

# SCIENTIFIC AMERICAN

JULY • 1941



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OUR SEARCH FOR THE SUPERNATURAL—IV

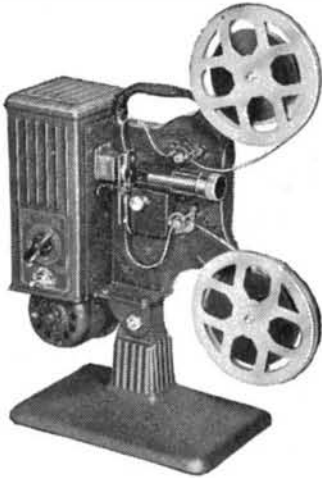
**Did Sir Oliver Lodge Write the Message?**

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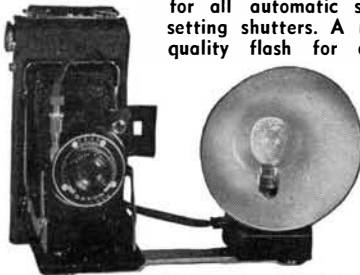
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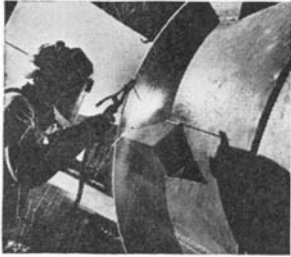
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# SCIENTIFIC AMERICAN

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NINETY-SEVENTH YEAR

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JULY • 1941

WELDING, a proved tool of industry, has an important job to do in the scheme of national defense. As told in the article starting on page 8 of this issue, welding brings to the machine tool industry not only a faster production method but also the possibility of using superior methods at less cost. Photograph by Robert Yarnall Richie, courtesy Wyatt Metal and Boiler Works.

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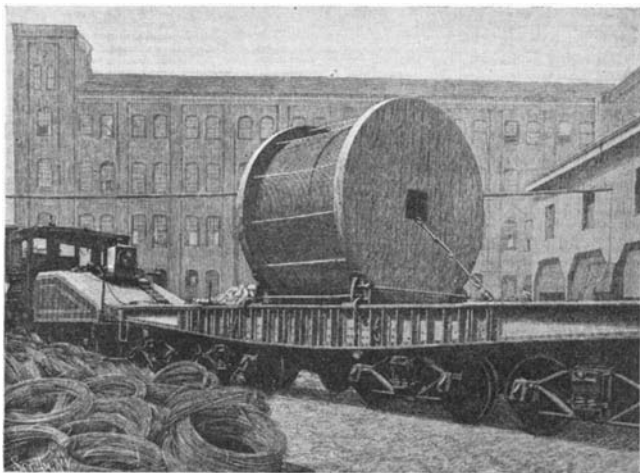
# 50 Years Ago in . . .

## SCIENTIFIC AMERICAN

(Condensed From Issues of July, 1891)

**WEALTHY ELECTRICIANS**—"No scientific body in the country has so many millionaires as the American Institute of Electrical Engineers. At the top of the list is Alexander Graham Bell, whose profits on the telephone are represented by eight figures. Next comes Edison with a seven figure fortune. Brush, of electric light fame, and Elihu Thomson, whose financial future is perhaps brighter than any of the others now, are more than millionaires, and a score of others have independent fortunes. Most of these men were telegraph operators, and most of them began their experimenting and study without a dollar."

**CABLES**—"The extensive use of street cable railways has necessitated the manufacture of wire ropes of great continuous length, and the problem of transporting such ropes, without injury, from the manufactory to the place of use, is a serious one. . . This is successfully solved by Messrs. John A. Roebling & Co., of Trenton, N. J., whose cable railway ropes have become everywhere famous for



Shipment of street railway cables

excellence. . . A single Roebling cable sometimes is required to have a length of  $6\frac{1}{2}$  miles. Such a rope,  $1\frac{1}{4}$  in. in diameter, will weigh 42 tons. It is reeled upon a single spool, over 10 ft. high, as shown in our engraving, which is from a photograph. A special car of superior strength receives the great package."

**LOCOMOTIVE WATER**—"The system of taking water into locomotive tender water tanks without stopping the train has been quite extensively introduced upon some of the leading railroads of this country. . . An iron trough is laid upon the sleepers. It is 6 inches deep, 18 inches wide, and about 1,200 feet long. . . The tanks, of 35,000 gallons capacity each, are fed by two Blake pumps. . . A dipper or movable chute is carried by the locomotive tender. It is arranged so as to be raised or lowered at will by a lever. . . To take in water the fireman lowers the dipper. As it meets the water in the tank, the latter is forced up in great volumes into the tender tank. From one trough two thousand two hundred gallons can be taken in on passing."

**URANIUM STEEL**—"Among the ores recently found in the Black Hills has been that rare and valuable mineral uranium. Although it has only appeared in one place, situated in the Bald Mountain district, it is found there in such large quantities as to warrant the prospect of early production of uranium salts, as well as the metal uranium, in the United States. . . Experiments and tests which have been made by the great steel and gun manufacturers in England and Germany have shown that the addition of a small percentage of uranium to steel increases its elasticity, and at the same time its hardness, to an extent that makes its use in the manufacture of guns, armor plates, etc., most desirable."

**SHIP BITES WHALE**—"While cruising with the Channel squadron, writes an officer of H.M.S. *Immortalite*, at nine o'clock on the morning of the 26th of May, in lat. 38 deg. 7 min. N, long. 9 deg. 19 min. W, steering  $S\frac{1}{4}W$  (about midway between Sardinia and the African coast), and going at a speed of thirteen knots, we struck a whale, about forty-five or fifty feet long, with our ram. It was unable to clear itself, which necessitated our going full speed astern, when the whale sank."

**TWELVE-INCH GUN**—"The first 12-inch steel gun made in the United States has been completed at the Watervliet Arsenal, West Troy, N. Y., and shipped to the Sandy Hook proving ground for testing. This is the largest steel gun ever built in this country. . . The gun weighs 52 tons. It is 36.66 feet long and the length of the bore is 34 feet. Its charge is 440 pounds of powder, and its projectile weighs 1,000 pounds. . . The initial velocity of the projectile will be 1,940 feet per second, the muzzle energy 26,000 foot tons. At the muzzle this projectile will penetrate 32 inches of iron, and at a distance of two miles 20 inches."

**SAIL AND STEAM**—"The sailing vessel is rapidly passing into the limbo of forgetfulness, and the deep and fast steamer is gathering to itself the business of the Great Lakes carrying trade. The lumber traffic still adheres to the sailing vessels, but iron ore, coal, wheat, flour, and merchandise go to the steamers for low rates and quick transit."

**HIGH-PRESSURE STEAM**—"In the early days of steamships on the Atlantic the steam pressure carried was five pounds only above the atmosphere, and the engines made from 10 to 12 revolutions per minute; the vessels made 8 knots per hour on an average. Now we carry exactly 36 times the pressure, make 7 times the revolutions, but go only  $2\frac{1}{2}$  times faster."

**COAST SURVEY**—"After nineteen years the United States steamer *Hassler* has completed the survey of the California and Oregon coasts."

**ELECTROCUTION**—"The new law of the State of New York, for the execution of criminals by the electric current, instead of by hanging, was enforced for the second time on the 7th of July, upon the bodies of four murderers. The execution took place at the Sing Sing State prison. . . The experience has proved that this method is superior to any other yet devised."

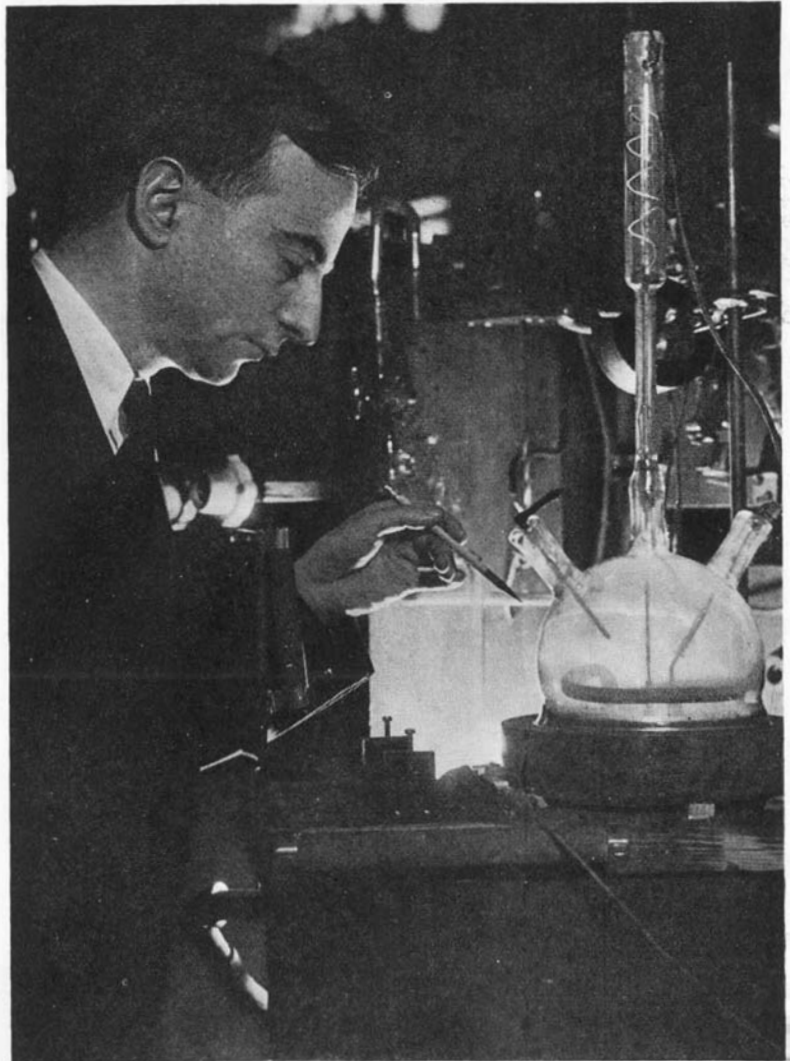


# Personalities in Science

**I**N 1915, Dr. Joseph Slepian, tired of teaching mathematics and anxious to work with motors and electrical things, put away his textbooks and took a job winding railway motors in the East Pittsburgh Works of the Westinghouse Electric & Manufacturing Company. Today he holds the position of associate director of the Research Laboratories of that organization. His inventions have played an important part in the last 20 years' development of electric power systems. He developed the modern lightning arrester which safeguards power lines and equipment. He and L. R. Ludwig, another Westinghouse engineer, invented the Ignitron, a device which changes alternating current electricity into direct current—essential in such processes as the manufacture of aluminum. His "De-ion" principle for putting out electric arcs fast helped make possible the distribution of electric power at the high voltages in use today.

Born in Boston in 1891, Dr. Slepian received his Ph.D. degree from Harvard University in 1913 and studied higher mathematics at Gottingen University in Germany and Sorbonne at Paris the following year. Later he taught at Cornell University. Despite the fact that his formal education included nothing about electrical engineering, Dr. Slepian has become one of the world's outstanding electrical engineers.

After joining Westinghouse, he began reading books on electrical engineering and soon was assigned to routine service problems and testing materials in the research division. Word got around that young Slepian had the answers to a lot of tricky technical problems, and experienced engineers began seeking his advice. When he told his foreman that this interfered with his regular work, the foreman said to let the routine work wait. Dr. Slepian did, and within six months he was asked if he would like to move up to the main research engineering office. His answer was "Fine"; but nothing more was said about it. When he thought he had waited long enough, Dr. Slepian found a vacant desk in the research office, picked up his



**JOSEPH SLEPIAN**

books and papers and moved in. That he was permitted to keep his desk, Dr. Slepian explains, "just goes to show how a big company can still be flexible enough to allow a man to make his own niche."

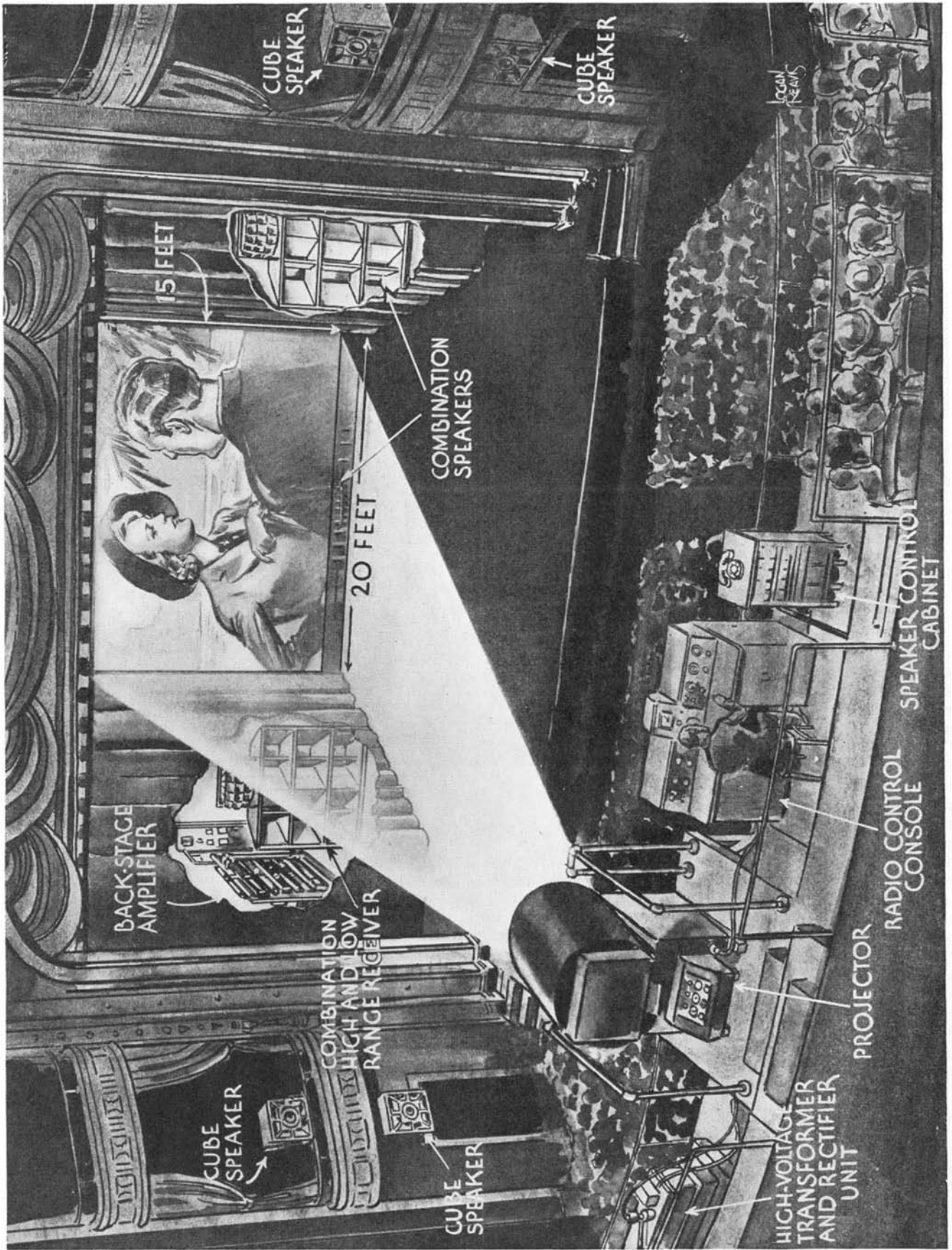
It became clear to most electrical engineers in 1922 that the electrical systems in the country had just about reached the limit of ability to carry higher voltages because switches which could break high-power circuits of greater voltages were big, slow-acting, and expensive. Up to 1922 they had handled arcs as a fire, putting them out by cooling and chilling them. But it seemed to Dr. Slepian that a better understanding of the arc's nature from the standpoint of a physicist was needed. He recalled the theory that molecules of gas or air are broken up into ions when an electrical current passes through the gas.

In conventional alternating current systems, the current passes through zero 120 times a second or

makes 60 cycles a second as it alternates forward and backward. At these zero points the current is not creating any new ions but is losing them. So Dr. Slepian reasoned that if he could make the ions disappear faster at the zero points, there would not be any ions to carry the current when it was ready to move again.

