stating that Nino Pecoraro insists that he "completely mystified" me by his mediumistic work and that I was "completely convinced of the genuineness of his spiritualistic ability," that he is now faking in some of his speeches as fully as he did in his earlier acts.

I am not unused to fraudulent mediums making such statements about me. For instance, the late Bert Reese, perhaps the most skilful "billet-switcher" of all time, told people that he had convinced me. It is true that I have never printed the rather interesting story of how I discovered his method, but he knew well that I did not believe in him after his one sitting with me, in spite of the pretty nothings which I said to him in the hope of studying his amazing skill again. He never would grant me another opportunity. He had twenty times the skill in the art of deceit that Pecoraro has. The latter never impressed me for one minute in the ten experiments which I had with him.

I am lending you from my file (hence desire its return) the *Journal of The American Society for Psychical Research* of June 1924, which contains a report which I wrote when I was an officer of that society. On pages 404-

409 you will see how much I was "convinced of the genuineness," rather, how thoroughly I demolished the claims of Pecoraro in my six experiments with him in September to November, 1922. You will also find a brief abstract of the experiments before the committee of the *Scientific American*, of which I was a member, on pages 409-410. The latter experiment took place in December 1923. A longer report on them may be found in the *Scientific American* of February 1924, and in both articles there is further evidence how thoroughly Pecoraro was exposed as a charlatan, and how contemptible I considered his claims.

I never even regarded the gentleman from sunny *Italia* as a skilful performer. I have analyzed in print the methods of a number of persons who faked far more adroitly than he. Consequently, his late confession had little interest for me.

Never yet have I had to withdraw, modify or apologize for any printed verdict of mine, regarding any medium, mental or physical.

Sincerely yours,
Walter Franklin Prince.

When Nino Backed Down

In order to show the extreme backbone and colossal nerve of Mr. Pecoraro, it may be mentioned that on one occasion he challenged the writer to expose his wares, if fraudulent, at Times Square, in broad daylight. He had invited the New York press to act as judges on that occasion. Needless to state the mid-day performance at Times Square, the busiest corner in the world, was not quite in keeping with police regulations, and therefore the medium failed to appear.

I could go on writing whole books on the interesting exploits and experiences of this most interesting character. Yet the closing chapter to his spiritualistic reign speaks for itself.

Here are bona fide copies of Nino Pecoraro's confession and statement he subsequently gave:

New York City,
Thursday,
April 9, 1931.

To Whom It May Concern:

I, Nino Pecoraro, previously known as a spirit medium for the past eleven years, hereby declare that I personally possess the psychic ability of liberating myself from all sorts of bindings and various forms of restraint, thereby enabling me to freely use my body to do all sorts of things, such as message writing, trumpet blowing, moving of objects, writing of messages upon paper, and creating all sorts of phenomenal effects.

I hereby state that I have, in the past, as in the present, been able to do these things PERSONALLY, and ABSOLUTELY UNASSISTED, and thereby state that inasmuch as I do these things MYSELF, and *am strictly conscious thereof*, I have never been aided by ANY SPIRITS, not any SPIRITUALISTIC force whatsoever.

I therefore do not believe that ANYONE ever saw a genuine spirit, inasmuch as in all of the eleven years of my experience, I NEVER SAW ONE, and DO NOT believe that anyone else ever saw a spirit.

I personally PRODUCED EVERYTHING that was ever seen by my investigators, without any SPIRITUALISTIC aid whatsoever.

(Signed)
Nino Pecoraro.

Witnessed by:
Dunninger
C. Spencer
Dorothy Wood
Paul Capron
J. E. Cambria
Stephen Funghni

April 11, 1931.
New York City,

To Whom It May Concern:

I, Nino, Pecoraro, do hereby state that the confession I made to Mr. Joseph Dunninger, before witnesses on Thursday evening April 9, was made of my own volition, and entirely without the influence of Mr. Dunninger or anyone else.

The statement referred to consisted of an expression which entirely denounced the fact that I have ever been aided or assisted by ghosts, spirits or spiritualism, in any manner whatsoever, in any of the seances or investigations which I have been subjected to in the past eleven years.

The so-called phenomena which I produced were accomplished entirely through my own personal ability to liberate from various binds and methods of restrain.

I made this confession of my own free will, and have not been bribed nor influenced by Mr. Dunninger or any one else to make this statement.

Signed
Nino Pecoraro.

Witnesses
Dunninger
J. E. Cambria
C. F. Spencer

Note:

I wish to emphasize that in this venture, I am speaking only for myself. It is not my intention to discredit or attack any other medium or mystic medium. I have no intention of exposing their work.

Signed
Nino Pecoraro.

The late Harry Houdini examining the bonds which lashed Nino Pecoraro to a chair.

The World of Black Light

(*Continued from page 219*)

equipment, and the patient will have his picture made as a matter of diagnosis.

This is because skin blemishes, particularly those caused by various diseases, photograph in a characteristic manner by ultra-violet light. You may have freckles and not suspect it until you have an ultra-violet photograph made, for pigmentation that occurs beneath the skin but is not visible on the surface photographs readily by short-wave light. Two skin diseases that appear identical by all other diagnostic methods reveal themselves as being totally different when photographed by ultra-violet rays.

One of the most remarkable bits of exploration ever done on the surface of the moon was carried out by Professor Wood . . . from a farm on Long Island.

He set up two telescopes, one employing conventional glass lenses, and the other having lenses of quartz, with the objective covered with a layer of metallic silver that shut out all light rays except the ultra-violet. With these telescopes he made pictures of the lunar landscape. Examination proved the photographs to be almost alike, but not quite. There was, near the crater Aristarchus, an area that photographed very darkly by ultra-violet light, but was hardly distinguishable from the surrounding moonscape by visible rays.

Apparently this spot was composed of different material from that surrounding it. But what was it? Experiments showed that there are many substances — sulphur, arsenic, powdered glass, chalk, etc.—that appear dark in ultra-violet light. Sulphur proved to be the most likely material, for a sample of rock bearing an invisible trace of it photographed in exactly the same manner as the part of the moon near Aristarchus. So, it seems likely that there is, on our nearest neighbor in the sky, a vast sulphur desert whose presence was detected only after science learned to use invisible light.

Since Professor Wood's study of the moon, astronomers generally have adopted ultra-violet and infra-red photography as a valuable ally in studying the heavens. They are able to photograph either the surface of Mars or its atmosphere, at will. Saturn, by ultra-violet light, shows a dense dark band around the equator, while this is wholly absent by yellow light. Professor Wood, by taking ultra-violet, violet and yellow pictures of a plant, and then combining these by familiar methods of three-color photography, obtained colored pictures that showed details clearly separated. It is as if he had moved the visible spectrum down into the invisible ultra-violet region.

Coming down to earth, science has found a number of other jobs for the ultra-violet camera, and doubtless will discover a great many more before long.

Because every kind of paper looks different to the ultra-violet camera, the detective has a means of finding substituted pages in wills and other legal documents. Erasures and other alterations can be rendered visible in the same manner. If a safe cracker gets oil on his fingers from his electric drill, and then touches a piece of paper or other material that he leaves behind, his fingerprint can be photographed by ultra-violet light as easily as if it had been made with printer's ink.

The scientist can do a great deal of detective work with this same black light. If he is studying fossils, he will find that some formations that cannot be distinguished from surrounding rock stand out clearly in an ultra-violet photograph. With an ultra-violet microscope, he can attain magnifications otherwise impossible.

Photos taken by infra-red light are distinctive, to say the least. Note the drilled-out effect in the (blue) eyes, and the total absence of detail in the shadows. Made on Eastman extreme red sensitive plate through "A" (No. 25) Wratten filter. Exposure 1/5 sec. at f/5.6. Photo of the author.

At the University of Upsala in Sweden there is a rare parchment manuscript known as the Codex Argenteus. This was written centuries ago with gold and silver characters on a purple dyed parchment. The lettering has become partly effaced so that reading by ordinary means is nearly impossible.

With the aid of ultra-violet light, however, photographic copies were made of the manuscript, and these showed the characters practically as clearly as they had appeared on the day they were formed. Under the influence of the short-wave light they shone with a light of their own. Even those invisible to the eye could be seen. Photographing the manuscript in this condition was a conventional matter, except that an exposure of several minutes in a dark room was necessary.

If you are an amateur photographer, you will not find the interesting field of invisible light photography closed. In fact, you need only a few dollar's worth of equipment to enjoy both ultra-violet and infra-red picture making. Although a camera that holds plates and cut films is necessary for extensive work, one using roll film can be used to a considerable extent, particularly for work in the ultra-violet region.

Ultra-violet pictures by extremely short-wave radiation are made through a quartz lens and a filter consisting of a thin film of metallic silver deposited on the front of the lens or on a flat plate of quartz. Ordinary films or plates are used. Fortunately, however, you need not invest in a quartz lens and silver filter in order to make ultra-violet pictures. The average camera lens of glass lets through considerable short-wave radiation: and commercial u.v.-filters that you can purchase transmit virtually the same rays. So, to make ultra-violet pictures, you need only place an ultra-violet filter over the camera lens, and give a longer exposure.

You will find the resulting pictures very much like visible light photographs in most cases. However, outdoor scenes made in bright sunlight have no shadows! That is because the atmosphere scatters ultra-violet light in every direction, in shadows as well as lighted areas.