Discovering that there was a layer near the negative electrode which lost its ions quickly, Dr. Slepian created a series of these "de-ionizing" layers by breaking up the big arc into a lot of smaller arcs, each with a layer in which the ions disappeared quickly—and a new era of high-power transmission opened up.

Dr. Slepian is married and has two sons—Robert, 21, and David, 17. For relaxation, he depends upon good music. But his real hobby is keeping track of David's hobbies, which include photography, metal working, and microscopy, among others.



## THEATER TELEVISION

**L**ARGE-SCREEN television pictures, made possible by a projector developed by the RCA Laboratories (see page 27 for more details), have been successfully demonstrated under commercial conditions. Drawing above shows arrangement of equipment required.

## OUR SEARCH FOR THE SUPERNATURAL—IV

### Did Sir Oliver Lodge Write the Message?

A. D. RATHBONE, IV

Secretary, Scientific American  
Committee for the Investigation  
of Psychic Phenomena

**D**URING the evening of May 12 the Scientific American Committee for the Investigation of Psychic Phenomena witnessed a manifestation of alleged "spirit-writing" by Reverend Edward Lester Thorne, President, United Spiritualists' Church. The demonstration took place in his church, which is located at 257 Columbus Avenue, New York City, and was presented before members of one of Dr. Thorne's "developing classes," representatives of the press, guests, and the following members of our Committee: Messrs. Dunninger, Bendix, Kane, Kraus, Odlum, Peck, and the Secretary of the Committee. The so-called "spirit-message" consisted of one word, purported to come from Sir Oliver Joseph Lodge, and, according to the Reverend Thorne, was written and signed by the spirit hand of the late British physicist. That single word held special meaning for Dunninger, who stated that it was a key word to one of the three secret messages confided to him in code by Sir Arthur Conan Doyle, Thomas Alva Edison, and Houdini before their respective deaths, in efforts to test the theory of spiritual return to this world.

Before an audience of some 40 persons, including the "developing class," the seance convened shortly after six o'clock with introductory remarks by Dunninger, who emphatically reiterated that neither the publishers of Scientific American nor the special investigating committee questions, debates, or in any way attacks any form of religion, religious belief, or cult in the search for realism in the physical type of psychic phenomena. The Committee, he stated, is concerned solely with a scientific, fact-

finding effort to secure conclusive negative or positive proof regarding alleged human abilities to produce physical manifestations of communication with what is commonly referred to as the "spirit world."

The lights of the little church were left on and Dunninger and Dr. Thorne seated themselves on

### PSYCHIC RESEARCH

• Scientific American, in collaboration with The Universal Council for Psychic Research, offers \$15,000 to any medium who can produce a spiritistic effect or a supernatural manifestation under the rules and regulations published on page 210 of our April 1941 issue. •

either side of a small table in front of the witnesses.

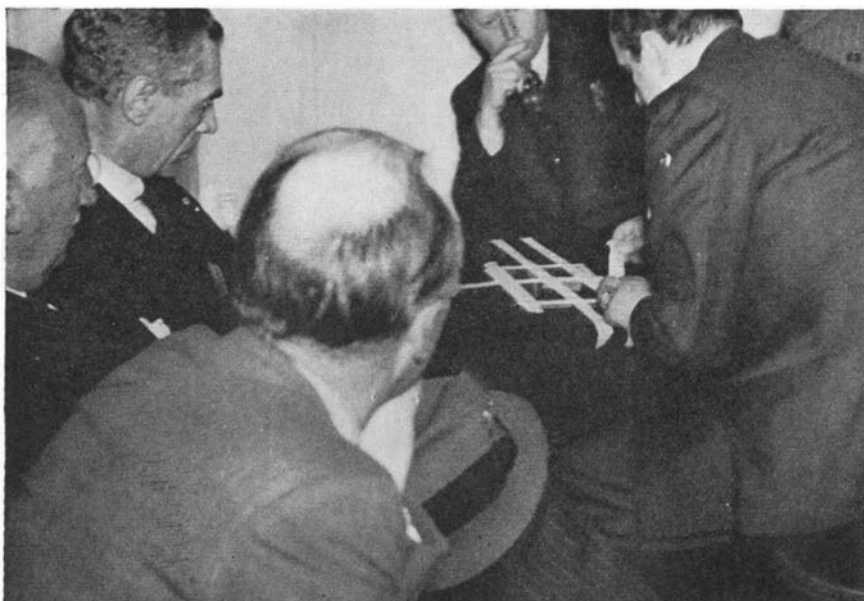
"I hope," announced Dr. Thorne, "to be able to produce phenomena, and may I ask those present who are members of my developing class to please work with me, to answer any clairvoyant force, and to tell me when they see anything. I shall endeavor to make contact with those very close to me very often—Sir Arthur Conan Doyle and several others. I have here two sheets of glass, the edges of which have been bound with adhesive tape for protection of the fingers, and several plain, white cards purchased from the 5 and 10 cent store." Holding five cards aloft, one by one, and apparently turning them so that the audience could see there was no writing on them, Dr. Thorne proffered Dunninger a card, asked him to write his name thereon. This card was placed, signature side up, on top of one of the sheets of glass, which

lay flat on the small table between the medium and our Committee chairman. The second sheet of glass was then laid upon the first, forming a "glass sandwich," within which reposed the card. The other four cards were offered to members of the Committee for inspection by Dr. Thorne, who stated: "No heat treatment or any other chemical solution was used in order to subsequently produce writing, and now I shall ask your chairman to tape the glass sandwich to the table so that it cannot be moved," and he handed a roll of white adhesive tape to Dunninger, who securely strapped the two pieces of glass in place. On top of the glass Dr. Thorne laid an ordinary lead pencil.

Seating himself beside the table, Dr. Thorne asked the congregation to join with him in the singing of "Abide With Me." This was followed by a few seconds of silence, during which the medium was observed to draw the back of his right hand slowly across his forehead. He then began to sing "Onward Christian Soldiers," and was joined by members of the audience.

**A** SECOND interval of absolute silence ensued, after which Dr. Thorne said: "I contact several spirit forces who tell me that it is their desire to present to the world startling evidence of survival after death, and that this evening the spirit of Sir Oliver Lodge will write on that card something about one of the messages you (Dunninger) have in your possession. He tells me this is the first time since his passing that this has been revealed to the world, and if you will admit that what you find on the paper is authentic, Sir Oliver Lodge will





At the request of the medium and in the presence of interested witnesses, Dunninger securely fastened the "glass sandwich" to the top of the table

return then another time and give the balance."

With this introduction, Dr. Thorne proceeded to bring vocally a number of alleged "spirit messages" to various members of the audience in much the same manner as the medium, Madame Rose Ann Ericson, had done on previous occasions, save that this time the room remained lighted and the medium gave no outward physical appearance of being in a trance-like state. The messages occupied several minutes and were apparently recognized by some of those present. Meanwhile, the glass sandwich with its enclosed card lay securely taped together and to the table in full view of everyone.

**F**INALLY, Dr. Thorne said, apparently addressing Dunninger, "I contact Houdini. He refers to the message in your possession and tells you to hold on tightly. Time will come when that will be presented to the world. You are a very psychic person and you may not understand, but I know that you do have a great number of impressions through spirit helpers." (In the course of his 20 years' search into supernatural manifestations Dunninger has become known as the world's foremost authority on illusionary effects, all of which, however, when performed by him, have been accomplished through the use of trickery and legerdemain. He denies that he is a "psychic" in the sense that the word is customarily applied to mediums and others who claim to have supernatural

or supernormal powers.—*Ed.*)

After his message to Dunninger, Dr. Thorne paused a few seconds; then began singing "The Battle Hymn of the Republic," in which he was joined by members of the congregation. "I see," slowly remarked the medium after another brief interval of quiet, "a spirit hand over that glass. The hand is Sir Oliver Lodge's. Has anyone else seen that force?"

Several members of Dr. Thorne's developing class promptly replied that they, too, could see the hand. One man, later identified as H. P. van Walt, New York City, made the following statement: "I saw that

hand. It was a light between you and Dunninger. I just saw the form—saw the force between you and Dunninger. I know it was not a human being—it was just a form."

Immediately thereafter a lady in the rear of the audience, subsequently identified as Mrs. Ramona Alexander, also of New York City, claimed she had seen the form of Houdini standing beside Dr. Thorne while he had been speaking. "I saw Houdini," she said. "I saw him. He was tall and thin, and he wore a green cape. He was holding a piece of paper with a message, but the message was not very long. It was short—only a few words."

It was evident that the climax of the seance was being attained, but Dr. Thorne made no move toward the glass sandwich. Instead, he stated: "I want all the members of my class to know their forces are helping mine. The hand is with me. My friends, will you please sing 'Onward Christian Soldiers.'"

**T**HE hymn ended. Dr. Thorne rose to his feet, followed by Dunninger, and there was a general stir among the audience. As the medium started to remove the adhesive tape fastenings, Dunninger said: "One question—I presume that the message is upon that card. Did the spirit write it with that pencil?" (No one present had observed the pencil move from its original position.—*Ed.*)

"Not necessarily," replied Dr. Thorne.



The taping process completed, a pencil was placed on the "sandwich." Medium and some of the congregation sang while awaiting the message.

"Was that pencil used?" asked Dunninger.

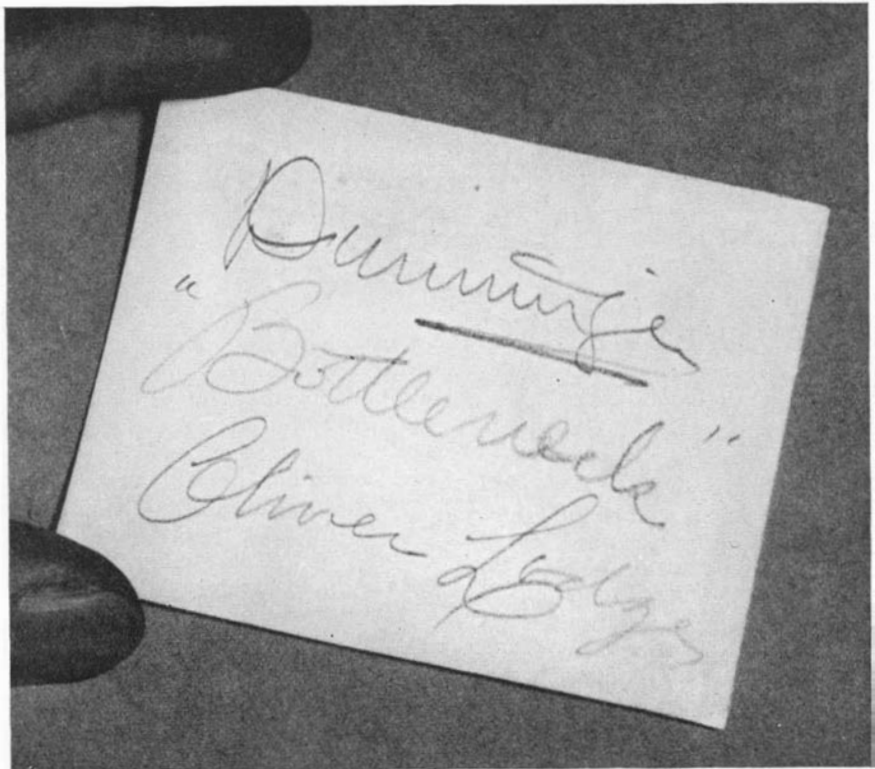
"It was a substance from that pencil," answered the medium.

With that interchange, the tapes were torn off, the card was picked up by Dunninger who announced it was the one he had previously signed. "Something about 'bottle-neck'," he said, "and Sir Oliver Lodge. 'Bottle-neck' is a sign of three things in connection with the three messages. The word 'bottle-neck' is significant. You tell me what that means."

"I told you," replied Dr. Thorne, "Sir Oliver Lodge would give you a word which would mean something in connection with one of the three messages."

"The word 'bottle-neck' is definitely significant," remarked Dunninger. "It is *not* one of the three code messages; it is not even one of the words in the messages, but it does have a meaning, and although this is closer than anyone has ever come, I cannot give you any further information beyond that fact. And while it is an important key, I am not mystified in the least as to how the writing appeared on the card, but the word, itself, is momentous. What do you know about it?"

Dr. Thorne replied, "Sir Oliver



When card was removed from the sheets of glass, it bore above cryptic message, addressed to Dunninger, apparently signed by Sir Oliver Lodge

and examination at an early meeting. By way of further explanation of the rather peculiar word which had been written on the card above Sir Oliver Lodge's signature, Chairman Dunninger stated that in connection with the three code messages in his possession the word "bottle-neck" does not have the same interpretation that is popularly attributed to it in national defense preparations today. "Rather," he said, "it is a word well known to magicians as being descriptive of a certain type of handcuffs, and could readily be associated in the mind in connection with Houdini."

**I**N accordance with the rules governing the search for the truth concerning psychic phenomena of a physical nature, it now becomes necessary that Dunninger "duplicate or explain through natural or scientific means" the actual production of words on a previously endorsed card during its insertion in a glass sandwich similar in every respect to the one used by Dr. Thorne in his manifestation. However, it is not required that Dunninger produce the same words, but merely that he duplicate the physical part of the performance, and in the event the so-called phenomenon is duplicated by natural or scientific means, the requirements originally established

to govern the activities of the committee will have been complied with.

### Interest of Readers

**A**s foreseen by the editors of *Scientific American* and so announced in our April issue, mental distress and uncertainty of all peoples has been enhanced by the world's war-like attitude, by international economic and social unrest, with the result that man's age-old query of what lies ahead next week, next year, brings about a dangerous public trend toward futility, and a tendency to turn to so-called mystic rites of cults or individuals in a desperate attempt to find the answer to the future. Since the publication of our April issue, letters have been received from all parts of this country, from Mexico, and from South America. Some implore our Committee to assist in solving "puzzling experiences;" others request an interpretation of a vision or a series of dreams which apparently foreshadowed a coming event; still others were written in praise or condemnation of our efforts to find some grain of scientific truth which could conceivably link unexplained episodes to some hitherto unknown but suspected psychic force.



Card bearing message was removed, then closely examined

Lodge did that. I didn't. I haven't the slightest idea what it means, and if I can, I will get more at some later time."

Thus did the third visit of the Scientific American Committee for the Investigation of Psychic Phenomena to a mediumistic seance end. In the Committee's files are the card and the two sheets of glass, still edged with the adhesive tape, reserved for careful scrutiny

# A Bottle-Neck Breaker

## Welding Presents Advantages of Speed and Low Cost to Machine Tool Industry

**ED C. POWERS**

Assistant Secretary,  
The James F. Lincoln  
Arc Welding Foundation

**E**LECTRIC arc welding is bringing to the machine-tool industry—that vitally important base upon which is being built the program of production for national defense—two outstanding groups of advantages. First, machine-tool builders have available, in the welding process, a proved means of producing tools in shorter time and at lower cost than by other methods, with the added desirable feature of lighter weight. Second, when machine tools are fabricated by welding, a substantial reduction can be made in the amount of machining required on tools of all types.

With these two groups of aids to production, the manufacture of lathes, punches, shears, broaches, milling machines, and so on can be stepped up to a point where there should be no outstanding difficulty in producing the \$450,000,000 worth of equipment per year which is currently considered to be necessary for our own defense demands, and for the war needs of England and Canada.

Substantial proof of the advantages of welding in machine-tool building are given in Tables 1 and 2, compiled from actual case studies reported by designers, engineers, and others. In the first table are shown examples of the savings that welding can make in matters of time, machine weight, and cost; in the second are figures on savings that have been made in machining time—and hence cost—in finishing the ultimate product.