In addition to direct ultra-violet photography through a u. v.-filter, you can make fluorescent pictures. That is, by shining only ultra-violet light on an object in a dark room, and photographing it through an ordinary camera lens and filter that keeps out ultra-violet, you employ the light that the object emits under the action of the invisible rays. Long exposures are necessary. As for the source of ultra-violet light, you will need some kind of an arc lamp—a quartz-mercury lamp being best, with a carbon arc a close second. Sunlight, too, can be employed. But whatever the source, you must place over it a filter that passes only ultra-violet light.

The third path that the amateur invisible-light photographer can take is at the other end of the light spectrum, in the invisible red. With ordinary panchromatic film or plates, such as are coming into wide use for all kinds of photography, and with an infra-red or deep red filter of stained gelatine, you are equipped to make pictures of distant objects that are obscured by fog or haze; to produce queer-looking portraits of friends, and to make surprisingly detailed likenesses of buildings and other objects.

If you have a plate camera, you will find two kinds of plates, recently placed on the market, of considerable interest. One of these, an infra-red sensitive plate, is intended for use in photographing light spectra and for other scientific work. However, it is very slow, and must be treated with ammonia before use. There is another plate, known as an extreme red sensitive one that is best for all-around work. It is fast enough to be used at snapshot speed, with a light red filter.

New Tools You Can Easily Make

(*Continued from page 235*)

ence between the first reading and the second is the depth measured.

To make the gauge, procure a piece of steel 2" by 1¼" by ⅜" or ½". Clamp the piece on the surface of a true face plate and turn one edge to form the base of the tool. Saw and file or machine the piece to the shape and dimensions shown in the plan, then reclamp the piece on its base to the face plate and turn the top surface true and exactly one inch from the base. Relocate the piece on the face plate so that the center of the top surface is centered in the lathe, then carefully drill and ream a 5/32-inch hole through the whole piece. A "V" groove on one side and two 6-32 tapped holes for clamping screws complete the job.

The illustrations show only the more typical of the many valuable uses the completed tool may be adapted to. At "A" long 5/32-inch diameter rods may be inserted to measure the depth of holes or recesses, but in this case, unless micrometer calipers up to 6 inches or so are available, only a ruler may be used. As at "B," however, the tool is useful to its maximum precisional capacity. The accurately faced rod inserted must be 1 inch in length or less if only a 2-inch micrometer caliper is available; measurements up to ⅝ inch are practical with this caliper.

At "C" is shown a variation of the tool of which there exists no commercial equivalent on the market—a small, sturdy surface gauge which functions with absolute precision on heights from 0 to ⅝ inch or higher if additional scriber rods are made. These scribers are constructed of drill rod, properly bent and pointed. The upper surface, "M," is turned in the lathe before hardening the rod and, if the lathe attachment is available, it may be ground true while mounted in the gauge itself.

In practice a surface plate is utilized and the distance between the surface "M" and the base of the gauge is reckoned with and measured with a micrometer caliper.

The scriber point, "P," is dropped to the surface of the plate and the upper clamp screw is tightened; then the distance between "M" and the base is measured. This measurement is the standard and is added to whatever scriber height is required.

In the same sketch "D" shows how the "V" groove of the gauge is used to deal with cylindrical surfaces. Small flanges, hubs, collars, pins, and such may be measured or located with ease.

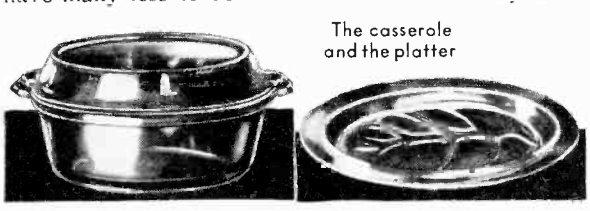
A majority of the smaller metal-turning bench lathes present an objectionable outlay and upkeep cost because of the forged tools which their posts hold. After some usage and regrinding, a forged tool becomes useless, since most of its shape has been lost. It will decidedly pay users of bench lathes to invest the time of making a small cutting bit holder, since none of ¼ by ¼-inch or 5/16 by ⅜-inch size are commercially available.

Simply procure a length of tool steel about 3 by ⅝ by ¼ inch in size and about 12 inches of 5/32-inch diameter high-speed rod for bits. Saw and file the holder metal to shape as in Figure 4 and drill and tap its head for a 6/32 or 8/32 hardened set screw. Roughly file the various bits to shape, harden and temper them, then grind them to edges.

Scientific Aids to Your Comfort

(*Continued from page 236*)

of transferring foods from baking dishes to serving ones is eliminated. As the dishes are heat and cold resistant the food will keep hot throughout the meal, or ice cold, as the case may be. When it comes to washing dishes, you have many less to do.



The casserole and the platter

The double compartment, round baking dish pictured will hold meat and a vegetable or two different vegetables. Instead of two separate cooking dishes and two serving ones, this dish does the work of four. The two-piece oval set is ideal for a small family, if you care to use the dishes separately. If, on the other hand, you desire to use the pieces in preparing mushrooms and other foods that require a cover to retain their delicate aroma, one piece fits upon the other.

The well and tree platter is particularly good for baking and serving fish. The annoyance of having your beautifully baked fish break apart as you lift it to a serving dish is done away with.

The casserole permits the use of the cover as a separate baking dish, as a tile for hot dishes, its flat surface allows you to stack another dish on top when baking, thus utilizing the lost up-and-down space in the oven. Tested and approved in our laboratory.

Erratum

The heater described in the May issue on page 40, under the heading "Turn on the Heat and Humidity," uses gas. We inadvertently termed it an electric heater.

Twenty Thousand Leagues Under the Sea Today

(*Continued from page 202*)

weighted and balanced as to be able to hang motionless in one spot under ordinary circumstances. This is due to the fact that the density of water, unlike air, increases at a negligible rate with increasing depth.

A strange phenomenon is encountered on rare occasions. Sometimes submarines execute "stationary dives"—i. e., they submerge when at a standstill. They take on a few bare pounds of negative bouyancy which causes them to settle slowly onto the bottom. While thus sinking slowly a submarine has been known to encounter a lower stratum of colder water—more dense than that above—and come gently to rest on the top of this heavier water. In other words, the ship was a shade heavier than the volume of the warmer water which it displaced but slightly lighter than the same volume of colder water. Whereas it possessed a small negative bouyancy in the lighter water its buoyancy was slightly positive in the colder layer. That is the nearest approach which we have to the very desirable attribute of the *Nautilus*. Ordinarily a speed of about one knot is the minimum at which a submarine can be properly handled when running submerged.

Cruising Radius

Now we come to the most remarkable part of the *Nautilus*—her propelling machinery. We must confess that in power, speed and cruising radius she far surpasses any present day submarine. In fact it is safe to say that in radius the *Nautilus* will never be equalled. For all practical purposes the capacity of her electric batteries seemed to be nearly infinite. She was driven by electricity on the surface as well as submerged. In this respect she was similar to the early French submarines. No power-driven submarines of any kind, however, existed until many years after the *Nautilus* was conceived. These early French vessels were truly "submarines" in that the energy used for submerged operation is all that was available for surface runs—and that very limited. They were designed solely for the defense of harbors whence they could issue for a short attack, being submerged for the greater part of the entire run. The modern craft are more properly termed "submersibles" in that all but a small bit of their operation is on the surface and under power different from that used when submerged. But more about these later.

The *Nautilus* was certainly a submarine in every sense of the word since Captain Nemo cruised submerged almost continuously. He was aware of the greater comfort in the still depths. Some of the American submarines encountered extremely severe weather when crossing the ocean in 1917-1918 on the surface, perforce. The attacks of seasickness suffered by several members of their crews very nearly resulted fatally. Captain Nemo also realized the impossibility of suffering collision when deeply submerged; his was then the only submarine in existence. Alas, he failed to consider the tragedy always lurking in a run made only a few feet below the surface. His ship was in collision under just such a circumstance. The surface vessel was the only one damaged. He was thus far more fortunate than the ill-fated U. S. Submarine *S*-4.

So much for the general method of propulsion. Now for the apparatus of the *Nautilus*. As has been mentioned, her sole power was electrical, the energy being supplied by batteries. These were "primary" batteries rather than "secondary" or "storage" batteries which, in very small sizes, are now such a familiar automobile accessory. In other words, at least their ingredients had to be replaced each time the batteries became exhausted. Recharging was then unknown. These wonderful batteries, however, required the rarest imaginable replacements, and then of sodium only. Their life seemed endless. The resourceful author, it will be remembered, discovered a coal mine beside a lake in the crater of an extinct island volcano. The lake could be reached from the ocean by a submarine passage. Here the vitally necessary salt was obtained by evaporating sea water, the coal being used as fuel. In all the "Twenty Thousand Leagues" only one stop was made at this base of supply.

The power of these batteries may be more easily realized when the main "engines" are considered. The electric motor in its present general form had been produced in a crude way when M. Verne wrote his book. He did not, however, conceive of an electric motor in the ordinary sense for his *Nautilus*. Instead, he had a number of huge solenoid electro-magnets. Their plungers, acting through cranks or ratchets, drove wheels geared to the single main shaft. This shaft turned a four-bladed propeller which had a diameter of 19 feet and a pitch of 23 feet. When the vessel was running on the surface it appears that the propeller blades thrashed out of the water like those of an old lightly-laden "tramp" steamer. This was necessarily so, since the ship itself was only 26 feet in diameter.

40 Knots an Hour—Submerged!

The batteries and magnets were able to drive the vessel submerged at the rate of 40 knots! Like many builders, the good Captain seems to have been a bit over-optimistic regarding the capabilities of his ship. He claimed for her a speed of 50 knots. But a test was provided during her return under the frozen sea from the South Pole. She was caught fast in the ice below the surface and freed herself only with the utmost difficulty after a long struggle. Following her release a dash was made for the open sea in order to save the crew from suffocation by the badly vitiated air. Full speed was ordered but the vessel responded with "only" 40 knots. Fifty knots corresponded to a propeller speed of 7,200 revolutions per minute. (The propeller pitch being 23 feet this figure of 7,200 is more than twenty times too high for 50 knots.) Her prodigious power made her "handy" enough to wreak terrible destruction by ramming when she took sides in that memorable battle between the right and sperm whales. On another occasion, however, the available power was insufficient to disentangle the propeller from the tentacles of the huge cuttlefish. This horrible monster thereupon had to be killed by the crew in that thrilling hand-to-hand battle on the deck of the submarine.

Probably the most remarkable attribute of the *Nautilus* is one which was awarded to her perhaps unconsciously by M. Verne. The crew seemed able to keep her in operation indefinitely, making only the few repairs possible with the restricted facilities existing aboard ship. There was no source, even, from which to draw the all-important "spare parts." Here was a ship indeed if it possessed such capabilities!

Our Modern Submarines

What do we find aboard modern subsea craft? First of all they are really "submersibles" and operate quite differently from the *Nautilus*. They are twin-screw, ordinarily, and are driven on the surface by Diesel engines or, in rare cases, by steam. Owing to lack of air for combustion purposes these methods are not available when running submerged. The propellers are then turned by electric motors, the electricity being furnished by great storage batteries.

These batteries are recharged when the vessel is on the surface, the engines driving the motors as generators. Thus on each shaft there are only two units. Starting from forward we have, in order: engine, clutch, "generator-motor," clutch, propeller. It will be seen that the generator-motor, during surface cruising, must still be driven by the engine even if no current is desired from it at the time.

The capabilities of the modern submarine for surface operation approach closely those of a surface vessel. One type is credited with 23.5 knots, developing 10,000 horse power. For another type a cruising radius of 20,000 miles is claimed, provided a low speed of 6 knots is maintained. For work beneath the surface, however, the modern craft fall far behind the *Nautilus*. This is true even if we select different vessels each exceeding all others in just one particular. We find none with a speed greater than 15 knots, none with more than 2,600 horse power, and none able to cover so much as 200 miles submerged, even at most economical speed. Ordinarily, in fact, the vessel with the greatest possibilities on the surface will necessarily by its design be handicapped for submerged operation; and *vice versa*.

Our *Nautilus* was capable of 40 knots submerged and therefore of a still higher speed on the surface. As has been noted, her cruising radius seemed to be almost infinite. We can at the present time claim an approach to equality only by stressing surface operation. At least on large craft the pleasures and advantages of being on the surface far exceed the drawbacks ordinarily. Also we can say that when the cruising radius is over 10,000 miles it is pretty nearly as great as can be desired. In other respects, however, the *Nautilus* still holds sway. Even on the surface its speed was perhaps *double* that of the swiftest submarine ever built. Below the surface we are still far, far behind.

The limit for submerged operation is set by the extreme weight of the modern storage battery. Its capacity for energy compared to its weight has slowly increased but there is still a long way to go. One occasionally reads in the press that a new battery has been invented which is of but *one-tenth* the weight of any other of the same capacity. Such statements have as yet had no foundation in fact. Some day a miracle worker may appear with a battery containing ten *thousand* times as much energy per pound of weight as the modern battery. Until then we must continue to concede full honors to M. Verne for the performances of his dream ship when travelling beneath the waves.

In the matter of auxiliaries, we find that the *Nautilus* was well equipped with devices very similar to those in use today. For ventilation, Captain Nemo supplied his submarine with air from reserve tanks. For lighting, the *Nautilus* boasted both incandescent electric and vapor-arc lamps, and her searchlight (with an underwater range of one mile!) was an arc operating in a vacuum. The *Nautilus* was well equipped with electric heating for galley ranges, water heaters and radiators.

When we turn to "interior communication," we find that M. Verne provided the not inconsiderable invention (in 1873) of a system of electric push buttons. His electrical "shaft revolution indicator," and depth gauges both operated in a manner very similar to those in use today. He also had a marvellous electric clock "more accurate than a chronometer," barometers, thermometers, marine glasses, sextants, hygrometers and magnetic compasses. When hull openings are sealed for a submerged run a barometer inside the hull is of use only to indicate the rise of air pressure due to a bad leak. Did M. Verne realize this? A magnetic compass is totally unreliable when enclosed within a steel hull. Modern submarines use gyro compasses.

Like modern submarines, the *Nautilus* was equipped with escape hatches, but Captain Nemo and his crew used them for the purpose of making excursions over the ocean floor and returning to the submarine, and not for escape in case of emergency. Another modern item of equipment was a boat which was bolted to the deck of the *Nautilus*, and to which access could be had from within the submarine.

It will be seen from all the foregoing that we have here a case where there is truly "glory enough for all"—praise for the uncanny foresight on the part of Jules Verne in seeing so many decades ahead of his time; renown for the many inventors and engineers who have worked their wonders of marine design and construction.

Magic

(*Continued from page* 238)

the silver piece, the hand is held in such a position as to enable the dime to secretly slide into the palm. There it is concealed, while the folding of the paper continues.

In the act of permitting a spectator to feel of the coin, the original coin is disposed of. The spectator, of course, feels the concealed dime, and is thus satisfied that the borrowed piece is actually hidden beneath the folds of the wrapping paper. The rest is easy.

A New Palming Device

A MAGICIAN'S dexterity is usually measured by his ability to palm small objects, such as coins, thimbles, playing cards, etc. This method is a short cut enabling the amateur to accomplish apparently difficult sleights with an exceptionally small amount of practicing.

A small piece of flesh-colored steel, of the shape illustrated, is all of the paraphernalia necessary. The magician secretly slides this beneath his finger ring prior to his performance. A number of playing cards, a coin or other small object, can be held in place firmly against the magician's palm, by simply sliding its edge beneath this feke. The back of the hand can be shown quite naturally, thereby conveying the thought to the audience that the palm is empty. Any number of effects and unusual sleights can be worked out by the wizard, aided by it. Being small in size, it can be easily disposed of.

The Vanishing Tumbler

A DRINKING glass is filled to the brim with water from a transparent glass pitcher. The glass is lifted off the table and carefully placed in a paper bag. The magician descends to the footlights, and suddenly crushes the paper bag between his palms, rolling the paper into a small ball, which he carelessly tosses aside. The glass and its contents have completely vanished.

The glass has an outer shell, which is made of opaque celluloid. In the act of picking the glass of water from the table, the tumbler and its contents secretly slide into a rubber-lined trap in the table top. The celluloid cylinder (supposedly the tumbler full of water) is put into the paper bag, and after a bit of magical byplay, is crushed with the bag between the magician's palms.

Eclipses Yesterday and Today

(*Continued from page* 205)

The interval, 6,585⅓ days or 18 years 11⅓ days (10⅓ days if *five* leap years intervene), is known as the *Saros*, derived from a word that signifies *repetition*. It was known to the ancient Chaldeans and was used by them in prehistoric times to predict eclipses.

Let us try our hand at eclipse predicting. On the 28th of May, 1900, the path of a total eclipse swept across the United States. One Saros later, June 8, 1918, another very similar eclipse should have occurred. Owing to the extra one-third of a day, however, the earth had eight hours extra to rotate in, and the eclipse track should lie to the west of the first, approximately 120°, one-third of the distance around the globe. The track of the 1900 eclipse is shown in the map. Transferring this 120° westward, the path of totality for the 1918 eclipse should be approximately given by the dotted line. The actual path, according to more precise calculations, is indicated by the full line. The agreement is all that could be expected. Usually it will not be quite so good as this. No doubt many people will remember the total 1918 eclipse. The tracks of several other interesting eclipses are shown on the diagram. One of them, that of June 19, 1936, is the Saros companion of the 1918 eclipse.

Some persons may wish to try their hand at a further prediction by projecting the 1918 path 120° farther westward. The actual path will be found to lie about as far above the approximately predicted one as the actual 1918 eclipse track did above our earlier prediction. This gradual northward creep will continue until finally the shadow track will no longer strike the earth. The last total eclipse of this particular series will occur on August 23, 2044.

The minimum number of eclipses that can occur in a given year is two, both of the sun. The maximum number is seven, five solar and two lunar or four solar and three lunar. Thus the sun is much more frequently eclipsed than the moon. This is not true, however, as regards the frequency from a given point on the earth. A lunar eclipse can be observed from any place the moon can be seen, *i.e.*, from half the earth, while, to see a solar eclipse, one must be located at least within the penumbral shadow (Fig. 2). This more than reverses the proportion of two kinds of eclipses. Though we have, on the average, about one total eclipse of the sun every year and a half, the central shadow track touches a given station about once in 360 years. The duration of totality cannot exceed eight minutes.