The manner in which welding makes possible these advantages to the machine-tool industry, and to other industries where products, machines, and structures are made of metal, is simple yet fundamentally sound. The older and perhaps more conventional method

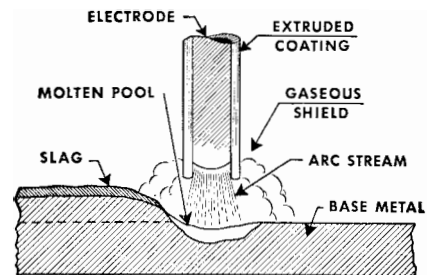
of producing the strong and rigid units which make up the great majority of machine tools, was to cast the required parts in cast iron and then assemble these parts by riveting or bolting. This procedure, of course, required time-consuming pattern-making, extensive machining of the cast parts, and expensive final assembly.

When welding, on the other hand, is applied to similar production problems, the machines and structures are built up of standard rolled steel as purchased from the mill. Cutting the steel to the sizes needed, assembling the various parts, and fusing them directly together without extra operations are features of the welding process. Here there is no need for such patterns as are used in casting, or for punching, drilling, and extra connecting members as in riveted construction.

**S**INCE steel is used in welded machine-tool production, reduced weight and lowered cost are obtained because the steel employed is two and one half times as rigid, four times as strong, and costs only 30 to 40 percent as much as cast iron.

Essentially, arc welding consists of merely forcing a powerful, though harmless, electric current

to jump a gap between an electrode and the metal to be welded. The current is carried from the arc-welding generator by rubber-covered wire cables, one of which is connected to the electrode, and the other to the work metal. When the electrode is touched to the metal and drawn away a fraction of an inch or so, the arc so formed generates an intense heat—approximately 6500 degrees, Fahrenheit—which melts both the end of the electrode and the work metal. The molten metal from the tip of the electrode flows to the molten spot on the parts being welded. When these mingled and melted metals cool, the parts are welded together and have become essentially one solid, single piece. And this piece is actually stronger in the welds than anywhere else. This is be-



Atmospheric oxidation is prevented by "shielding the arc"

cause of the superior qualities of modern weld metal, as compared to rolled steel, due to the exclusion of oxides and nitrides from the metal as it is deposited. This exclusion is accomplished by a gas which is produced as the coating of the electrode is consumed in the heat of welding. This gas surrounds the molten metal and shields it from the atmosphere, giving the name "shielded arc" to

**TABLE 1**  
Time, Weight, and Cost Comparisons of Machine Tools Produced by Casting and Welding

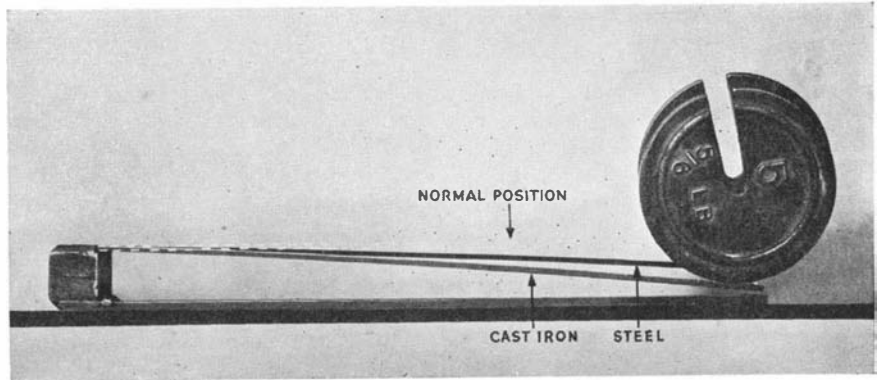
MACHINE TOOL	CAST IRON			WELDED STEEL		
	Time	Weight	Cost	Time	Weight	Cost
700-Ton Metal Forming Press	90 days			35 days		
Boring Mill		70,952 lbs.			60,000 lbs.	35-40% less
Shaft Roll Forming Machine			\$ 1,045.86			\$ 638.13
Planing Machine		134,400 lbs.	6,286.00		98,900 lbs.	4,925.05
Riveting Machine	5 mos.	9,500 lbs.	1,554.23	3½ mos.	8,400 lbs.	902.99
High-Speed Metal-Forming Machine		11,200 lbs.	2,104.00		6,835 lbs.	908.00
Saw		900 lbs.			600 lbs.	
Rotary Planing Machine	18 mos.		12,879.00	3 wks.		5,200.20



modern welding. This one favorable factor of arc welding—that it attains the full advantage of steel throughout a welded structure—is shown in Table 3 where comparisons are made between properties of weld metal and rolled steel.

But even with the advantages of welding that have been outlined, the process would not be able to enter the production picture if the material with which it is used did not peculiarly lend itself to the job in hand. Machine tools, designed to turn out precision work and to continue with the same degree of accuracy for thousands and often millions of operations, must of necessity have ample margins of rigidity and strength. Without maximum rigidity, parts will bend under stress and cause inefficient and faulty operation; without maximum strength, the machine will be unable to sustain the loads put on it.

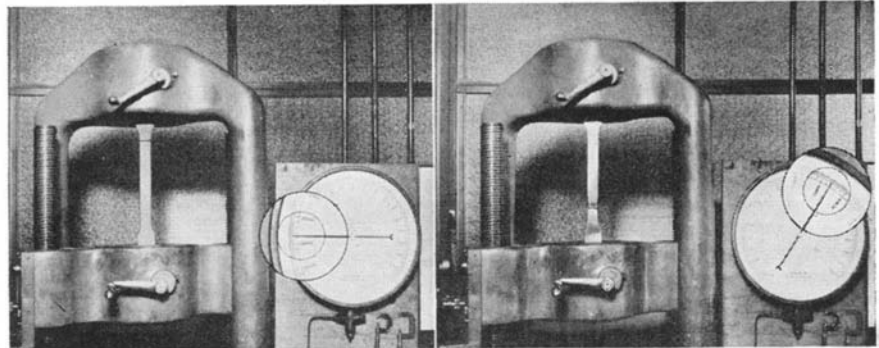
**P**ERHAPS the comparison of these two qualities, particularly that of rigidity, in steel and cast iron is not fully appreciated. It is frequently thought that, of the two, cast iron is the stiffer; that is, more resistant to bending. The actual facts in the matter, however, are brought out by a simple test of rigidity. This test consists of attaching two rods, one of cast iron and one of steel—equal in length, width, and thickness—to a block so that the ends are free to move. When equal weights are placed at precisely the same positions near the ends of the rods, it will be found that the cast-iron rod will



Rigidity test deflects iron bar two and one-half times more than steel

TABLE III  
Properties of Weld Metal and Rolled Steel

Material	Tensile Strength Lbs./sq. in.	% Elongation in 2" (Rigidity)	Density Grams per c.c.	Endurance Limit Lbs./sq. in.	Notched Bar Ft. Lbs. (Impact)
Mild rolled steel	55,000-65,000	20-30	7.86	24,000-28,000	20-80 (Izod)
Modern weld metal	65,000-75,000	20-35	7.84-7.86	28,000-32,000	25-80 (Izod)



Tensile tests indicate breaking points: iron bar on left, steel on right

bend 2½ times more than the steel. In other words, under equal load, steel is deflected only 40 percent as much as cast iron.

The greater tensile strength of

steel in comparison with ordinary cast iron is an acknowledged fact. Just to complete the comparison, however, it may be stated that when two equal size bars, one of steel and the other of cast iron, were tested to destruction in a tensile testing machine, the steel bar withstood a stress of 61,800 pounds per square inch, while the cast-iron bar broke at only 16,420 pounds per square inch.

Also important in the construction of machine tools are the factors of fatigue and of resistance to shock and impact. In fatigue resistance, steel is three times better than ordinary cast iron; its resistance to shock and impact is many times greater.

The reduction in the amount of machining required on finished products produced by welding, as compared with those produced by casting methods, may be explained in this way: Since steel has qualities of strength and rigidity in excess of cast iron, only a fraction

TABLE II  
Savings in Machining Time and Cost on Various Products of Welded Construction

PRODUCT STRUCTURE OR PART	MACHINING TIME AND COST				MACHINING SAVED BY USE OF WELDED CONSTRUCTION		
	Former Construction		Welded Construction		Time (hr)	Cost (\$)	%
	Time (hr)	Cost (\$)	Time (hr)	Cost (\$)			
Deep Well Pump	40	32.00	24	19.20	16	12.80	40%
Bulldozer Die for Tractor Steer Rod	21	16.66	19	14.90	2	1.76	9½%
Boring Fixture	54	43.12	45	36.25	9	6.87	16½%
Locomotive Guide Yoke	26	20.62	20	16.00	6	4.62	23%
Metal Cutting Machine	19	15.00	12	10.00	7	5.00	37%
Dust Collecting Bench	65	51.63	35	28.38	30	23.25	46%
Copper Sheet Coiling Machine	160	128.00	128	102.00	32	26.00	20%
Die Cutting Press	244	195.00	206	165.00	38	30.00	15½%

NOTE:—Figures based on the present rate (80c per hour) for skilled labor in the machine tool industry.

as many pounds of steel are required in a given machine to obtain equal strength (Table 1). Obviously, the amount of machining will in general be in proportion to the amount of metal used. With half as much metal, or even less, it will naturally follow that only



**Arc welding reduced weight of this boring mill 15 percent; cut costs about 40 percent**

approximately half as much machining will have to be done. Furthermore, since welded structures are built up of standard rolled steel shapes cut to correct sizes to meet design requirements, there is little or no excess metal to be machined.

**I**N the words of an engineer in one of the country's largest manufacturing plants: "Each of the two methods formerly used in machine part construction, casting and riveting, had one very desirable property. The former, at its best, produced a homogeneous structure, but in the case of iron castings the metal is of relatively low tensile strength, having little resistance to impact or fatigue stresses, while steel castings present technical difficulties so great that soundness in complicated forms is seldom attained. If the advantages of the two processes could be combined in one method of construction and the resultant product sold at competitive prices, it would be an outstanding accomplishment. Arc welding does this, taking rolled steel in either plate or structural forms, joining the pieces together

as they would be in a casting and fusing the various members into a structure of uniform physical properties by the use of high strength, ductile steel as a joint metal. The product can be sold for the same or somewhat lower price than that built by either of the older methods, leaving a greater margin of profit to, in turn, permit the manufacturer to provide improved service for his customers."

Following are some opinions of executives, engineers, and designers in the machine-tool industry regarding welded construction:

*Designer of Rotary Planing Machine:* "Many as are the benefits which industry and the community have derived from the use of welding, one of the most important is the opportunity it has afforded of rapidly supplementing production of the whole or part of essential machines when the branches of the industry which had specialized in these were found incapable of meeting demand for their products."

*Chief Engineer of Planer Manufacturing Company:* "On the basis of approximately \$6,000,000 worth of planers sold in a normal year, the industry would realize a saving of at least \$1,200,000 in purchasing power alone. Added to this would, of course, be the continual saving of power, and the initial saving of freight and foundation costs."

*President of Company Making Band Saws:* "It is interesting to observe that we launched this new line of arc-welded machines during the depression. Because of the lower price and larger capacity, these new models are actually solving an acute problem for us in getting a profitable volume of business."

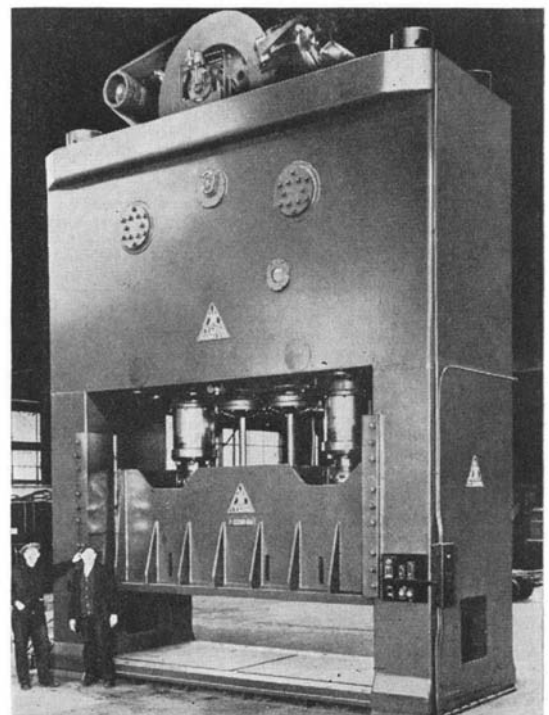
*Chief Mechanical Engineer, Machine Tool Builders:* "The welded machine can be designed more efficiently than the

cast machine. In the latter type, the material has to be increased at certain points in an endeavor to have the thicknesses as uniform as possible. In the welded machine the material need be no thicker than required to develop the stress."

*Designer of High-Speed Metal Forming Press:* "The time element plays a very important part in the construction of most presses. When prompt delivery of a machine is required, welded design offers another distinct advantage over the cast method of construction. In most cases the time that would be required to produce the necessary patterns for a cast product is more than ample to cover the welding time on the job."

**S**OME machine tool builders still have the opinion that the arc-welding method of production is fine for special machines but for mass production it can't equal castings. They hold to this opinion because they have their patterns made and their whole production geared to the idea of cast construction. But builders who have utilized arc-welded steel to the full extent of its efficiency say: "It doesn't matter whether you're building 1 or 1000; you can produce them faster and at less cost by welding!"

These extreme views can be accounted for by habit—the accustomed way of doing things—which



**Giant press, built by arc welding process**

is the most important factor in resistance to adopting welding for certain jobs.

Success in the use of welding is chiefly a matter of design. The importance of this is expressed as follows by the president of a nationally known company:

"It is only through having the courage to depart from past experience and training that welded design can succeed. The writer has experienced instances in his company where attempts to redesign cast details for welding have failed nine times, but the tenth try resulted in a design highly successful, from both the standpoints of efficient operation and reduction in cost. The promises of revolutionary design in castings is remote, but, with welding, the opportunities are unlimited. All that is needed to insure success is inspiration, imagination, creative thinking, and the will to pioneer."

In order that the benefits of modern arc welding may be fully

appreciated and more speedily attained, an award program offering 458 awards, totaling \$200,000, is being sponsored by The James F. Lincoln Arc Welding Foundation. Speeding up production is an important factor of judgment for the Foundation awards. Also, machine tools, both metal cutting and metal forming, are definitely designated as subjects for awards in two principal divisions of participation. Lathes, broaches, milling machines, planers, and all other machine tools are covered.

Considering the spectacular industrial developments brought about by application of data from studies in the Foundation's previous award program, it is expected that the current program will stimulate further advances. Previous studies, principles of which are now being employed by leading manufacturers, have speeded up production of machine tools and countless other products by as much as 30 percent.

veloped several years ago to fit into the small space of an electric locomotive. The new portable transformer is about one fifth as large and weighs three fifths as much as a permanent substation unit of the same rating.

## PROTECTION

### New Standards To Benefit

#### Industrial Workers

**B**ETTER protection for workers from the hazards of toxic dusts and gases in many industries is foreshadowed in the completion of three new standards by the American Standards Association. One of these sets safe limits for the amount of hydrogen sulfide in the air of factories and other workplaces. Another covers carbon disulfide, and a third benzene.

The need for some standard method of determining permissible concentrations of these and many other dusts, fumes, mists, vapors, and gases used commercially, has been recognized for a good many years. For example, a tremendous amount of research has gone into bringing the amount of carbon monoxide given off by gas ranges and other gas burning appliances down to safe limits.

These three standards which have just been completed, and a fourth covering allowable concentrations of carbon monoxide, are

## PORTABLE SUBSTATION

### Transformer on Wheels for Emergency Use

**O**UT of the Westinghouse plant recently rolled a "power guardman" on wheels, ready to keep electric power flowing to national defense industries, hospitals, and homes. Built for the Cincinnati Gas and Electric Company, this mobile substation is essentially a transformer that can restore power quickly if a regular substation should break down. Transformers are the necessary distribution links between high-voltage lines and factories or homes, reducing voltage to usable stages.

If the lights in a city go out because of trouble developing in a regular substation, a power company can speed a trailer unit to the scene and "plug in" to the power line, restoring power in a short time. The four-wheel trailer carrying the mobile substation can be towed on a highway at speeds up to 40 miles an hour.