Natives, terrified by the eclipse of the sun, appealing to Columbus

The next total solar eclipse will be visible from Canada and Maine August 31, 1932. Total eclipses that can be seen from the United States will occur in 1945, 1954, 1970, 1979, and 1984.

Total solar eclipses present a rare opportunity to the astronomer, who often travels to the antipodes to take advantage of the few minutes the bright solar disk is obscured. For only then can he photograph and study in detail that mysterious outer appendage of the sun—the corona. This halo of pearly colored light surrounding the solar disk is undoubtedly a sort of rarefied atmosphere, but there are still many puzzles connected with it. For example, it emits a peculiar hue of green light that no terrestrial atom has been able to match exactly. This fact led astronomers to assert that some new and unfamiliar element, which they termed "coronium," probably existed in the corona. We know now that this view is incorrect. "Coronium" is probably some familiar substance, perhaps oxygen, nitrogen, carbon, or helium in masquerade.

One of the most striking sights visible at a total solar eclipse is the appearance of the prominences—tongues of rose-colored flame leaping out sometimes hundreds of thousands of miles

above the surface of the sun. Prominences are not flames in the ordinary sense of the word, since the sun is not "on fire." Though composed, to a large extent, of the highly combustible mixture, hydrogen and oxygen, the sun is too hot to burn*. Combustion, the process of chemical union of the two elements, could not occur on the sun, which is hot enough to make the reaction proceed in the opposite direction. Prominences can be studied to best advantage during eclipses, though they can be photographed at other times.

The Einstein theory has placed an added premium on the few precious moments of totality. According to relativity, a beam of light in the neighborhood of the sun and originating from a star should experience a small displacement owing to the action of solar gravitation. Such displacements, of course, exist continually, but we can see stars apparently in the vicinity of the sun only during total eclipse, when the shining solar surface is shadowed by the moon. Observations for the purpose of testing this prediction have been made at many of the recent eclipses.

With a three-minute total eclipse every eighteen months, on the average, an astronomer with an observing life of sixty years would have had little more than two hours for study of eclipse phenomena, allowing no margin whatever for unfavorable weather. To observe them he would probably have to journey more than half a million miles. Dozens of unsolved problems would occupy his attention. No wonder, then, that the astronomer travels to the ends of the earth for the sole purpose of studying solar eclipses!

*See last month's article, "What Makes the Sun Hot?"

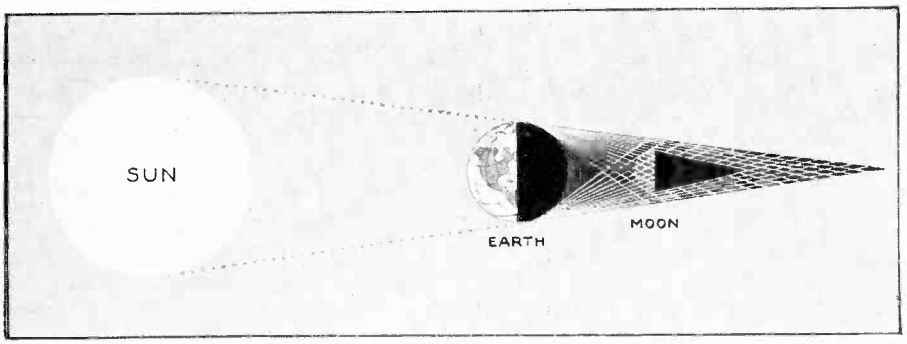


Fig. 4:—A sketch of an eclipse of the moon, showing how light rays are bent into the earth's shadow by the atmosphere.

Spectacular Harmless Fireworks

(*Continued from page 229*)

position is poured in, the pellet dropped in on this, then a sprinkle of perchlorate fuse composition added, the case then being filled the rest of the way with whatever proper color fire is desired. In action, the perchlorate fuse composition burns, and ignites the pellet containing aluminum and drives it out of the case, forming a silver-fountain effect which is very beautiful.

The above pellet composition could be termed sparkler composition, and with it some wonderful homemade sparklers nearly equaling the commercial kind can be made. The pellet or sparkler composition is made into a paste with the dextrine-water or diluted alcoholic solution of shellac and rubbed over wooden sticks, or splints such as are used, tipped with absorbent cotton, to sterilize open cuts and wounds. These can be bought at drug stores. If the adhesive composition made as above is contained in a large test tube and the sticks dipped and rolled in it, they can be withdrawn, coated, and dried. Several dippings and dryings are necessary to produce a built up sparkler.

An excellent night fireworks piece can be made from the same sparkler composition. (Barium nitrate, iron borings and aluminum powder.) Four (or more) blobs of the sparkler composition paste are placed about 1 inch apart on a thin strip of wood which serves as a base. Several tacks driven partly into the wood will serve to hold the blobs on. Each blob of sparkler composition is then connected with its neighbors by a length of the perchlorate fuse. A dab of the perchlorate is placed at the lath blob of composition. A composition is made into a paste with dextrine-water is applied on top of the fuse where it contacts with the aluminum sparkler composition blobs. The whole is dried over night. When the fuse is lit, the perchlorate fuse powder dab is ignited by the fuse and sets off the aluminum sparkler composition, giving a very dazzling white light. The fuse continues to burn and sets off the next blob of composition. The perchlorate fuse composition is used because the fuse alone will not cause ignition of the sparkler composition; the perchlorate fuse powder composition acts as a first-fire. The fuse can be made of such a length that the blinding white flashes produced by the sparkler blobs igniting, will follow one another in any time-order.

The perchlorate fuse composition can also be applied to the tip end of the finished sparklers to make them more easy-lighting.

In the above tried and found true formulas, all ingredients should be powdered before mixing. Wood charcoal such as willow should be used.

Science and Invention Announces the Third Prize Winners of the $3,250 Ideal Home Workshop Contest

William W. Klenke, Third Winner in the $400 Class, Says:

I WAS born in New York City, Dec. 27, 1888. Was educated in the public schools of that city. Graduated from the New York Trade School, 1905; graduated from the De Witt Clinton High School, 1910. Studied at the Art Students' League, New York, for one year in Antique Drawing—won Honorable Mention, 1911. Graduated from Pratt Institute, 1913; won competitive scholarship in Art, although specializing at the time in Manual Training. Received license to practice Architecture in the State of New Jersey, 1919. Graduated from the Fawcett Industrial School of Newark, N. J., Arts & Crafts Course, Saturdays only, for six years, 1922. Teacher of Manual Training and Mechanical Drawing, Central High School, Newark, N. J., for almost eighteen years.

William W. Klenke

To gain practical experience in wood working, I worked as a journeyman carpenter for three years. Trained in photography under a professional for two summer vacations—use photography extensively in my book and mazagine work. Author of "Art and Education in Wood Turning," "Joints and How They Are Made," "Selected Furniture Drawings" and a Syndicated Feature "Things Easy to Make." Two new books to come out this Fall—"Glue and Its Use" and "One Hundred Things Easy to Make."

I am the first person to syndicate Manual Training in the newspapers throughout the United States and Canada. Have written for the following magazines: *Popular Science, Popular Homecraft, Youths' Companion, Architecture, Photo-Era, McCalls Needle Work & Decorative Arts, Needlecraft, Peoples' Home Journal*, besides I have worked up several advertising booklets for the Russia Cement Company, makers of Le Pages Glue and the Walker Turner Manual. I have worked extensively in all branches of cabinet work and many of the Arts & Crafts.

Why Mr. Klenke Chose the Tools He Did:

In making my selection of Ideal Tools and Equipment costing $400.00, I decided to divide the expenditure into two classes—one for the hand tools and the other for machinery. I am aware of the fact that the amount of money to be spent for machinery would naturally have to be far greater than that to be used for hand tools; however, with the use of machines, I can do so much of my work, that I will not require so many hand tools.

I have chosen well known standard makes in each of the various classes, because I would then have confidence in the tools and equipment. Therefore, I feel that quality and value have been fully represented in this list.

In making my selection, I constantly kept in mind that I not only wanted excellent tools, such as a master craftsman would use, but I desired this list of tools to be complete so as to serve me in all of my general repairs around the house, in both wood and metal work.

Therefore I included tools for electrical work, minor plumbing jobs, some helpful tools for tinkering around my automobile and a very complete line of portable motorized machines.

The machines I selected are sturdily built and capable of doing a large variety of different kinds of work in wood and metal in an accurate manner. The sizes of my motors are sufficient to perform all of the duties I have a right to expect without stalling the motor, and with the V-shaped pulleys, I should get the maximum amount of efficiency.

These machines are large enough so that I can turn out good sized jobs and without much interchanging of parts, yet they are portable and compact.

In reviewing this list of Ideal Tools and Equipment, I feel that possessing them, I would be in a position to turn my spare time or to make my pet hobby into a profitable thing—yes, I consider it complete enough to start a shop as a business proposition, should I so desire.

William W. Klenke's List of Tools:

Tools for Measuring and Laying Out

1	Two foot, four-fold rule	$ .65
1	Combination try and miter square	1.00
1	Steel square, body 24", tongue 18"	2.40
1	Marking gauge (double bars)	.70
1	Pair of bronze trammel points	1.65
1	Plumb and level, 18"	1.35
1	Sloyd knife	.40
1	Spring dividers, 6"	.90
1	Spring calipers, outside 6"	.90
1	Spring calipers, inside 6"	.90

Saws for Wood and Metal Work

1	Hand saw, cross cut, 24", 10 points	1.70
1	Rip saw, 26", 6 points	1.75
1	Back saw, 10"	2.00
1	Compass saw, 10"	.85
1	Coping saw and 12 blades	.35
1	Hack saw frame, 8"	1.00
12	Blades for hack saw, 8"	.45

Hand Planes and Chisels

1	Jack plane	$4.35
1	Block plane	2.20
1	Scraper	2.25
1	Spoke shave	.30

1 Reg. tanged firmer chisel, beveled edge, ¼"	.59
1 Reg. tanged firmer chisel, beveled edge, ½"	.63
1 Reg. tanged firmer chisel, beveled edge, ¾"	.70
1 Reg. tanged firmer chisel, beveled edge, 1½"	1.14
1 Reg. tanged gouge, ¾"	.54
Wood Turning Chisels	
1 Skew point, ½"	$.79
1 Skew point, 1"	1.20
1 Skew round point, ¼"	.82
1 Skew round point, ½"	.90
1 Square point, ½"	.90
1 Square point, 1"	1.31
1 Gouge, ½"	.57
1 Gouge, 1"	1.49
Boring and Drilling Tools	
1 Ratchet bit brace, 10" sweep	$1.40
1 Hand drill	.85
1 Auger bit No. 4 (¼")	.50
1 Auger bit No. 6 (⅜")	.50
1 Auger bit No. 8 (½")	.50
1 Auger bit No. 12 (¾")	.70
1 Expansion bit, large size	1.95
1 Rose countersink, ½"	.30
1 Screw-driver bit, ½"	.25
1 Dowel sharpener, ½"	.45
1 Set drills	1.35
Hammers, Mallet, Hatchet	
1 Hammer adze eye, bell faced, 13 oz.	$1.15
1 Ball pein hammer, 12 oz.	.90
1 Hickory mallet	.40
1 Hatchet	2.00
Wrenches, Pliers and Pinchers	
1 Monkey wrench, 8"	$1.00
1 Wrench, 8"	.75
1 General purpose pliers, 6"	.90
1 Cutting and pulling pinchers	.60
Screw-drivers and Awl	
1 Screw-driver, 2½" blade	$ .30
1 Screw-driver, 5" blade	.50
1 Brad awl	.20
Files	
1 Mill bastard file, 8"	$. 18
1 Mill smooth file, 8"	.20
1 Flat bastard file, 6"	.16
1 Half round cabinet file, 10"	.50
1 Slim taper file, 6"	.11
1 Round bastard file, 5"	.12
Vises and Clamps	
1 Iron bench vise	$1.30
2 Steel bar clamps, 3 feet, at $2.30 each	4.60
2 Hand screws, at $1.30 each	2.60
2 Hand screws, at $1.70 each	3.40
Glass Cutter and Putty Knife	
1 Glass cutter	.15
1 household putty knife	.35
Miscellaneous	
1 Nail set, 3/32"	$ .12
1 Center punch, 5/16"	.18
1 Electric glue pot	27.00
1 Carborundum oil stone	1.25
1 Electric soldering bit	2.50
1 Tinners' snips, 8"	1.45
1 Work bench, Gnome brand	19.00
1 Miter box (Gem folding)	2.00
Portable Machinery	
1 Complete, circular saw, jointer, mortiser	$94.10
1 Repulsion Induction motor	31.75
1 Band saw, 12" guard and pully, complete	47.65
1 Lathe, 36" between center, complete with belt and pulley	27.20
1 2-shaft 1/3 H. P. motor	16.00
1 Emery wheel arbor	1.25
1 Sanding disc, 8½"	2.50
1 Comb, boring and sanding table	5.00
1 Sanding drum	2.00
1 Drill press, complete except chuck	11.75
1 ½" chuck	9.00
1 1/3 H. P. motor	16.00
This motor is for the drill press	
1 Special Collet chuck for all routers	.50
1 ⅛" Router for inlaying ("Driver")	.50
1 ⅜" Router for inlaying	.50
1 ⅜" Dovetail router	.50
1 ½" Dovetail router	.50
4 Cutters No. 16, 17, 18 and 19 "Driver" SS cutters for spindle shaper on drill press	4.00
1 Special nut to hold cutters	.05
1 Polishing heads	2.40
1 Cutter and chisel grinder	1.30
Total	$399.95

Laurence F. Burns, Third Winner in the $200 Class, Says:

I RECEIVED my education in New Brunswick, New Jersey, where I was born, graduating from the Grammar and High Schools. One of my earliest recollections was the time passed in building houses for pigeons and hutches for rabbits and, at one time, a complete miniature theatre in which I gave plays with scenery of my own design and building — all made with the few tools usually found about the house — a hammer, a saw, and a screwdriver.

Laurence F. Burns

Upon finishing High School, I was offered a choice of a college or an art school.

The choosing of the latter finally brought me an apprenticeship with a lithographic house and finally a real position with a large advertising agency —there to remain until, with some others, we formed our own company to produce illustrations for advertising.

However, in spare time at home, it is still a pleasant, but much of an amateur pastime, to build small things about the house, such as shelves or cabinets and to make those repairs that are always waiting to be made—with only a few more tools, as I look back, than I had as a boy.

However, with these new tools, that I am so happy to acquire, there is no end to the things that can be planned.

Why Mr. Burns Chose the Tools He Did:

Two hundred dollars to spend for tools and equipment have given me a chance to make quite a complete and varied selection and enabled me to include in this list, some small machines, which I feel are essential today.

I was guided to a great extent, in making my list, by the catalogs I received and from the reading of current magazines dealing with the home crafts.

As I thought of rules, squares, levels and planes, the name of one of the oldest firms came before me. Chisels recalled another well known concern, and also as I thought of wood bits, precision squares, dividers and the like.

I strived to make my list include tools and equipment that would be of value to me in many different branches of handicraft. I wanted master quality tools at fair prices.

My machines had to be real machines, not toys. They had to be compact, due to the lack of space I have available for this work, and, above all, well built units. I wanted machines for both wood and metal work; I preferred *not* to have my tools in drawers, which had been built in the bench, but I would make handy racks for them instead and place these on the walls near by; with this saving of money, I could then buy other tools and equipment.

Laurence F. Burns' List of Tools

1 Work bench, complete	$19.00
1 Electric shop, complete	99.50
1 Electric glue pot	7.25
2 Steel bar clamps, 3 foot	4.60
4 Hand screws	6.00
1 Vise	1.65
1 Rule, 6 foot	.65
1 Square, 12" combination	1.30
1 Steel Square	2.95
1 Bevel, 6"	.72

Read Classified Advertising — It Pays!!!

Advertisements in this section fifteen cents a word for each insertion. Name and address must be included at this rate. Cash should accompany all advertisements unless placed by an accredited advertising agency. Not less than 10 words accepted. Objectionable or misleading advertisements not accepted. Advertisements for these columns should reach us not later than 1st of 2nd month preceding issue.

Classified Advertising Manager—Radio-Science Publications, Inc., 381 Fourth Avenue, New York City

Advertising

Advertise. Inch Display. 50 magazines. three issues. $6.00. Lists free. Pennell Standard, Covington, Kentucky.

Agents Wanted

250,000 ARTICLES WHOLESALE—DIRECTORY 10c. J. Patterson, 4111 University, Des Moines, Iowa.

THIS Advertisement may make you thousands of dollars, if you write immediately for my "Eye-Opening" literature describing guaranteed formulas; valuable trade process, money-making information how to easily make the world's best-selling specialties. All lines. Investment small. Profits immense! Start anywhere. Make the good money you're entitled to. Dr. H. Liscombe Miller, Chemist, Tampa, Florida.

$10 daily silvering mirrors, plating and refinishing lamps, reflectors, autos, beds, chandeliers by new method. Outfits furnished. Write Gunmetal Co., Ave. D, Decatur, Ill.

INVENTOR DISCOVERS "ELECTRICAL WIZARD." Saves motorist up to $100 yearly. One minute installation without tools. Pays for self first week. Write for details. REARDON MFG., Dept. SAI, Peoria, Illinois.

SUCCEED WITH YOUR OWN PRODUCTS. Make—sell them yourself. Formulas. Processes. Trade-Secrets. Expert analytical service. Catalog free. D. Thaxly Co., Washington, D. C.

AMAZING NEW FLY KILLER offers you wonderful chance to make $15 profit a day. Instantly kills flies, mosquitoes and other insects. Easily demonstrated. Tremendous demand in homes, stores. Tremendous demand in homes, stores, restaurants, etc. Particulars free. ALBERT MILLS, 9148 MONMOUTH, CINCINNATI, O.

MAKE YOUR OWN PRODUCTS. Employ Agents Yourself. Toilet articles, soap extracts. We furnish everything. Valuable book Free. National Scientific Laboratories. 1955W Broad, Richmond, Va.