Portable units can also be substituted for permanent substations which are shut down for inspection or maintenance work. Another use is supplying power for construction work. One of these substations can take power from a 33,000

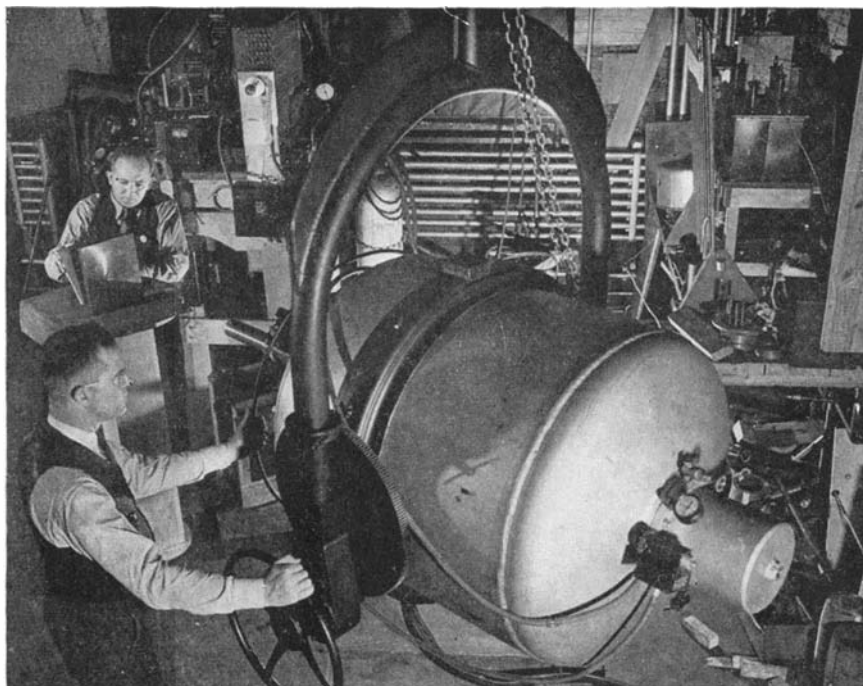
volt line and step it down to 4500 volts, or the same unit can transform 13,200 volt power to 4500 volts.

Heart of the portable substation is a compact transformer in which the core and coils are laid on their side and cooled by forced oil circulation. This transformer is an outgrowth of one which was de-



A complete transformer substation on wheels





Portable X-ray unit for industrial use is aimed like a gun

part of an ambitious program to set safe limits for every toxic substance that presents a serious industrial health hazard. The limits set forth in these three standards were arrived at after a careful study of all previous work in the field, reinforced by the experience of the members of the committee in charge which represents 12 national organizations interested in industrial health problems, and the U. S. Department of Labor. Wide industrial participation in the work ensures that the limits set are not merely medical or physiological limits but can be maintained by industry without undue cost.

Hydrogen sulfide, the subject of one of these new American Standards, is familiar to most people as a colorless gas having an offensive odor, as of rotten eggs. Exposure to it causes irritation of the entire respiratory system and of the eyes. In high concentrations it may produce respiratory paralysis and damage to the nerves. This gas occurs naturally in the gases of volcanoes and in the water of certain spas. In mines, it is frequently produced by the decomposition of pyrites and it is present in certain sulfur-carrying brands of coal oil. It is formed wherever protein-containing materials are rotting, as for instance in tanneries, in the manufacture of glue, the washing of sugar beets, and in sewer gases. Hydrogen sulfide is very widely used in the chemical industries, in

the manufacture of rubber, and in the manufacture of rayon. The newly completed American Standard sets as the maximum allowable concentration of this gas, 20 parts per 1,000,000 parts of air for exposures not exceeding a total of eight hours daily.

Carbon disulfide, the subject of the second new American Standard, acts as a narcotic in high con-

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**For Information on New Products  
and Processes, See the Section  
Industrial Growth**

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centrations, and in low concentrations with prolonged exposure results in cases of severe general nerve poisoning. Its removal presents a serious problem in the rayon industry. It is also used as a solvent for sulfur, fats, oils, and so on, and in the manufacture of carbon tetrachloride, camphor, and of rubber and other waterproof cements. The newly completed standard recommends that concentrations of carbon disulfide be kept below 20 parts per 1,000,000 parts of air for general factory and workroom purposes.

Benzene, or benzol, is the subject of the third standard. It is a toxic substance which acts predominantly as a nerve poison, causing depression of the central nervous

system; and, with chronic poisoning, damage to the blood, the blood forming organs, and the blood vessels. The newly completed standard provides that the maximum allowable concentration of benzene (benzol) shall be 100 parts per 1,000,000 parts of air for exposures not exceeding a total of eight hours daily.

## MILLION VOLT

### New Industrial X-Ray Unit Is Portable

**A** MILLION-VOLT X-ray unit weighing 1500 pounds is capable of making pictures through an inch of steel at snapshot speed. If necessary the entire unit can be moved to the scene of operation to study structural supports of bridges or steel foundations of buildings.

## BLUE GLASS

### Increased Protection and Greater Visibility for Welders

**A** BLUE glass compounded to filter out injurious rays of light in conditions of excessive glare is now being used in welder's lenses specifically recommended for aluminum and bronze welding. The lenses are also suitable for use in other occupations where a sodium yellow glare is encountered. This glass, called Alubro-Weld, is a recent development of the Willson Optical Research Laboratories.

Welders on aluminum and bronze can far better see their work through Alubro-Weld lenses, it is claimed. Hence the flow of metal onto the weld can be more accurately controlled.

## REFLECTORS

### Chromium-Plated Copper Substituted for Aluminum

**I**N co-operation with the national defense program to conserve aluminum, chromium-plated copper is being substituted by various manufacturers. It is stated that, of all the possible substitute materials for reflecting surfaces on sodium luminaires, chromium plated over nickel plating on copper provides the most satisfactory result.

## INDUSTRIAL TRENDS

### CHEESE . . . AND CHEESE

**C**HEESE may be only that final touch which, to the connoisseur, hails the end of a perfect meal; to those in the industry it is a commodity which may be seriously affected by world conditions. So it is that, today, the entire cheese industry finds itself in a state of change, brought about by World War II.

Importation of such foreign types of cheese as Roquefort and Camembert ceased abruptly when France was occupied by the Nazis; cheese of Italian origin, such as Gorgonzola and Bel Paese, are now difficult to obtain. Consignments of cheese from Switzerland have, of course, been affected by shipping difficulties, and Canada has forbidden exports of Cheddar and other types except to the British Isles.

It is not to be expected, however, that those in the cheese business in the United States have taken these setbacks without attempts—and apparently successful attempts—to build for themselves a domestic industry that will not only replace the foreign sources of supply but will eventually create an American cheese-producing group which will supply world markets with cheeses second to none.

Domestic "Swiss" cheeses have been on the market for some time and, in some quarters, are considered to be equal, if not superior, to those imported from Switzerland. The same is true of Camembert and Liederkranz, Brie and Limberger. It is in the Roquefort type, however, that present progress is being made and in which cheese producers are the most interested. This "bleu" cheese cannot, because of restrictions placed by the Roquefort Association of France, be called "Roquefort" when produced elsewhere than in France. Regardless of name, however, the flavor is there in American *bleu* cheeses, even though, in some cases, it is made from cow's milk instead of the goat's milk that produces the "genuine" Roquefort. Aging methods, so essential to the ripening of this cheese, are being developed in this country, and underground caves are being built in various localities, especially for this part of the process.

### PICTURES FROM THE AIR WAVES

**A**LTHOUGH the television industry in the United States appears to be on the edge of a boom, triggered off by the final consent of the Federal Communications Commission to permit commercial operation, it is still too early to forecast a wide-spread trend. Frequency modulation has now entered the picture and, at the time of writing, it is pretty definite that this system will be used for transmitting the sound accompaniment for television pictures. This, of course, will make necessary major operations on, if not complete replacements of, those television receivers already in the hands of the public. Then, too, the national defense program looms large, taking precedence in essential materials that are necessary both to its needs and to the construction of television receivers. Thus any large-scale production in this field

may be a long time coming, despite the enormous technical strides that have been made in the laboratories where television has been gestating for years.

### TIN FROM TIN CANS

**T**IN, that strategic material of war which also protects so many of our foodstuffs from the corrosion of sheet-iron cans, is the subject of much speculation today, both financially and mentally. Why not reclaim the thousands of pounds of tin that daily are coated on sheet-iron which, in turn, is formed into the familiar tin cans? This is a question that is often asked, the answer to which, eventually, may have to be used to solve a really acute shortage of the metal. At the moment, however, and until such time as financial considerations are overbalanced by need, the question may be answered simply: The process is too expensive.

As the tin situation now stands, and as it has stood for some time in the past, it is cheaper to throw away used cans and to fill requirements from new stocks. It has been estimated by a committee of the National Academy of Sciences that 12,000 long tons of tin—about one eighth of our national needs—could be recovered annually from tin cans used in the United States. But, adds the committee, the over-all cost of recovery would be high.

Many are the processes that have been proposed for reclaiming this bright metal which plays such an important part in our national economy, but so far none of them has proved practical from every standpoint. When one does come along that fills the bill, it will have a virgin field to work; in the meantime, or until the pinch of necessity forces recourse to expensive processes, city, town, and village dumps will continue to be the final resting place for millions of pounds of tin.

### HERE COME WELDED SHIPS

**S**OME 15 years ago the United States Navy started experimental work with welding for the fabrication of the hulls of vessels; since then this process has been applied to a variety of small craft and to tankers and freighters. Now, by the time this is being read, there will be afloat the first all-welded passenger ship ever built—the *African Comet*, scheduled for launching sometime in June.

Briefly summarized, the advantages to shipbuilding of welding are smooth contours of the hull, which decrease water resistance, and a saving of some 13 percent in hull weight. These two features go hand-in-hand to increase the carrying capacity of a given vessel and to increase her speed, decrease cost of propulsion, or both.

The trend toward speedier merchant ships is thus being assisted by the application to the ship-building industry of technical advances in welding. Soon the *African Comet* and two sister ships will be plying between the United States and Africa, in general cargo and passenger service, linking New York and Capetown in 16½ days, nearly a week faster than the fastest schedule now being maintained. One important duty of these ships will be transportation of vital supplies of chrome and manganese.

—The Editors

# Wartime Astronomy

## A Mere War Does Not Sidetrack European Astronomers from Regular Work

**HENRY NORRIS RUSSELL, Ph.D.**

Chairman of the Department of Astronomy and Director of the Observatory at Princeton University. Research Associate of the Mount Wilson Observatory of the Carnegie Institution of Washington

**N**EWs of the activities of astronomers on the continent of Europe is more than ever welcome when it comes through in these days. Among the last to be received come new numbers of the *Publications* of the Observatory of the University of Tartu. The Soviet stamps on the envelope show that no diplomat would now refer to this city as Esthonian; but the contents of the publications show that our colleagues there, Dr. Öpik and his assistants, are still actively at work. Most of the individual papers are in English; the rest in German. All are of interest to professional astronomers, and some deserve a wider attention.

There is a discussion, for example, by Dr. V. Riives, upon the old but still mooted question whether the changes in terrestrial climate which are indicated by the recurrent ice-ages can be explained by the passage of the solar system through a cosmic dust-cloud which cut off part of the Sun's heat.

There are plenty of such absorbing clouds in space, but most of them are composed of haze so thin that light which had traversed it for a whole light-year is weakened by much less than half. If the Sun, with all the planets, were immersed in such a cloud, the heat carried by its direct beams would be weakened by a very few parts per million. If the change could in some fantastic manner be effected over night, we would find the sky a little brighter, perhaps as if illuminated by faint moonlight, with a stronger glow visible in the east before sunrise and in the west after sunset — as the zodiacal light is now. If the great cloud extended far enough, all the stars in the heavens would seem dimmed, and astronomers would find a large part of their occupation gone. But none of these changes would affect

climate by a thousandth part of the least discernible influence. To weaken the Sun's heat enough to produce geological changes would demand an absorbing cloud more than 10,000 times as opaque.

Nothing of this sort has ever been observed in inter-stellar space. We would probably miss one, even if it lay in front of a bright part of the Milky Way, provided it was small enough — say less than 100,000,000,000 miles across. But the solar system, moving as it does in space, would pass through a cloud no bigger than this in a few centuries — too rapidly to produce geological effects.

**E**VEN if the Sun overtook a cloud moving almost at the same rate, and remained inside it for thousands of years, the Earth would experience no ice-age. Dr. Riives points out that even a dense cloud of matter between us and the Sun would not diminish the heat which the Earth receives. The outflow of heat from the Sun depends on conditions deep inside it, and would be quite unaltered by any external cloud. And the flow of heat must ultimately escape from the cloud itself, otherwise the cloud would get hotter and hotter. Draw a sphere centered on the Sun, and as big as the Earth's orbit. The heat produced by the Sun will all pass out through this sphere. Some of it may have been caught by particles in the cloud, heating them up, but this would be re-radiated and, at one or more removes, would ultimately escape through the sphere. So our planet, on this sphere, would get as much heat per day as before from the Sun and the cloud together.

This is what would happen if the absorbing cloud filled this sphere and went no farther, leaving clear space outside. But if it was larger — say as big as Jupiter's orbit —

its presence would make the Earth hotter. The particles in the shell beyond the Earth would themselves be heated by the outgoing radiation, would be warmed, and send out heat, both outward and inward. The outgoing stream might escape; the ingoing flux would in part be trapped by particles inside the Earth's orbit, and relayed once more. When a steady state was reached, our sphere would have heat flowing into it from the outer parts of the cloud and flowing out through it from the inside; and the net balance would amount to an outflow equal to the heat-production from the Sun at the center. The total amount of heat caught by the Earth, or by any other test-body, would thus be increased — not to mention the additional heat supplied to it by those particles which actually fell into the atmosphere.

Hence an obscuring cloud in the solar system would not cool the Earth, but might make it hotter. The only possible escape from this, according to Dr. Riives, would be to assume a cloud of particles moving so fast that they got far away from the Sun, on the "lee side," before they could cool. But calculation shows that this demands conditions which are absurd in practice.

One possibly attractive explanation of glacial periods is thus eliminated, and a new and amusing addition made to the list of real paradoxes.

**A**NOTHER good communication deals with the velocities of meteors. Dr. Öpik, its author, spent months in Arizona, in 1931, observing the paths and velocities of these tiniest of celestial objects, and has continued his studies in Esthonia since his return.

To find the real path of a meteor we must have observations of its apparent track among the stars from two stations, 20 or so miles apart. It then requires merely a little trigonometry to work out the actual path in the upper stratosphere.

The most accurate records, by far, are photographic: but these have two disadvantages. First, meteors streak across the sky so fast that only the brightest — brilliant objects to the naked eye — leave a trace on the plates. Second, these bright meteors are of rare occurrence, so that only one meteor-path will be found, on the average, on hundreds of plates.



It would be a heart-breaking waste of time and money to photograph the sky simply in the hope of getting a meteor once in a while. But the regular "sky patrol" at Harvard, in which the whole available part of the heavens is photographed, field by field, many times a year, for the sake of the permanent record, catches many bright meteors incidentally. The two stations at Cambridge and Oak Ridge, 23 miles apart, form an excellent baseline, and by planning the program so that cameras at each station are simultaneously pointed toward the same region in the high atmosphere, a good many doubly observed trails have been secured. By placing a rotating shutter, comparable to a very narrow air-propeller rotated ten times per second by a synchronous motor, in front of each camera, the meteor may be timed as well as surveyed and its velocity found. Dr. Whipple, working up a number of such observations, has found that a large majority of these bright meteors were moving around the Sun in elliptical orbits of small inclination and rather short period, like those

of the short-period comets. These bodies are evidently members of our solar system, and might fairly be regarded as minute stragglers from the great swarm of the asteroids.

**F**OR fainter meteors which "go by too fearfully quick" to be photographed, the paths in space can still be found with fair precision if each of two observers has carefully plotted the apparent track of the meteor among the stars, immediately after seeing it. But to get the speed is much harder. Few of us are trained to estimate, even very roughly, the duration of an unexpected phenomenon which lasts a few seconds, or less.

But even the best observer may not spot the meteor at the very first instant it appears. A mechanical aid, invented by Dr. Lampland of the Lowell Observatory, consists of a mirror, mounted on supports in such a way that it makes a small oscillation 10 times per second. The image of a fixed star, seen in such a manner, will be

drawn out by the familiar persistence of vision into a small circle. That of a moving meteor will appear not as a straight, but as a wavy track, each wave corresponding to a tenth of a second.

It takes some care to learn to observe accurately with this device, but the observers at Flagstaff, and later at Tartu, have succeeded excellently by placing a reticle of wires beyond the mirror and between it and the sky. As seen reflected from the observing point, the wires divide the sky into squares nine degrees on a side. By noting the number of waves in the

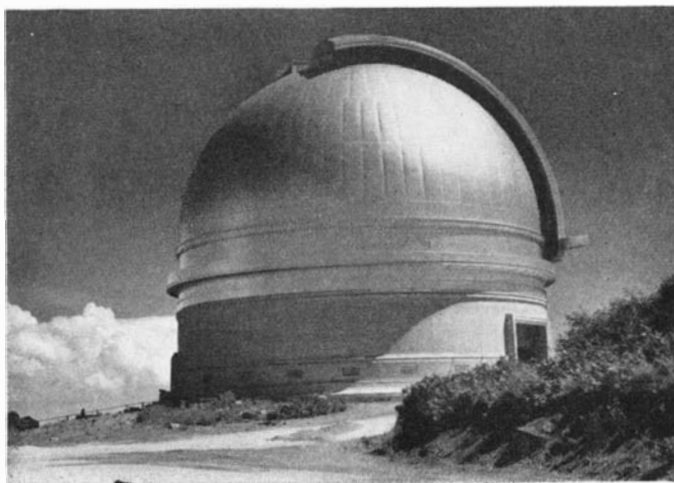


Photo by Major Martin D. McAllister

**It awaits the 200-inch mirror at Mt. Palomar, whose date of completion is known to no man (unpredictable)**

part of a trail which crosses a given number of squares, the apparent velocity of the meteor's flight in degrees per second was found.

Öpik's memoir gives details for 406 observations in Arizona, and 380 in Esthonia. For the latter, no observations at a second station were available, so that the distances of individual meteors could not be calculated. There were, however, a large number of meteors belonging to known showers. For these, the real velocity relative to the Earth is known. The mean height at which they appear was furnished by the Arizona observations, and the angular velocity with which a meteor observed at a given place in the sky and at a given hour *ought* to move, can be calculated. In this way the observations could be checked, and certain corrections applied.

For about one third of the meteors, the duration of flight was not measured with the rocking mirror, but simply estimated. The discussion showed that Öpik's esti-

mated lines were nearly as accurate as those found by the mirror, but a couple of other observers, not previously trained in precise observation, did pretty well with the mirror, while their direct estimates were wild.

**F**OR the general run of the sporadic or non-shower meteors, the observed velocity transverse to the line of sight was then calculated. To make allowance for the effect of motion toward or from the observer, so as to get the velocity in space relative to the Earth; to pass from this to the velocity relative to the Sun; and to correct the results for the inevitable error of observation, was an intricate task whose description occupies many pages of mathematical argument which our readers may thank us for skipping.

The final results show that these faint meteors are very different from the bright fireballs. Between 75 and 80 percent of these have such high velocities, relative to the Sun, that their orbits are hyperbolic, showing that they are intruders into the solar system from interstellar

space. About 15 percent have velocities comparable to that of the average comet and appear to be revolving about the Sun, but in highly elongated orbits of long period, while the proportion of short period orbits is 10 percent or less.

This remarkable conclusion is not new, but confirms, with a higher degree of security, results reached by several earlier investigators.

How these innumerable tiny specks of matter got into interstellar space no one knows; maybe they "were always there."

Once, at least, according to astronomers' gossip, Harvard cameras caught something different. A beautiful straight trail was found on two plates taken by telescopes a few yards apart. On superposing the negatives, there appeared a quite definite shift which indicated that the altitude of the moving luminary was about 1,000 feet. All the data indicate that it was a green starboard light; the red port light did not record itself on the plates.

# Radio Runs a Transit

## Accurate Ocean-Floor Topographic Maps

### Made Through Acoustical Surveys

**CAPTAIN GILBERT T. RUDE**

United States Coast and Geodetic Survey

**M**ODERN science has fostered revolutionary improvements in instruments and technique for sounding the ocean's depths with ease and accuracy, as well as for determining with increased precision the geographic positions of the soundings. The hydrographer of today invades the shop of the radio engineer for his equipment, and searches the laboratory of the physical scientist for his methods. As a result he is able to extend coordinated surveys hundreds of miles offshore and to make accurate hydrographic surveys of such features as the Atlantic Ridge, accomplishments quite impossible a decade ago.

Ocean surveys made by echo sounding and controlled by radio-acoustic ranging, the new method developed by the United States Coast and Geodetic Survey for determining the positions of soundings, have disclosed a wealth of dissected underwater topography — submarine gorges along the continental shelves that rival the Grand Canyon, submerged moun-

tains rising to towering heights, and huge trenches that form the great ocean deeps.

Echo sounding is almost self-explanatory. Depths are determined by measurement of the time required for a sound impulse from an electric oscillator to travel to the ocean floor and to return as an echo to a hydrophone in the ship's bottom. This time interval is automatically measured and converted to depths by a "fathometer," an instrument of extreme accuracy, constructed on principles involving the transmission of sound in water. By old methods a sounding in 20,000 feet, with piano wire and a spherical weight, required an hour with the ship stopped. An echo sounding can now be made in the same depth in eight seconds with the ship cruising at full speed.

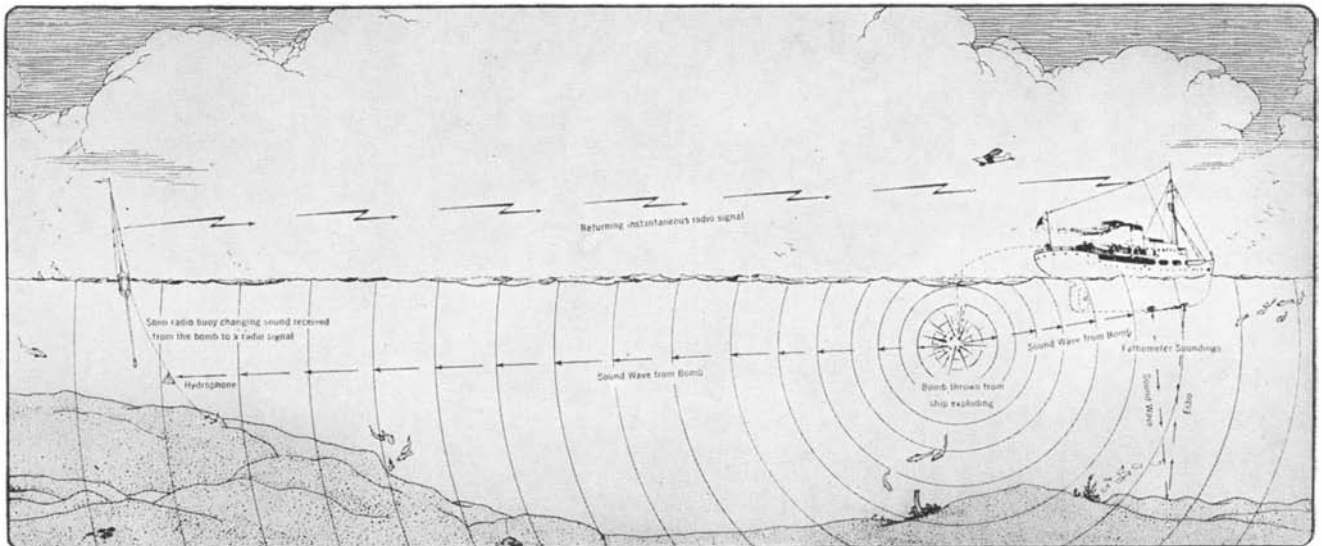
The knowledge of the velocity of sound in sea water is used in determining the geographic positions of the soundings. Radio acoustic ranging accurately locates the survey ship when out of sight of land by measurement of the time inter-

vals required for the sound impulse from a depth bomb, exploded near the ship, to travel horizontally to hydrophones, sensitive mechanical "ears," suspended from buoys planted at sea and located geographically by a scheme of marine triangulation.

The impulse from the bomb explosion near the ship (Figure 1) moves to a hydrophone in the ship's bottom and is there passed electrically to a time-measuring instrument, the chronograph, which records it on a tape. The later receipt of the same water-transmitted sound wave at the distant hydrophones of the various widely separated sono-radio buoys is flashed back instantly to the survey ship by the automatic radios on these buoys, and is recorded on the same tape. The time intervals, scaled from the tape to a hundredth of a second, and multiplied by the velocity of sound in water, gave the distances of the ship from the buoys. The intersection on the plotting sheet of these distance arcs from two or more of the buoys determines the ship's position.

**T**HESE sound impulses travel comparatively long distances, occasionally well over a hundred miles. They reach greater distances in cold water than in warm. During the previous summer, surveying ships of the United States Coast and Geodetic Survey obtained bomb returns of 138 seconds — about 110 miles — in the cold waters of the Aleutian Islands.

The bombs are timed by the length of fuse to explode at a depth of about 100 feet. They are made



**Figure 1: To make a topographic map, the vertical elevations and horizontal positions of innumerable points must be determined. Drawing shows how, despite difficulties, this is accurately being done at sea**

on board as required and contain from four ounces to four pounds of T.N.T., depending upon the distances to be measured. Their construction is simple, requiring only a friction-top tin can, weighted with a small quantity of lead.

The sono-radio buoy (Figure 2), built aboard the survey ship, consists of a 50-gallon oil drum with a 20-foot superstructure for attaching the antenna of the automatic radio contained within the drum. One such buoy was recently anchored in 7800 feet of water, by a Coast and Geodetic Survey vessel operating in the Gulf of Mexico. Aircraft wire was used, with an anchor-detaching apparatus near its lower end to insure recovery of the wire. Anchors usually consist of discarded car couplings of little value.

Radio-acoustic triangulation at sea, not to be confused with the radio-acoustic ranging just described, is similar in principle to triangulation for control of land surveys, and consists of surveying a continuous scheme of triangles (Figure 3). On land, the apex of each triangle is marked by a metal disk set in a concrete monument; the lengths of the triangle sides are



Figure 2: An all-metal sono-radio buoy (compare with sketch in Figure 1) and its attached hydrophone, in the arm of the sailor on right

computed by trigonometry, using the angles of the triangles observed with a theodolite mounted on top of towers erected over the disks (Figure 4). First, however, a base line is measured as an initial distance, from which other distances in the scheme can be computed. Such a line is represented by the heavy line near the middle of the island in the sketch (Figure 3) of the triangulation recently established on Cagayan Sulu Island in the Sulu Sea. The sketch also indicates the method of expansion of a scheme from this base line to off-lying islands. By other computations the geographic positions of all the stations can be readily determined. These stations furnish control for both the land survey and the hydrographic survey of the nearby water area.

**I**N establishing triangulation at sea, obviously a theodolite can not be used on the unstable deck of a ship, nor can stations be permanently marked. Resort must be made to the expedient of anchoring sono-radio buoys to mark the apex of the triangles and to taut-wire measurements and radio-acoustic ranging to determine the lengths of the triangles and to taut-wire lengths, the geographic positions of the buoys can be determined by computations similar (Figure 5) to those used in land triangulation. Radio-acoustic triangulation recently established for controlling a survey of a part of the Gulf of Maine is shown in this figure. The area surveyed, indicated on the sketch by stippling, is roughly 115

miles in length, 70 miles in width, and covers about 7200 square miles.

First a closed loop of "sea traverse" was measured from buoy A (located by sextant angles to shore objects) to buoy B, thence to buoy C and on to buoy D, which was also located by sextant angles from shore. Intermediate buoys, the adjacent ones intervisible from the

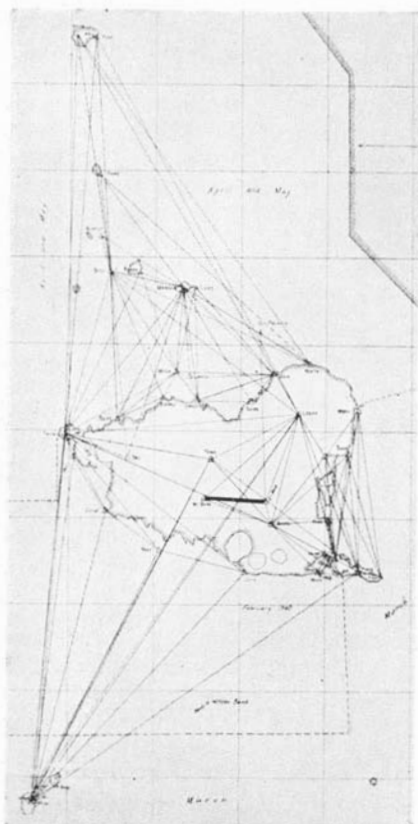


Figure 3: Triangulation scheme from a measured base line (heavy line) on an island, expanded to the off-lying islands



Figure 4: Steel towers like this can be used for triangulation on land, but cannot be set at sea, hence, less direct means are used

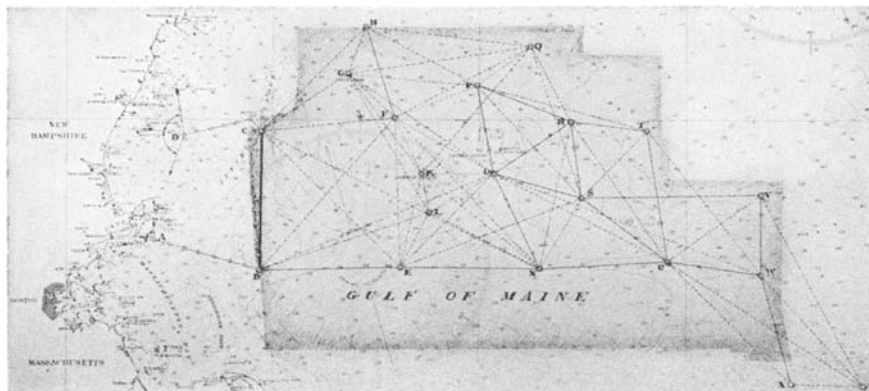


Figure 5: Radio-acoustic (marine) triangulation for controlling a hydrographic survey of the Gulf of Maine. Explained in the text

ship's bridge, were also planted along the line of traverse CD. Next, the traverse was measured by a "taut-wire" apparatus (Figure 6), developed by the British and adapted by the Coast and Geodetic Survey to buoy control. This apparatus is composed of a reel of piano wire (about 140 miles in length) which can be payed out under constant tension over a registering sheave as the surveying ship steams along. The end of the wire is anchored near the initial buoy, the ship steams along the line of intermediate buoys paying out the wire, and the distances between buoys are determined by readings on the sheave as each buoy is passed. No effort is made to recover the wire.

The true azimuth (horizontal angle) between adjacent buoys is obtained by a determination with sextants of the horizontal angle

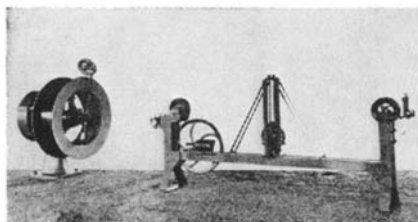


Figure 6: Taut-wire apparatus: 42½-inch reel, recorder, sheaves

between the Sun and the buoys when on range. With such data the geographic positions of buoys A and B (Figure 5) and the distance BC (heavy line), can be readily computed. In the survey made, the line BC served as a base for the radio-acoustic triangulation. Buoys E and F were then planted and the lengths of the lines BE, BF, CE, CF, and EF determined by radio-acoustic bombing or by taut-wire measurements. With the lengths of sides of all triangles known, quadrilateral BCFE was computed. This

procedure was continued throughout the scheme as it progressed seaward. To increase the accuracy, more lines were bombed than the necessary minimum, as is shown in the figure. Wire-measured lines are indicated by continuous lines, bombed distances by broken lines.

As the summer advanced, the warming of the top layer of water impeded the progress of the sound waves and it became necessary to increase the number of buoys in the scheme so that the surveying ship could determine its position at any time from at least three buoys. When the survey gradually progressed seaward, the buoys were removed to new locations.