MAKE—SELL YOUR OWN PRODUCTS. Formula Catalog Free. Clover Laboratories, Park Ridge, Ill.

Big money and fast sales. Every owner buys gold initials for his auto. You charge $1.50; make $1.35. Ten orders daily easy. Write for particulars and free samples. American Monogram Co., Dept. 71, East Orange, N. J.

Free Booklet describes 67 Plans for making $20—$200 weekly in home, or office. Business of your own. Elite Co., 84-B, Elizabeth St., N. Y.

Big Profit putting our gold sign letters on store windows, without experience. Samples. CONSOLIDATED, 69-R West Van Buren, Chicago.

$60-$200 a week. Genuine Gold Letters for store windows. Easily applied. Free samples. Liberal offer to general agents. Metallic Letter Co., 441 B., North Clark, Chicago.

BIG MONEY applying Gold Initials on Automobiles. Easiest thing today. No experience needed. $1.45 profit every $1.50 job. Free Samples. "RALCO", R-1043 Washington, Boston, Mass.

BIG MONEY SELLING SHIRTS, TIES, UNDERWEAR, Sox, Raincoats, Coveralls, Pants, Playsuits. Outfit Free! Experience unnecessary. NIMROD CO., Dept. 148, 4922-28 Lincoln Ave., Chicago.

Business Opportunities

ARTIFICIAL Marble. Beautifully colored glossy tiles. No polishing, almost uncanny. Saws and planes, or hacksaw proof. Cheap, fireproof, enamels wood. Cement composition. Make tabletops, floors, base, inkstands, mantelpieces, novelties, imitation lumber, garden furniture. Astonishing samples with particulars, 10c. John C. Payn, 945 Grande, Vista Drive, Los Angeles, Calif.

Opportunity—Your own business spare or full time. Investment small. Profits large. Proven plan. Working instructions $1.00. Roger Guthrie, Marissa, Illinois.

AMATEUR CARTOONISTS, Earn $25. week, copying cartoons for advertisers. Service Syndicate, Argyle, Wisconsin.

NEW INVENTION — Real knockout—liquid marble—hard as porcelain, high gloss—waterproof, no balking, no oil, costs only 50c gallon—officially tested—25c, brings samples. The Brown Laboratories, Box 1481, Washington, D. C.

Sell by Mail, Books, Novelties. Bargains! Large Profits. Particulars FREE. E. Elfco, 525 S. Dearborn, Chicago.

Cameras

Used V. P. Eastman Special F. 4.5 Lens—$17.50. 2¼ x 3¼ Voigtlander Rollfilm F. 4.5 Lens in Compur Shutter—$22.50. New York Institute Movie 35mm. with 1 inch F. 3.5 Tessar—$72.50. Our free bargain book lists 100 others. Central Camera Company, Dept. 37A, 230 South Wabash Ave., Chicago, Illinois.

Chemicals

HANDBOOK FOR EXPERIMENTERS. Illustrated, 50c. Booklet of Experiments, 15c. Chemical price list, 5c. General Chemical Company, Reading, Pa.

Chemistry

YOUR CHEMICAL PROBLEM solved and formula or process furnished. Five Dollars. Write me. W. Stedman Richards, Industrial Chemist. Box 2402, Boston, Mass.

PAR LABORATORIES, SALINA, KANSAS. Will analyze your soils, water, commercial products, etc. Processes solved—formulas. Accurate work. Honest prices.

Correspondence Courses

CORRESPONDENCE COURSES—Sold, Bought, Exchanged, Rented. Bargain Catalogue Free. Handling, B-799 Broadway, New York.

Used correspondence school courses sold on repurchase basis. Also rented and exchanged. Money-back guarantee. Catalog free. (Courses bought). Lee Mountain, Pisgah, Alabama.

Detectives

DETECTIVES. Work home or travel. Experience unnecessary. Particulars free. George Wagoner, 2190-X Broadway, N. Y.

Electricity

ELECTRIC FUN! 200 Stunts, 110 Volts, $1. Kutting Bros., Campbell, Calif.

For Inventors

Inventions commercialized. Patented or unpatented. Write, Adam Fisher Mfg. Co., 205 Enright, St. Louis, Mo.

INVENTOR'S UNIVERSAL EDUCATOR: Contains 900 mechanical movements; 50 Perpetual Motions; instruction on procuring and selling patents and selecting an attorney, etc. Suggests new ideas. Price $1.00 postpaid in U. S. A. Address Dieterich Co., 602G, Ouray Bldg., Wash., D. C.

Unpatented Ideas Can Be Sold. I tell you how and help you make the sale. Free particulars. (Copyrighted.) Write W. T. Greene, 908 Barrister Bldg., Washington, D. C.

Fields Glasses, Microscopes, etc.

Special Central Barometer $2.95. 6 power Wollensak Field Glass $3.95. Giant Microscope working at 40-50-60 diameters—$3.95. Our free Bargain Book listing 100 of others. Central Camera Company, Dept. 37B, 230 South Wabash Avenue, Chicago, Illinois.

For Inventors

"HOW TO SELL your invention," patented or unpatented. Booklet free. McFranklin, 11227 So. Fairfield, Chicago.

Sound, practical inventions, patented or unpatented, now in demand to meet keen industrial competition. What have you? Write Chartered Institute American Inventors, 1122 Barrister Building, Washington, D. C.

Formulas

Any formula $1.00. Absolutely guaranteed. Send for lists. Doris Chemical Laboratories, 1311Q East 81, Cleveland, Ohio.

500 FORMULAS and Big Illustrated Catalog 25c. Ideal Book Shop, Park Ridge, Ill.

Instruction

STEADY U. S. GOVERNMENT JOBS. $105-$250 month. Men-women, 18-50. Paid Summer vacation. Short hours. Common education usually sufficient. Experience usually unnecessary. 25 coached free. Full particulars and list positions FREE. Write today sure. Franklin Institute, Dept. E1, Rochester, N. Y.

WANTED—Men-Women, 18-50, qualify for permanent Government positions. $105-$250 month; experience not required; vacations with pay; common education; thousands appointed yearly. Write, Instruction Bureau, 293, St. Louis, Mo., quickly

DON'T BE UNEMPLOYED. Become expert armature winder and electric motor repairman, start your own business, in your basement or garage, regulate your wages and working conditions. We instruct you the right way with simple instructions and practical charts. Everything explained in plain non-technical terms you understand. Write for free information today. RANDLE BROS. ARMATURE SHOP, 520 Fourth St., Waukegan, Ill.

MEN 18-35. Steady. $158.00-$225.00 month. RAILWAY POSTAL CLERKS. Common education sufficient. Experience unnecessary. 25 coached free. Write today. Franklin Institute, Dept. E-14, Rochester, N. Y.

Inventions Wanted

HAVE you a good patent, or pending application for sale? If so, write American Patents Corporation, 1142 Barrister Building, Washington, D. C.

Inventions Wanted—patented, unpatented. If you have an idea for sale write, Hartley, Box 928, Bangor, Maine.

Inventions Commercialized. Patented or unpatented. Write, Adam Fisher Mfg. Co., 205 Enright, St. Louis, Mo.

Inventors

Inventors—Sell your inventions before patenting. Free particulars. Write W. T. Greene, 941 Barrister Bldg., Washington, D. C.

Inventors: Send us sketch or crude model of your idea. Crescent craftsmen will develop it into a practical working model. 30 years' successful experience and thousands of satisfied clients. Confidential service guaranteed. Bank references furnished. Free illustrated book: "Making Inventions Pay." Crescent Tool Co., Dept. U-7, Cincinnati, Ohio.

INVENTORS—If you want to sell your patent or invention communicate with Foreign Patents Service, Paramount Building, New York City.

Magic

Magic Catalog, 20c. Lynn, 105 Beach, Dept. 6, Jersey City, N. J.

Miscellaneous

SILK TIES! Fine quality silk. Newest patterns. 3, $1.35. Circular free. Ourmette's Mailorder House, 81 Holly, Dept. 15, New Bedford, Mass.

Ten pictures beautiful girls, 25c. Four 10c. ARTS, BG-1611, Denver.

E-DENT-2 for False Teeth, marvelously Cleans, Purifies, Preserves Plates; Removes Film, Stain, Odor. Send 2c stamp for 30 days' free package. NELSON LAB., Pasadena, Calif., Dept. H.

FREE CIRCULARS ON SELF CULTURE—SPECIALS. Newthought, Personality, Seership, Mediumship, Health, Yogi Philosophy, Mystic, Occult Books. Martens, Publisher, N-to-J, Burlington, Iowa.

Resistance, Condensers, Transformers, Choke-coils, Etc. Write for sensational price list. Bronx Wholesale Radio Company, 5 West Tremont Avenue, New York.

Over 200,000 articles at low wholesale prices. Directory 10c. A. T. Downing, 18 Greenough Avenue, Jamaica Plain, Mass.

Old Coins

California gold, quarter size: 27c, ½ size 55c. Old dollar bill and catalogue 10c. Norman Shultz, Salt Lake, Utah.

Old Coins Wanted

Old money wanted. $5.00 to $2,500.00 each paid for old coins. Buying catalogue 10c. Em. Cohen, Box 483, Muskogee, Okla.