At the close of the survey season two ordinary navigation buoys were planted at positions X and Y (Figure 5) in the comparatively shoal water on the north edge of Georges Bank and connected with the triangulation scheme, to serve in the next season as the base for continuing the scheme, just as the line BC served to start it.

The Gulf of Maine project is indicative of the distances co-ordinated surveys may be carried offshore. In addition, radio-acoustic ranging methods permit the surveying ship to work through the night and during the densest fog with its position as accurately known to the hydrographer as on the clearest day.



## OIL WELLS

Sciences Beat Hunches in Discovering New 1940 Fields

**O**IL-WELL drillers who took the advice of scientists in their search for new oil fields in 1940 were three to four times as successful as

the drillers who located their exploratory wells by non-scientific doodle-bugs, dreams, or what-not.

One tenth of all the wells drilled by the petroleum industry in 1940 were out beyond the limits of present oil fields—wildcat wells drilled in an attempt to find new fields. One eighth of these wildcat exploratory wells, 366, were successful, opening up new oil and gas fields; the remaining 2672 were failures—dry holes.

Most of the wells drilled by the industry are within the supposed boundaries of proved fields, to develop those fields. But every year several thousand locations are picked where no oil has been found, and exploratory wells are drilled. That even one eighth of these are successful is a tribute to the scientific skill and daring of oil men. Many of these wildcat wells penetrate more than two miles, cost from \$150,000 up, and find nothing but dust.

A number of well sites still are chosen because of guesses, witch-hazel rods, or divine inspiration. Some of them do find oil. Most new drilling locations, however, are picked after detailed scientific surveys, and their chance of success is three to four times as great as those located by non-scientific methods. Of the 1940 wildcats, 2051 were drilled on technical advice—geology, geophysics, or a combination of the two—and 320 of them were successful. Sundry non-technical reasons were the excuse for drilling other exploratory wells; only 35 found oil.

## COSMIC RAYS

They Turn Out to be Protons And Produce Mesotrons

**T**HE cosmic rays seem to be mostly of protons, the heavy parts of atoms, rather than electrons. New evidence in favor of this theory is contained in experiments reported by Dr. Arthur H. Compton.

Measurements made of the cosmic rays far above the surface of the earth, from airplanes and balloons, fit in with the idea that protons, with positive electrical charges, are the primary cosmic rays. When these strike the nuclei of atoms in the air, they produce mesotrons, which constitute an important part of the cosmic radiation observed on the earth's surface.—*Science Service.*



## AIR CONDITIONING FOR HUMANS

**A**s far as its use in connection with *wares and materials*—cotton, wool, tobacco, paper, and the like—is concerned the high value of air conditioning stands established, but what of its use in connection with *human beings* and their health, not for materials?

Here medicine has something to say; it says, mainly, that we still lack the final answers, and it says in effect "Not so fast—not so fast"; for a human being is not a quantity of merchandise. No doctor has uttered just these exact words but they are not far from thoughts recently expressed by the chairman of the American Medical Association's Committee to Study Air Conditioning, Carey P. McCord, M.D., of Detroit, who pointed out to the Third Annual Congress on Industrial Health that "engineering capacity is far ahead of medical guidance in connection with air conditioning." Dr. McCord's report—some 5000 words of it—is set forth in the *Journal of the American Medical Association*.

Judged by comments about air conditioned buildings, made by those whom one meets here and there, a great many persons have rather pointed private opinions about air conditioning, especially where cooling in summer is involved; the reader no doubt has his own. Let's see what American Medical Association Committeeman Dr. McCord has to say about it.

When man's ancestor some hundreds of thousands of years ago began to substitute for his coat of hair a layer of subcutaneous fat, he could scarcely have foreseen air conditioning, for he thus became a naked animal organism highly individualistic to his atmospheric environment. He adopted scores of delicate physiological mechanisms not needed by the other animals—a sensitive system of temperature balance and control—to compensate for his nakedness. These established controls now simply refuse to get in line with the present effort by air conditioning to divert the biologic course of a million years, nor can all man's boasted scientific skills make them get in line.

The incidence of respiratory diseases—colds, pneumonia, and the like—is the central strand of Dr. McCord's discussion and he points out how naively people took for granted, some years ago, that air conditioning would lessen these diseases among assembled groups of people, as in offices and factories. By air conditioning is meant not merely ventilation but control of air quality by heating or cooling, or by drying or moistening, or by purifying.

If we try to isolate the effects, in causing respiratory diseases, of a given air conditioning feature—dust, for example—we cannot with assurance do this because the evidence seems uncertain and opinions differ. Do so-called harmless industrial dusts play any considerable part in causing ordinary respiratory diseases? Dr. McCord has himself observed, as has the present writer, that when troops live in tents, hence without close congestion, these diseases nevertheless increase enormously after dust storms; though they do not so increase with troops similarly exposed to wind but not to dust. Hence dust alone must be a factor in these diseases and its trapping by installations may be praiseworthy, though mere filtration is not air conditioning.

"Some atmospheres provided in the name of com-



fort air conditioning are so far removed from optimal air conditioning," the report significantly notes, "as to favor both discomfort and the occurrence of respiratory and probably other diseases." Have any of our readers ever entertained similar thoughts, possibly with less polite trimmings, as they slowly congealed?

Such, however, are bad types of air conditioning; how about the best types—do they too cause less respiratory disease or more of it? The doctor says that here enormous benefits have been claimed on poorly supported evidence, but newer evidence of a statistical nature now gives answer. In three places, large numbers of workers in modern air conditioned buildings were given prolonged tests against similar numbers in old buildings not air conditioned. The result is a surprise: no lowered incidence of colds or other respiratory diseases was found.

Of course, if records are made where people live continuously in air conditioned buildings—for example, patients in hospitals—respiratory disease is usually diminished. But how can most of us so live—unless we were willing to live as does Gargantua, the Ringling Circus gorilla who dwells in continuous air conditioning, but in a cage.

"Air conditioning shock" is the discomfort on emerging from a cooled place into warmer air, and the results often are not good if the temperature differential is as much as 20 degrees, Fahrenheit, on a hot day—though it must be admitted that we do not think it extraordinary when emerging from an 80 degree room into a zero degree winter's day. Factors possibly not yet understood or even yet discovered may someday explain this odd discrepancy. Generally, it is admitted, an air conditioned room is a comfort on a hot, muggy day, but who has not actually shivered or even taken cold in an overcooled motion picture house or other place? In place of the 15-degree differential now so widely endorsed many would prefer and be satisfied with only a five-degree differential; the hotter the day the lower the differential.

Thus Dr. McCord concludes, as has been said, that engineering capacity is still far ahead of medical guidance in connection with air conditioning, and he even fears that doctors never will be able to put in the hands of engineers any bill of air conditioning particulars uniformly suited to all person's bodies and tastes. And, anyway, he says, too much is expected of air conditioning, to begin with. That, largely, is what probably is wrong; it isn't the air conditioning but *us*, and the worst of it is that next to nothing can be done about us. We—our physiological mechanisms—are fixed, or practically so. Won't evolution alter and adapt us to a future where everything will be air conditioned? She probably would—in about 100,000 years.—A. G. I.

# Pilots, Pilots, More Pilots

## Encouragement of Glider Clubs Would Provide Ample Raw Material for Military Needs

COMMANDER E. F. McDONALD, Jr.

**I**F there is one phase of our present national-defense effort which has supreme importance, it is the training of military pilots. Despite the doleful carping of critics who do not understand the long preparatory work necessary for mass production, our industrial facilities for the manufacture of war materials are expanding rapidly. Man power for the navy is being trained as rapidly as ships are, or will be, built, and our ground soldiers will be ready by the time we have weapons to give them. But in the air the situation is different.

We need pilots, pilots, and more pilots; but where the mechanically trained youth of America give us an abundance of potential mechanized fighting men, we have no pool of flying youths on which to draw for pilots. It takes a long time to train a competent military flyer; a youngster who has never flown knows little more about actual flying than the Russian peasant who kicks a stalled tractor knows about mechanics. College youths now taking the CAA courses spend about nine months getting the rough equivalent of the primary basic course given at our flying "West Points." These courses are available to far too few; we must have flight training for millions of youngsters, and not restrict it to the select minority who reach college. I know from my experience in the industry that everything we have in radio today came from enthusiastic amateurs, and that a large percentage of them did not have the benefit of formal education. Had radio been restricted to a limited circle, we would have few of the technical developments which have given America the finest radio system on earth.

There is a practical, economical, and effective solution to this problem. We can open aviation to every interested youngster by giving him the opportunity to

learn to soar. When he has learned to operate his sailplane, to use the moving air currents to maintain flight, to meet the ever-recurring small emergencies that come on every glider flight, he will know so much about flying that he can be turned into a power-plane pilot in a fraction of the time and at a fraction of the cost for training a raw beginner. Moreover, he will be a

• **Other aspects of soaring flight than those of pilot training, dealt with in the accompanying article, are receiving serious attention by military authorities abroad. Thus, *The Aeroplane* (London), in a recent issue, discussed troop-carrying glider trains in which the gliders to be towed by a powered plane are connected by cables that are wound on drums prior to take-off, permitting operation from relatively small fields. Seriously considered, also, are gliders for transporting supplies to military forces in the field, and even winged tanks for invasion purposes. These latter consist essentially of gliders in which the fuselage is replaced by the tank itself. Says *The Aeroplane*: "in the design of a glider . . . to carry a tank . . . both supporting and controlling surfaces would be attached and braced direct to the tank. . ."—*The Editor*. •**

better pilot than the lad who starts directly on power, for he will learn things about the air that a power pilot may never learn until it is too late. The difference is much the same as that between a man who learns to sail a boat and one who learns motor-boating first; the sailor can go into power-boating with little trouble, but the motor-boat operator must learn all over again when he takes up sailing. He does not know the importance of wind and current until the day his power fails and he drifts upon the rocks.

American youth is very air-minded, but the great majority of our boys begin to lose interest after they have outgrown the model-

building stage. They have neither the money nor the opportunity to learn power flight, and in many cases their parents object on grounds of safety.

With gliding it is different. There is hardly a hamlet or city in the land where gliding instruction cannot be given, hardly a community that cannot support a gliding club of 15 or more persons. Membership need not be restricted to potential warbirds; men and women of all ages can learn to soar and participate in one of the safest and grandest sports that human ingenuity has ever devised.

Even with the relatively high cost for gliders, the expense of club membership is low. One training ship is sufficient for instructing 15 or 20 persons, more if the students are under 18 years of age. Its cost, with trailer for transporting it, will range from \$800 to \$1000. One club member can qualify as an instructor by taking a course at any of several glider schools; the cost will be about \$225. In addition, the club will need an old car for towing; another \$100. A winch for high-altitude towing will cost anything up to \$250, depending on whether it is purchased complete or built up from an old automobile. Operating expense then comes down to fuel, tow ropes, occasional patching of wing tip fabric, and so on — perhaps \$75 for a year of operation. It works out that a club of 20 boys can operate for its first year with an initial fee of \$20 per boy and dues of \$5 per month. Dues can be slashed after the first year, or can be maintained with the intention of purchasing additional ships.

**G**LIDER costs will come down as mass-production methods are introduced. Moreover, we can borrow from German experience, and let our youngsters build their own. In the early 1920's German youth was given an opportunity to buy plans and specifications at cost. From these they built gliders costing less than \$100, had them inspected by the government before covering the framework with fabric, and were ready to start gliding.

As their technique improved, they began construction of the higher performance sailplanes which were then being developed. Their tremendous progress in the art is shown by the way records toppled. Although a flight of over 1300 feet was made as early as 1891, it was not until 1920 that anybody

glided more than a mile. Then the records began to fall: 8.6 miles in 1922, 15 miles in 1925, 93 miles in 1929, and 143 miles in 1933. The world's record today is 465 miles.

When Hitler came to power in 1933 he found a ready-made group of skilled flyers who had never touched an airplane throttle. From these he rapidly developed his immense air force. There has been much propaganda from both sides about the relative merits of German and British pilots. Impartial observers seem to agree that their ability is about the same. However, it is certain that Germany had vast numerical superiority, and that this was true even after the war had been in progress for a year. Britain got started on a program of pilot-training and air-force expansion shortly after Munich, but British pilots had to start their training from scratch.

**W**ITH our present knowledge of gliding and soaring we can develop an enormous reservoir of air-minded youngsters in a few months—something that is physically impossible under present training systems. From the cream of this reservoir we will be able to select thousands of apt pupils for military training, and, because of their basic flight knowledge, will be able to save weeks and months in finishing their training. It is impossible to estimate the financial saving with any degree of accuracy, but it will be tremendous. Gliders do not require expensive airports and ground crews; local clubs will carry the boys through to proficiency for a fraction of what it would take to make equivalent progress in power. Moreover, by learning their ABC's without cluttering up our other training facilities, these boys will leave the power instructors and their equipment free for more advanced training.

Learning to glide is simple and safe. The glider is nothing but a light, engineless airplane. Its flying controls are identical with those of a light powered ship. The student is strapped into place, shown what to do, and towed slowly across the field until he learns the use of rudder and stick to keep his ship in line with the tow car and balanced on its single landing wheel. Then the tow speed is increased until flying speed is reached. The fledgling hedge-hops for a few tows, and is then permitted to go higher, release the tow rope, and glide to



A Frankfort sailplane seeks a thermal

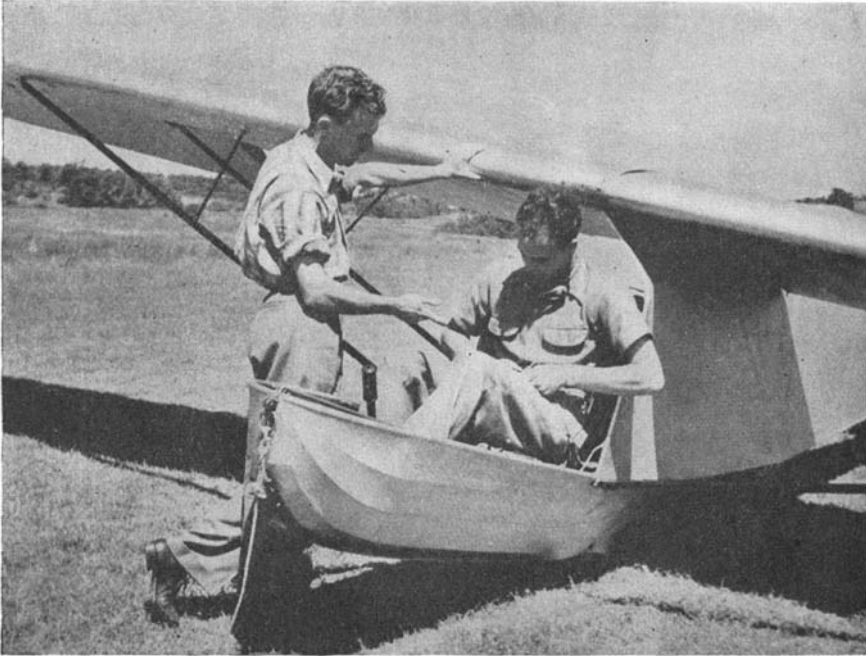
earth. Even if he gets excited and comes down on a wing tip, little harm will be done, for he is moving only 20 or 30 miles an hour.

After a few hours instruction the beginner is ready for longer glides and is towed 50, 60, or more feet into the air before cutting loose. His ship has a sinking speed that is an inherent characteristic of its design—usually about three feet per second in a trainer. He watches his airspeed indicator to make sure that he maintains the proper gliding angle. If he slows down, the stick goes forward to steepen the glide; if it picks up too much speed, the stick is eased back.

With the straight glide mastered, the embryo pilot is ready for turns, starting with simple right angles and progressing to full circle, figure-eights, and so on. He will make the same mistakes a beginner in power flying will make; his bank may be so flat that he skids, or so steep that he side-slips. He maneuvers in exactly the same way

that he would with power, but his controls are a little softer because of the low speed, and he has to master the feel of flight and use of instruments much more completely than the power pilot. He must also plan his flight more carefully, because he has no engine to help him if he underestimates his glide, or to pull him out of trouble if he overshoots. If he misses his mark and lands far from the field he has selected, he may have a rather unwelcome chore in disassembling the ship and getting it back to the landing field. If he lands in trees he may damage his ship, but usually not seriously, and in any case, due to low landing speed and a light ship, his chances of personal injury are very slight.

**W**HEN he graduates to a sailplane he is ready for soaring. This ship is simply a lighter, higher performance glider than his trainer. Its sinking speed may be little more than two feet per second, its cruis-



Student, in training glider, receives last-minute instructions

ing speed from 35 to 60 miles per hour. When launched from a high tow with a sailplane, the student begins feeling for ascending columns of air, going by sense of touch, observation of weather conditions and topography, and by the reading of his variometer, which is calibrated in feet per second rather than in feet per minute. If the wind is blowing against a bluff or ridge, he will fly in that direction, and soar along the upward current like a gull or eagle. His sinking speed, relative to the air, remains constant, but the air through which he flies is rising. He may soar on thermals — ascending bubbles of heated air — which he spots by the clouds above them, the movements of soaring birds, or by his knowledge of topography. When he finds one he will spiral within it while the vertical air current carries him up.

**A**LL of this is precision flying, with careful attention to topography, drift, and position. The pilot forms flying habits of great value; for example, he knows that there are descending currents on the lee sides of hills, and will never miscalculate the effect of a down draft, an error which has cost lives when made in power-planes. He knows the turbulence inside thunderheads, and knows the smooth and turbulent portions of "fronts." He can utilize these conditions to his advantage when flying with power, and will automatically avoid danger zones which have caused ac-

cidents for experienced power pilots who had no training in motorless flight.

Some of our best commercial pilots today are soaring experts and enthusiasts. Captain Shelly Charles, of Eastern Airlines, uses his mastery of the art to bring greater safety, passenger comfort, and efficiency while flying his heavy Douglas transport. Lewin Barringer once used his knowledge of ridge currents to avoid a forced landing miles from camp while piloting for the Joint Iranian Expedition of 1935-36. Estol Coll took

a light plane over Mt. McKinley after another pilot, schooled only in conventional flying, was unable to exceed an altitude of 17,000 feet with a more powerful ship. Peter Riedel's knowledge of up-and-down air movements enabled him to make crossings of the Andes at phenomenal speeds.

Germany is the only outstanding example today of mass pilot training by gliders. In our country, however, the idea is beginning to catch on. The Lewis School of Aeronautics at Lockport, Illinois, is including glider instruction in its course. The Wilbur Wright Junior College of Chicago has an aviation club of 105 members, 20 of whom are girls. Sailplane lessons are part of their training. A group of graduates from the CAA primary course in power flight were given sailplane lessons last summer. One student, cocky over his wings and contemptuous of gliding, came close to a serious accident because he forgot about not having power to pull him out of a stall.

There will unquestionably be a vast increase in soaring activity during 1941, but there is much that should be done to speed it up. Schools, service clubs, youth organizations, churches, and civic organizations should encourage formation of clubs in their communities. The government should take it up seriously, subsidizing gliding schools and encouraging other schools to get programs started. It should go even further



Operator of tow winch signaling for a start



and include glider construction and training in the NYA program.

Commercial production is still lagging, although rising public interest has stimulated manufacturers, and one company, the Frankfort Sailplane Company, of Joliet, Illinois, has just received the first Class I certificate issued for sailplanes by the CAA. As yet no manufacturer has been able to use mass production methods as a means of lowering costs, but that

development is rapidly approaching. As the demand for sailplanes and gliders increases, there is no doubt that means will be found to reduce production costs and hence the final price per glider or sailplane unit to the user.

If we bring down the cost of soaring to where more youngsters may learn to fly, and put American youth into gliders, we need have no fear for our future air-force personnel.

reduce "drag." These requirements are met by Plexiglas, a crystal-clear plastic, shatterproof and less than half the weight of glass, now in general use on American-built bombers and fighters being delivered to Britain and to our own armed forces. Accompanying photos show steps in fabricating a bomber's nose from this material.



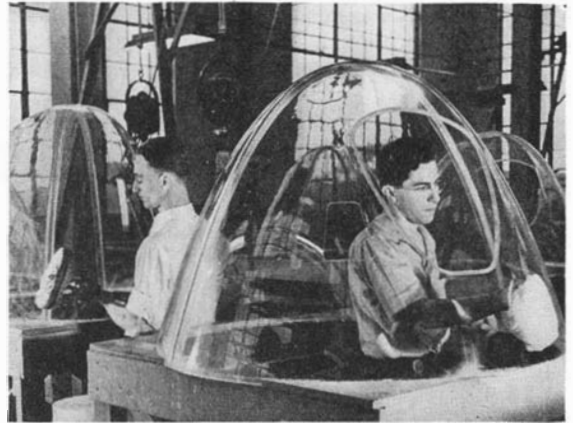
## 'Green-Houses' For Bombers

Plastic Enclosures Reduce Plane Weight,  
Hence Increase Speed or Bomb Capacity

**P**ROVIDING perfect vision and protection for the combat crew of a modern warplane is no small problem. Perfect vision is vital, for blind spots in the crews' enclosures would permit enemy planes to sneak up unobserved; flaws would throw off the gunners' aim. Protection for the crew is just as important; a gunner or bombardier who is cold or wind-battered is inclined to be inaccurate or careless. Other problems include the need for more perfectly streamlined contours to

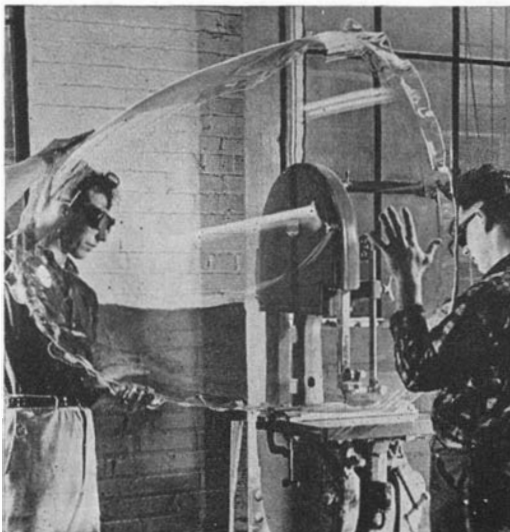


The Martin bomber, at right above, is equipped with a "green-house" of plastic sheet, shown at left in the first stages of being molded to shape while heated to plasticity

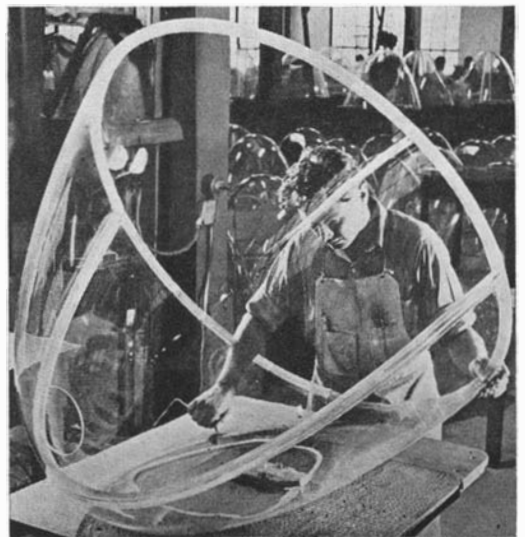


Left: The formed plastic sheet is cut with a band-saw to exact size. The material is shatterproof but is not actually bullet-proof

Right: Trimming the edges of bombardier's door and gun mount hole. The hardware will be bolted in place directly on the plastic



Above, right: Polishing and buffing are the final step in the production of the bomber noses



# More Power to the South

## Development of South Carolina Engineering Project Will Provide for New Industries

HAMILTON M. WRIGHT

**T**HE Santee-Cooper power and navigation project, located less than 50 miles north of Charleston, South Carolina, and with an estimated completion cost of \$45,795,000, ranks with the most important public works that have been recently constructed in the United States. Unlike many similar enterprises whose development has attracted national interest, however, the water held in the two huge reservoirs, covering an area of 250 square miles, will not be used for irrigation; its primary purpose is to provide power for needed industries, and, secondarily, to make available a commercial waterway 164 miles in length for craft of draught not exceeding ten feet, between Charleston and Columbia.

Incidentally, the developed area is expected to create a huge pleasure vacation ground in which large fresh water lakes teeming with game fish, adjoining a region in the historic South famed for its game birds and deer, will provide a new national attraction.

The Santee-Cooper project will furnish low-cost electrical power to a nearby region which for many decades has been undeveloped and which, even within the past genera-

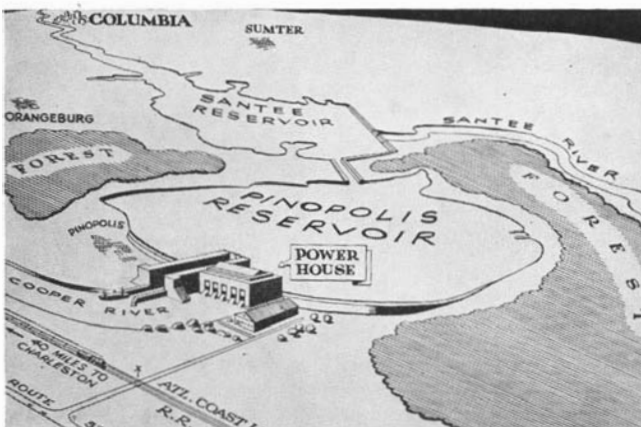
tion, has lost considerably in population and wealth, but which now has become a rapidly progressing section of the South. The coastal country where the project lies is rich in pine and hardwood timber and in agricultural products, and contains extensive mineral deposits, all of which are suitable as the raw materials for new manufacturing industries when cheap power or fuel are available. The lack of cheap power is one of the alleged reasons for the failure of the rich coastal area of South Carolina to advance proportionally with the interior Piedmont section of the state.

The Santee is the largest river, within the limits of the United States, which flows into the Atlantic Ocean. It is almost the sole source of the water which will be impounded to provide electrical power, since the Cooper River, from which the project partly takes its name, is, in comparison, an almost negligible contributor. The mean annual flow of the Santee at Ferguson, South Carolina, for the past 32 years, has been 18,349 cubic feet per second. With its principal tributaries, the Wateree, Broad, and Saluda Rivers and their affluents, it has a drainage basin upstream from the Santee Dam of 15,000 square miles. Reservoirs which feed power plants are al-

ready installed along these important tributaries. They include the Parr Shoals Plant on the Broad River, Lake Murray on the Saluda River, and Camden Reservoir on the Wateree River. These reservoirs, of course, directly affect the flow of water in the Santee River at the Santee Dam. At times they may act as a balance wheel in equalizing the flow, but they may also decrease it. The minimum discharge of the Santee River at Ferguson during the 32 years of record, was 2570 cubic feet per second, this low figure being due to the regulation of the upstream reservoirs.

**U**PON completion of the Santee-Cooper project, the first dam to be seen by the pilot of a craft proceeding down the Santee Reservoir from Columbia, South Carolina, will be the great Santee Dam at Wilson's Landing on the Santee River, which is now almost finished. He will not reach the dam, however, but when within a mile or so of it will turn to the right, passing through a diversion canal almost eight miles in length, 200 feet in width, and 10 feet maximum depth, to the vast Pinopolis Reservoir, created by the damming of a huge forested swamp whose waters flow into the Cooper River. He will pass from the reservoir to the river by a navigation lock with a lock chamber 180 feet long and with a 75-foot lift, one of the highest single-lift locks in the United States. Upon its exit from the lock, the barge will pass by a canal to the Cooper River and thence to Charleston.

Next to the lock is the power station, the heart of the Santee-Cooper Project, which will have a total water head of 75 feet discharging through the turbines and



Left: Map of Santee-Cooper project, showing rail, highway, and steamship facilities which tap forest, agricultural, and mineral resources. Right: Air view of Pinopolis locks and the power house

flowing into a tail canal four and one-half miles in length, connecting with the Cooper River.

The normal elevation of Santee River above sea level at Santee Dam is approximately 40 feet, and it is 80 miles down river to the sea. When the reservoir upstream from the dam is flooded next fall, the water will be raised by an earthen dyke or dam, the crest of which will be 88 feet above sea level, to a height of 75 feet above the sea. The dyke is approximately eight miles long, including a 3400-foot concrete spillway protected by extensive use of deep-driven steel pile sheathing and steel and concrete foundations to prevent water from undermining or working around the spillway. Starting at elevation 88 feet the dyke will be faced with concrete slabs down to elevation 55 feet, or natural ground level.

**T**HE slope of the Santee Valley is from one half to nine tenths of a foot per mile and in a lake as big as Santee Reservoir, covering as it will 155 square miles and extending up the Santee Valley for many miles, a considerable wash can be expected when the wind is in the right direction. The concrete slabs will serve as a protection against these waves and their action on the soil.

Upstream from Santee Dam, the great swamp of the Santee was filled with dense forests of valuable hardwoods, gums, cypress. Contracts were let by the South Carolina Public Service Authority,

in charge of the project, to some 30 lumber companies to clear the forests from the reservoir site. Logging railroads, some of them 20 miles long, were run deep into Santee Swamp, and trainloads of huge logs from an area of virgin timber began to issue from the swamp in great volume, until by the first of the year only 40,000,000 feet of timber remained to be removed.

After the forests were logged, camps of workers, 6000 to 8000 in number, cleared the basins of the remaining timber. They are still, at this writing, engaged in this work.

Pinopolis Dam, which will hold back the water of Pinopolis Reservoir — 95 square miles in area — is two miles in length and is of earth construction, except for the lock and power station. The latter is approximately 380 feet in length and is bordered on one side by immense concrete stanchions, six stories high, which connect with the dam, and on the other by the navigation lock. There are approximately 26 miles of earth dykes around the Pinopolis Reservoir; these, like the dyke at Santee Lake, have a crest elevation of 88 feet and will be similarly surfaced with concrete slabs in the exposed sections.

Equipment to be installed in the power house will consist of four 40,000 horsepower turbines di-



Construction view of longest earthen dam—the Santee—in the United States

rectly connected to four 34,000 kilo-volt-ampere generators; and one 13,300 horsepower turbine directly connected to one 11,350 kilo-volt-ampere generator. Provision is made for an additional 40,000 horsepower generating unit in the future.

Thus the Santee-Cooper power station will have an initial installed capacity of 173,300 horsepower, and an ultimate installed capacity of 213,300 horsepower. Installation of the huge turbines, from the General Electric Company, has already begun.

**T**HE Santee-Cooper power station will provide cheap power in an area which had a population in 1940 of 743,977 and which is rich in natural products but lacks manufactures. As is almost always the case, the area operates at an economic disadvantage when it exchanges its agricultural products for manufactures produced elsewhere and lacks the money distributed by manufacturing industries. For example, the coastal area of South Carolina produced 307,125 five-hundred pound bales of cotton in 1940 and has not a single cotton mill in operation. This cotton ranks among the best, producing 95.5 percent of its crops with lint 15/16 of an inch or longer, in comparison with an average of 73.4 percent for the whole United States.

South of an imaginary line extending from Augusta, Georgia, through Bamberg, Orangeburg, Sumter, Florence, and Dillon, South Carolina, and on to Lumberton, North Carolina, there are no cotton mills in operation. On the line in the counties traversed by it are only seven mills. A high official of the Cotton-Textile Institute said recently that he knew of no reason why this coastal area should not engage in cotton manu-



Retaining wall, turbine construction, discharge end of draft tubes

facture. A spinning mill operated by 1000 horsepower from the Santee-Cooper Project, producing 20 to 30 thread on the average, would consume 5000 to 6000 bales of cotton per annum.