Patents

Inventions Commercialized. Patented or unpatented. Write, Adam Fisher Mfg. Co., 205 Enright, St. Louis, Mo.

Patent Attorneys

INVENTIONS PATENTED AND EXPLOITED by former United States Patent Office Examiner. Address Benjamin Webster, M. P. L., Suite 1708A, 15 East 26th St., New York.

PATENTS, TRADE MARKS—All cases submitted given personal attention by a member of the firm. Information and booklet free. Lancaster, Allwine & Rommel, 242 Ouray Building, Washington, D. C.

Patents. Time counts in applying for patents. Don't risk delay in protecting your ideas. Send sketch or model for instructions or write for Free book, "How to Obtain a Patent" and "Record of Invention" form. No charge for information on how to proceed. Communications strictly confidential. Prompt, careful, efficient service. Clarence A. O'Brien, Registered Patent Attorney, Security Bank Building (directly across street from Patent Office), Washington, D. C. See page 243.

Patents Procured; Trade Marks Registered—Preliminary advice furnished without charge. Booklet and form for disclosing idea free. Irving L. McCathran, 703 International Building, Washington, D. C.

Unpatented Ideas can be sold. I tell you how and help you make the sale. Free particulars. (Copyrighted.) Write W. T. Greene, 909 Barrister Bldg., Washington, D. C.

"INVENTORS GUIDE." valuable information, free. Frank Ledermann, Registered Attorney-Engineer, 1712-W, Woolworth Bldg., New York.

PATENTS—Write for Free Information, HOW TO OBTAIN A PATENT, and RECORD OF INVENTION — or send Drawing or Model for Examination. Miller & Miller, Patent Attorneys (former Patent Office Examiners), 1006-C Woolworth Building, New York; 258 McGill Bldg., Washington, D. C.

Patents at low cost. Write today for free booklet. See page 242. Harry W. Johnson, 910 G St., Washington, D. C.

Patents or Inventions

INVENTIONS COMMERCIALIZED. Patented or unpatented. Write Adam Fisher Mfg. Co., 205 Enright, St. Louis, Mo.

Personal

TALKIE AND MOVIE PRODUCERS are clamoring for new short-story ideas, plots, etc. Perhaps you can write one that we can shape and sell for you. One writer (V. M.) received $3,000. New York best market. Write now for free booklet, without obligation. HOW TO WRITE FOR THE TALKIES! Daniel O'Malley Company, Inc., Suite G, 1776 Broadway, New York.

Photo Finishing

First film developed, six prints, 25c silver. Enlargement free. Superior Photo Service, Dept. S, Waterloo, Iowa.

Photoplays Wanted

$ $ $ PHOTOPLAY Ideas for Talking Pictures. Accepted any form. For revision, criticism and submission to studios. Estab. 1917. Booklet free. Universal Scenario Co., 228 Meyer Bldg., Western & Sierra Vista, Hollywood, Calif.

Printing Outfits and Supplies

Print your own cards, stationery, circulars, advertising, etc. Junior Press, $5.90; Job Presses, $11 up. Power, $149. Print for others, big profit. Easy rules furnished. Write for free catalog and full information. Kelsey Co., R-6, Meriden, Conn.

Salesmen Wanted

Wanted County Salesman with car, to demonstrate for large Ohio Manufacturer. First class job. Fyr-Fyter Co., 2183 Fyr Fyter Building, Dayton, Ohio.

PUNCHBOARD SALESMEN—most gigantic line ever featured. Vending machines—all kinds. Make high as $28.00 on single order. Repeat commissions. Beautiful colored catalog free. LION MFG., Dept. 11, 308 W. Erie, Chicago.

Salesmen—At last! New feature sells punchboards everywhere — Dealers wild with joy—prosperity back again—profits enormous — Samples free — Puritan Co., 1417 Jackson Blvd., Chicago.

Songwriters

SONGWRITERS: Read "Song Requirements of Talking Pictures, Radio and Records," an explanatory, instructive book SENT FREE to aspiring writers of words for songs. We compose, arrange music and secure copyright. Write today. S.N., Newcomer Associates, 1674 Broadway, New York.

SONGWRITERS write now for free booklet how to make money out of songs, by America's well-known composer. Stan Tucker, 330-B Wadsworth Ave., New York.

SONG-POEM writers. We compose music. Guarantee publisher's acceptance. National, 1475WK, Broadway, New York.

SONG-POEM WRITERS—"REAL" PROPOSITION, HIBBELER, D191, 2104 Keystone, Chicago.

Typewriters for Sale

TYPEWRITERS, all standard makes, $10 up. Fully guaranteed. Catalog free. Northwestern Typewriter Exchange, 121 N. Francisco Ave., Chicago.

Wireless

Learn Wireless (Radio) and Morse telegraphy. School, oldest and largest; endorsed by Telegraph, Radio, Railway and Government Officials. Expenses low—can earn part. Catalog free. Dodges Institute, Stone St., Valparaiso, Ind.

1 Plumb & level, 18"	1.35
1 Calipers, 5" outside	.85
1 Calipers, 5" inside	.85
1 Dividers, 6"	.90
1 Hammer, 13 oz.	1.45
1 Hatchet	2.10
1 Mallet	.40
1 Ratchet brace, 8"	1.75
1 Hand drill	1.50
1 Breast drill	4.55
1 Plane, Jack, ¼"	4.35
1 Plane, Block	1.65
1 Hand saw, 22", 10 points	1.60
1 Rip saw, 26", 6 points	1.75
1 Back saw, 10", 10 points	2.00
1 Keyhole saw, 10 points	.45
1 Hack saw	.30
12 Hack saw blades for saw	.60
7 Wood bits, set	5.25
1 Bit	.95
1 Bit	1.00
1 Bit	1.23
1 Bit	1.62
1 Set of 8 drills, driver	1.00
1 Expansion bit	1.95
1 Countersink, ½"	.30
1 Chisel, ¼"	.50
1 Chisel, ½"	.52
1 Chisel, 1"	.72
1 Spoke shave	.65
1 Wrench, adjustable	1.50
1 Stillson wrench, 10"	.95
1 Pliers, general purpose	.90
1 Screw-driver, 4½"	.40
1 Screw-driver, 7½"	.60
1 File, mill bastard, 6"	.13
1 File, mill smooth, 8"	.20
1 File, cabinet, 10"	.50
1 File, slim taper, 5"	.09
1 File, round, 6"	.13
1 Glass cutter	.15
1 Putty knife, household	.35
1 Nail set, 1/16"	.12
1 Center punch, ⅜"	.18
1 Oilstone, carborundum	1.05
1 Tinners' Snips, 12"	1.75
1 Electric soldering iron	2.50
1 Screw-driver bit, ½"	.24
1 Knife, Sloyd	.45
Total	$199.90

George E. Morris, Third Winner in the $50 Class, Says:

I WAS born in Fall River, Massachusetts, and received my education in the public schools. On leaving school I became associated with my father in the painting and decorating business and, after the retirement of my father, conducted the business for a period of fifteen years.

George E. Morris

In 1925 I joined the staff of the Recreation Department of the City of Fall River, during which time I taught Handwork and Miniature Airplane construction at the indoor centers of the outdoor playgrounds. I held special classes in toy making in two Parochial Schools taking the boys while the girls were having a cooking lesson.

Last August I was appointed instructor of Painting and Decorating at the Diman Vocational School, Fall River, which position I now hold.

I am a married man, the father of four children and the husband of a woman who has been a source of constant encouragement during all my endeavors. My hobbies are working with tools, reading technical books, especially painting and decorating books, and helping boys and young men to make good use of their leisure time, to help prepare them for the battle of life that will soon be their duty to face.

Why Mr. Morris Chose the Tools He Did:

To be able to construct with his own hands an article of beauty and worth is one of the greatest achievements the home worker can hope to accomplish. To do this good tools are a prime requisite. The average home worker can only afford a minimum outlay for tools and therefore should get all that he possibly can for the money expended, at no time sacrificing quality for price.

In the first division of the SCIENCE AND INVENTION Home Workshop Contest, with $50.00 to expend, the contestant should bear in mind that good workmanship demands good tools and that good tools are made only by reliable manufacturers, and while the selection can not be large it should be of the best tools obtainable.

The tools selected should be able to stand sharpening and retain their edges under ordinary conditions. Working with inferior tools soon discourages the amateur workman and if he is to be kept at the task at hand until finished the best tools should be secured.

To my mind there is nothing so helpful to the growing young man as the Home Workshop, it keeps him contented and pleasant to live with. I have never seen a man whose hobby is working with tools who is not agreeable and a credit to the community in which he lives.

The manufacturers and dealers I have used take pride in their goods and the average person need not have any fear that goods purchased from them would not be up to standards they jealously maintain.

George E. Morris' List of Tools

Tool Size	Cost
Awl, No. 3	$ .20
Awl, No. 2	.15
Bevel, 8"	.54
Bit, 4/16"	.50
Bit, 6/16"	.50
Bit, 8/16"	.50
Bit, snail	1.35
Bit, gimlet, 4/32	.12
Bit, gimlet, 6/32"	.13
Brace, 8"	2.75
Carborundum, 4"-13/4-5/8"	.72
Chisel, ¼"	.38
Chisel, ½"	.42
Chisel, 1"	.58
Countersink	.40
Draw Knife, 6"	1.20
Drill, ½"	3.00
File, 8"	.27
File, 5½"	.11
File, 12"	.27
Gauge	.60
Glass Cutter	.15
Gouge, ¾"	.54
Hack Saw, 8"	1.00
Hammer	1.50
Hammer	.80
Hatchet	2.10
Level, 18"	1.20
Miter Box, 14"	2.00
Mallet, 2¾"	.40
Nail Set	.12
Oiler	.20
Plane, 14"	4.80
Plane, 5"	2.85
Pliers, 6"	.75
Putty Knife, 3⅜"	.45
Rasp, 8"	.48
Rule, 24"	.55
Saw, 10"	2.00
Saw, 22"	2.75
Saw, 22"	2.75
Saw, 15"	1.00
Saw, 6"	.40
Screw-driver, 2½"	.30
Screw-driver, 4"	.40
Screw-driver, 6"	.60
Spokeshave, 10"	.70
Square, 24"	2.70
Square, 6"	.57
Winged Dividers, 6"	.60
Wrench, 6"	.65
	$50.00

IMPORTANT

TO NEWSSTAND READERS

IN order to eliminate all waste and unsold copies it has become necessary to supply newsstand dealers with the actual number of copies for which they have orders. This makes it advisable to place an order with your newsdealer, asking him to reserve a copy for you every month. Otherwise he will not be able to supply your copy. The dealer will then be in a position to supply copies to you regularly every month. If you are interested in reserving your copy every month, do not fail to do this. It costs you nothing to do so.

Index to Advertisers

(While every precaution is taken to insure accuracy, we cannot guarantee against the possibility of an occasional change or omission in the preparation of this index.)

STATEMENT OF THE OWNERSHIP, MANAGEMENT, CIRCULATION, ETC., REQUIRED BY THE ACT OF CONGRESS OF AUGUST 24, 1912, of Science and Invention, published monthly at Jamaica, N. Y., for April 1. 1931.

State of NEW YORK } ss.
County of NEW YORK }

Before me, a notary public in and for the State and county aforesaid, personally appeared Joseph H. Kraus, who having been duly sworn according to law, deposes and says that he is the Editor of the Science and Invention and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management (and if a daily paper, the circulation), etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, embodied in section 411, Postal Laws and Regulations, printed on the reverse of this form, to wit: 1. That the names and addresses of the publisher, editor, managing editor, and business managers are: Publisher, Radio-Science Publications, Inc., 381 Fourth Ave., New York City; Editor, Joseph H. Kraus, 381 Fourth Ave., New York City; Managing Editor, A. Dinsdale, 381 Fourth Ave., New York City; Business Managers, None. 2. That the owner is: Radio-Science Publications, Inc., 381 Fourth Ave., New York City; B. A. Mackinnon, 225 Varick St., New York City; H. K. Fly, 225 Varick St., New York City; R. B. Asmus, 551 Fifth Ave., New York City. 3. That the known bondholders, mortgagees, and other security holders owning or holding 1 per cent or more of total amount of bonds, mortgages, or other securities are: None. 4. That the two paragraphs next above, giving the names of the owners, stockholders, and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him. 5. That the average number of copies of each issue of this publication sold or distributed, through the mails or otherwise, to paid subscribers during the six months preceding the date shown above is: (This information is required from daily publications only.) Signed, Joseph H. Kraus, Editor. Sworn to and subscribed before me this 27th day of March, 1931. (Seal) John Meskel, Notary Public, City of New York. (My commission expires March 30, 1932.)

Scientific Book Reviews

ENERGY AND POWER, by Morris Meister. Published by Charles Scribner's Sons, New York, 233 pages. Price $1.08.

Here is an interesting little volume intended for children of Junior High School age. Just about at this time the youngsters are beginning to wonder and inquire what makes things go, and what is power.

The material is written in conversational style and its presentation is such that the youngster can feel that the various phenomena described in the reading matter have a distinct bearing upon his life. Chapters are devoted to subjects such as "The Source and Transmission of Light," "Inertia," "Friction," and "Levers," which are discussed in an elementary fashion. Subsequent chapter heads are "Simple Machines," "Steam Engine," "Gasoline Engine," and "Automobile." We think that the book is most charmingly written.

RECREATIONS IN MATHEMATICS, by H. E. Licks. Published by D. Van Nostrand Co., Inc., New York. 155 pages. Price $1.50.

This very interesting little book derives much of its interest from the fact that it covers a large field. Arithmetic, Algebra, Geometry, Trigonometry, Analytical Geometry, Calculus, Astronomy and the Calendar, Mechanics and Physics, make a pretty formidable list of subjects and they all find places in this book. There are some most amusing paradoxes and fallacies. The author seems to be one who enjoys the search for fallacies. Thus in the chapter alloted to analytical geometry he says that he tried hard to find a single fallacy, but could not, while the lower branches of mathematics yielded him over a dozen. The way in which he presents the scope of Integral Calculus is very concise, and brings out the fact that integration is to some extent an educated guess. Throughout the work little bits of literature and history appear, and there is certainly an immense amount of good suggestion in the 155 pages of Dr. Licks' book.

STEEL CONSTRUCTION, by Burt and Ritow. Published by the American Technical Society, Chicago, 411 pages. Price $2.50.

Industry many years ago passed out of the hands of the man who did his work by rule of thumb and built as the problem presented itself. Nowadays building is not a layman's nor a mason's job. It is a science followed by carefully trained technicians. This is very strikingly brought home to us when we read a book like "Steel Construction."

It is intended to be used as a text book and for ready reference. It details many of the generally accepted methods of construction and includes examples of the techniques employed. Because of its text-book nature, numerous charts are found and the addition of the formulas and specific instances in which they are applicable tend to make the reader feel that this is a practical treatise on the subject.

FORD MODEL "A" CAR, by Page. Published by the Norman W. Henley Publishing Company, New York, 692 pages. Price $2.50.

Major Page has written extensively on the care of automotive equipment. He has not confined his studies to land machines, but has issued a comprehensive work on aviation engines. It was almost to be expected that as soon as the Ford Company decided to manufacture a new model, Major Page would simultaneously engage in the production of a work that would detail the care and handling of that car.

The contents will not disappoint even the most critical and exacting information seeker. Here are 692 pages chockful of instruction, data and supplementary illustrations. Even engineers will find the book well worth reading.

AVIATION ENGINES, by Ray F. Kuns. Published by the American Technical Society, Chicago, 198 pages. Price $2.00.

Now that aviation has come into its own, text books are being published which are expected to teach one how to handle and take care of planes. Very properly several of them are devoted to the care of the engine. Mr. Kuns has, we think, very fortunately discussed the more popular and generally used aircraft motors individually. Among those which are treated are the Curtiss "OX-5," "Liberty V Type," "Wright Whirlwind" and "Gypsy" and many others that are in everyday use. The book is well illustrated and the writing technique of discussing each part by itself helps a good deal in the understanding of the explanations.

NEW FRONTIERS OF PHYSICS, by Paul R. Heyl. Published by D. Appleton & Company, New York, 162 pages. Price $2.00.

The title of this book is in itself very attractive. In the opening pages it brings out the existence in the '90's of the last century, of a species of pessimism. In those days the advanced school had the idea that they had reached definite certainty about many things and would not listen to anybody having different views. Today this is all greatly changed. We are almost too much the other way. There seems to be no end to what man may yet do and discover. The fact that Dr. Heyl starts his book by "Looking Backward," for that is the title of the first chapter, is emphasized by the subsequent treatment in which he brings out forcefully the great changes in the viewpoints and open mindedness of the true scientist. In the closing chapter entitled "Looking Forward," he gives hints of what we may see in the near future.

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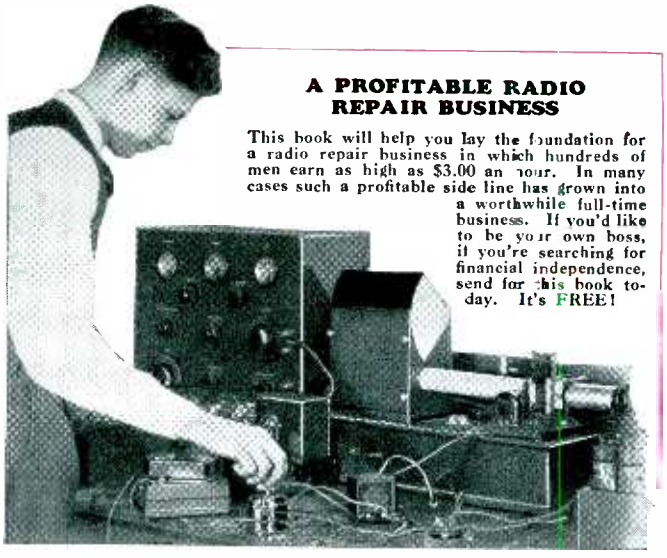

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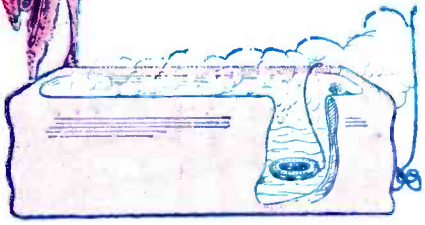

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