But cotton manufacture is only one of the industries that may be stimulated by the Santee-Cooper Project. Experts have listed many new industries now possible to the area, basing their opinions on the power out-put of the project. The annual generating capacity during a year of average stream flow will be 700,000,000 kilowatt-hours, of which 450,000,000 kilowatt-hours will be prime and 250,000,000 kilowatt-hours secondary power. It has been estimated that cotton mills and tobacco factories would con-

sume 30,000,000 kilowatt-hours of this electricity annually, and two inland machine kraft mills 160,000,000 annually. There are vast pulp resources in the coastal area of South Carolina, and, despite the great increase in kraft paper production in the South, the demand for paper boxes and containers has so swiftly risen that importations of pulp, pulpwood products, and similar raw materials for the paper industry continue at a rate upwards of \$150,000,000 annually. The manufacture of cement, fertilizers, and of many other products of local consumption is also made possible by the new plant, which is hailed as a major step in the big comeback now being staged by the southeastern states.

deepest areas at perhaps only one tenth of this rate.

Sediment samples from the ocean depths provide material for studying the history of the earth in general, in a manner not possible with material obtained elsewhere.

## MINE LOCOMOTIVES

### Electric Power for Hauling Copper

**M**ORE than 25,000 tons of ore, containing 500,000 pounds of copper, will be hauled each day from an Arizona mine by nine powerful electric locomotives built by Westinghouse. This amount of ore would load 500 fifty-ton-capacity freight cars—enough to form a train more than four miles long. The amount removed in a year would nearly equal the volume of concrete in Boulder Dam.

The new locomotives will bring the latest mass production methods to a region that has been mined for more than 60 years. During that time, the richest ores have been removed by underground mining operations. Now the locomotives will move large masses of copper-bearing rock in an open pit mine to recover the metal from the lower grade ores.

Each locomotive weighs 125 tons. Its four 380-horsepower electric motors give it a maximum pulling force of 31 tons. The locomotives are equipped to operate from a 750-volt overhead trolley wire on the main line between the mine and the ore crusher. At the loading benches, where track is moved frequently as the wall of the pit is dug away, each locomotive will receive power from its 13-ton storage battery.

## SAMPLING

### New Apparatus for Taking Sea Bed Samples

**T**wo Swedish scientists, Prof. Hans Pettersson and Dr. Börje Kullenberg, both of the Oceanographic Institute at Gothenburg, expect to be able to explore the history of the oceans over thousands of years with the aid of a new apparatus which they have jointly constructed. With this device, which they have named the "vacuum lead," they aim to secure cross-section samples of the sediment layers on the sea bed of a greater length than has ever been possible before.

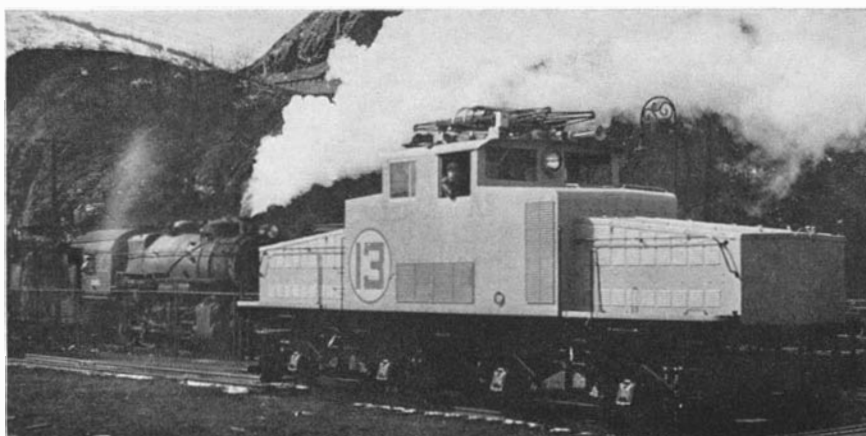
For a long time, the only method of obtaining such samples was with a so-called "push lead," a heavily weighted pipe which can be forced a couple of feet or more into the bottom of the ocean. It has seldom been possible to secure samples of more than a few inches in length with this device, however. An American scientist, Piggott, has developed a method of shooting such tubes into the sediment by means of an explosive charge, and in this way it has been possible to force down the instrument about ten feet into the bottom, but the method is both expensive and dangerous.

The two Swedish scientists let the water pressure itself force the tube into the sediment. Their apparatus consists of a tube 18 feet long, topped by a hollow ball of cast iron. When it is let down,

the whole tube is filled with water, while the ball has been pumped empty of air. By means of a device in the lower end of the instrument, a valve from the pipe to the ball is opened at the moment the pipe touches bottom. The water then rushes into the ball, or "capacity," the pipe becomes empty of water, and is pushed into the sea bed by the enormous pressure of the surrounding water.

With their vacuum lead the two Swedish scientists have recently drawn up a plug of sediment layers about 14 feet long from the bottom of the Gullmar Fjord, on Sweden's west coast, which has enabled them to study the geo-chronological history of this inlet, layer by layer, for at least 4000 years back.

In such coastal waters deposits grow rapidly—about three feet per thousand years—but in the deeper parts of the ocean the deposits increase at a rate of only some three feet in 60,000 years, and in the



One of the new electric locomotives designed for use in copper mining



# Television Today

## Commercial Operation, Large-Screen Projection, and Color Are Recent Developments

A. P. PECK

**A**T THE time of writing it is pretty definite that television transmission will be permitted to start on a full commercial operating basis on July 1. This will mean that television companies will be in a position to develop regular program services, paid for, at least in part, by advertising, and that public interest in this method of communication will start on the up-grade. As pointed out on page 13 of this issue, however, the future course of television will largely be determined, for some time to come, by the availability of materials and trained technicians, as dictated by the needs of national defense. In any event, there are certain aspects of the present television situation that hold immediate interest.

Large-screen television pictures, suitable for theatrical exhibition, constitute the most dramatic development of recent days. Projected from a device resembling a steel barrel, located at the edge of a theater balcony, these pictures fill a screen 15 by 20 feet. At a recent RCA and NBC demonstration in a New York theater, a complete program was presented utilizing equipment specially installed for the purpose. The program consisted of a playlet put on by "live" actors, a news broadcast, a news-reel picked up from film, and a ring-side pickup of a championship boxing match. All of these features were projected onto the large screen; spectators stated that the quality of reproduction was good, that the views of the fight were better than could be had from a ring-side seat.

All the transmission for this program was accomplished over specially balanced telephone wires, establishing a miniature network of the type which, television engineers state, may some day make theater television available all over the United States. The cost of

equipping a theater for television projection, it is estimated, is between \$25,000 and \$30,000 under present conditions; increased demand for equipment and the consequent mass production would undoubtedly reduce these costs considerably.

Here is how the fight was televised and reproduced. Television cameras picked up the scene at the ringside, while long-range parabolic microphones caught the sound. The resulting picture and sound impulses were transmitted by wire to the theater; there they were unmixed, the light or picture impulses being directed to the projector and the sound impulses to a group of loudspeakers by means of two control consoles in the balcony. (See illustrations on this page and on page 4, this issue, for placement of equipment.)

**T**HE sound system consisted of 16 loudspeakers set up in different positions throughout the auditorium. The arrangement of the speakers was such that the man at the control console could give direction to the sound. For example, if the operator saw from the screen that the sound was coming from the right, he would bring the loudspeakers on the right into

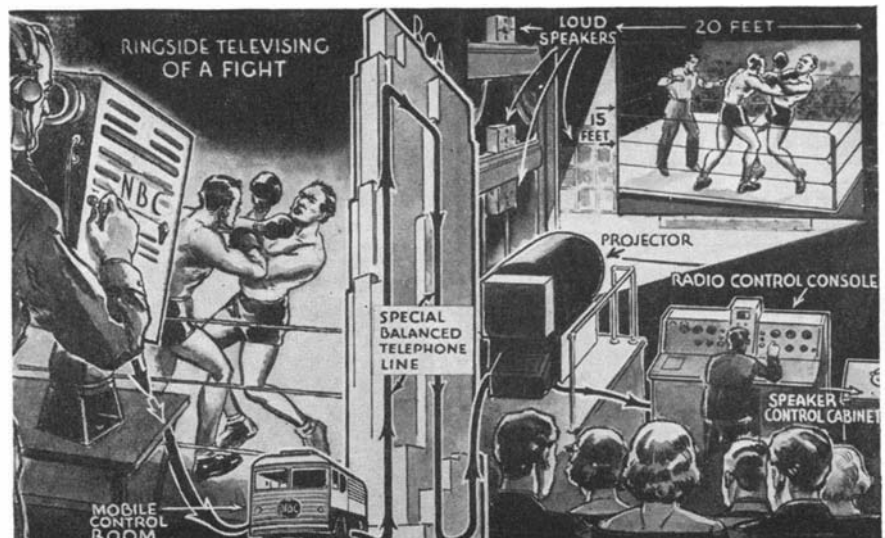
play, and so on. The audience was thus given an illusion of three-dimensional sound.

The projector used in this demonstration is 34 inches in diameter and 34 inches long. Inside it is the kinescope, a large television receiving tube built to handle 60,000 to 70,000 volts, supplied by a high-voltage transformer. At the back of the barrel-shaped projector is a concave mirror 30 inches across. This reflector takes the televised images as they materialize on the face of the tube and casts them through a rectifying and magnifying lens to the screen, 60 feet away. When they reach the screen, the images are 15 by 20 feet.

While large-screen television reception cannot be termed "new" in every sense of the word, it is apparent that the system just briefly described holds the greatest promise of success of any of the other systems that have been experimented with and demonstrated in the past.

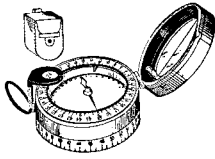
When the realm of television pictures in natural colors is considered, another new-old subject is found. Many workers in the television field have studied this phase, but the systems employed were usually impractical for one reason or another, complication of equipment being the general stumbling block. For some time, however, Dr. Peter C. Goldmark, Chief Television Engineer of the Columbia Broadcasting System, has been experimenting with a practical method of rendering television images in full color, using simple equipment and employing the same channel width as black-and-white transmission.

This color system is based on the



How a boxing match was televised for theatrical exhibition

# U. S. ARMY & NAVY SURPLUS ITEMS



## Lensatic Compass U. S. ARMY

2-inch Liquid, compensated. For taking bearings in horizontal plane. Measuring angles, distances, triangulation, topographical drawings. Needle attached to jeweled dial azimuth circle in 64 divisions revolves on fixed center point. Case has glass sight etched hairline, underneath is a horizontal level, in line with center of needle is a hinged slit-sight. Also magnifier for reading compass bearings when object is sighted. Leather case. **\$3.50**

**U. S. ARMY LIQUID COMPASS (Sperry)**  
Bronze jewel bearing. Leather case.  
2 3/8" diameter, 1 1/4" high 360° **\$2.50**

## "PLAN" COMPASS

New U. S. Army Engineers

Floating day and night dial on jeweled pivot. Used for map reading; setting and keeping a course, etc. Heavy metal case with automatic stop; sighting window with reflecting mirror. Jeweled floating dial, radium marked, 0 to 360 degrees, 1/2 inverted markings. Radium arrow on lens. Price **\$5.50**

## U. S. Army Prismatic Compass

Pocket type. 360° Limited Quantity **\$10.50**

**U. S. Army Watchcase Compass "Taylor"**  
Marching type "Ceebynite" 360° **\$2.95**

## U. S. N. AEROMARINE COMPASSES

Suitable for car, boat or plane made for Navy  
All at fraction of original cost (\$60 to \$140)

### MAKE

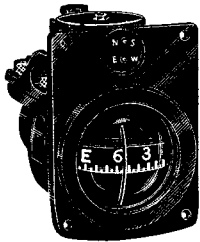
Kollsman .....  
1° grad. **\$25.00**  
5° grad. **20.00**

Pioneer .....  
1° grad. **25.00**  
5° grad. **20.00**

Air Control .....  
1° grad. **22.00**  
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Star. (illustrated)  
5° grad. **12.50**

If electric illumination desired, add **\$2.50**



## PERISCOPES, U. S. ARMY

Made in France in France  
33" long 2" dia. Optical equipment: 1 3/4" prism, 1" pent. prism, 42 mm.achr. lens and 1" F. L. Ramsden eyepiece stand. 1 1/4" dia. **\$15.00**

## HAND CLINOMETERS, PENDANT

U. S. Army Engineers, Geologists, Surveying, Mapping, etc. Magnifying Eyepiece. **\$3.50**

## "FRIEZE" BAROGRAPHS

7-day graphic, 7-jewel movement, completely refinished. Price **\$55.00**

## U. S. ARMY ALIADDES

Hardwood, metric scale, 0-15 cm. and reverse, and 45° angle adj. type, made in France **\$1.95**

**Engineers U. S. Army Precision Type Tripods**  
Keuffel & Esser, precision type hardwood, 42" long, 3" diameter bronze platform with 5/16" #18 threaded stud 3/4" long. Has brass tension adjusting screws. Legs reinforced with cast bronze and steel tips. Weight 5 lb. Price **\$4.95**

## U. S. Navy Divers Lantern

Electric 150 watt, any voltage, solid cast brass. 300 lb. test. Weight 12 lb. Price **\$8.50**

## U. S. NAVY LEYDEN JARS

Copper plated capacity .002 operating volts, 12,500. Height 14", diameter 4 1/2". Price **\$4.50**



## United States Govt. Fire Extinguishers

(Refillable)

Heavy Copper & Bronze

Carbon tetrachloride (pyrene liquid), pressure type, ideal for labs, trucks, boats, garages, office, etc. (10 times more pressure than hand extinguishers.) Just turn handle. No pumping necessary. Ideal for remote control with wire. (Original cost \$40.00.)

1 qt. (100 lbs. pressure) **\$8.95**

2 qts. (200 lbs. pressure) **\$14.95**

Lots of 3, 5% discount.

Lots of 6, 10% discount.

## U. S. Army Generating Plants, New

Gasoline Driven. "Delco" 1000 watts 120 volt direct current generator. Single cylinder, 4 cycle air cooled 2 1/2 inch bore, 5 inch stroke. 1400 RPM, battery ignition. Hand crank. Weight 340 lbs. Price **\$200.00**  
Additional data on request.

## Edison Storage Batteries

Cells are in excellent condition. Complete with solution, connections and trays. Prices below are about 10% of regular market price. Average life 20 years. Two-year unconditional Guarantee.

A-4	Amp. Hrs.	150	Ea.	\$5.50
A-5	"	187	"	5.50
A-6	"	225	"	5.50
A-7	"	262	"	7.00
A-8	"	300	"	7.00
A-10	"	375	"	8.00
A-12	"	450	"	12.50
B-4	"	75	"	4.00
B-2(J-3)	"	37	"	3.50
M-8	"	11	"	1.50
L-20	"	13	"	2.00
L-40	"	25	Pr.	4.00

All cells 1.2 volts each.

Above prices are per unit cell. For 6 volt system use 5 cells, 12 vt.-10 cells, 110 vt.-88 cells. Note: On all cells 75 amps. or less an additional charge of 10% is to be added for trays.

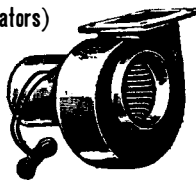
## Electric Blowers (Ventilators)

90 cu. ft. Min.  
2 3/4" intake, 2" x 2" outlet.

Cast aluminum housing **\$9.85**

Cast iron housing **\$7.50**

Available in 6, 12, 32, 110 volt d.c., 110 v. a.c., 110 v. universal. Specify type and voltage desired.



## Prismatic Rifle Sight & Observers' Scope



### BAUSCH & LOMB OPTICAL SYSTEM

Made by Warner & Swasy. 6 power. Consists of achromatic ocular and objective lens, calibrated reticule with Cross Hairs, 2 highly polished prisms firmly set in solid cast bronze frame with soft rubber eye-cup. Micrometer adjustments for yardage and windage. Used on Krag, Enfield, Savage, Springfield, etc. Fits any bolt action rifle. Complete with mount and oak leather case (not shown). Regular Price **\$38.00** **\$15.00**  
Now

## U. S. Army Parabolic Searchlight Mirrors Precision Quality

DIA.	FOCAL LENGTH	GLASS THICKNESS	PRICE
11 in.	4 in.	3/4 in.	\$12.
18 in.	7 1/2 in.	5/16 in.	25.
24 in.	10 in.	5/16 in.	50.
30 in.	12 1/2 in.	7/16 in.	55.
36 in.	18 1/4 in.	7/16 in.	75.

Made by Bausch & Lomb & Parsons. Perfectly ground and highly polished.

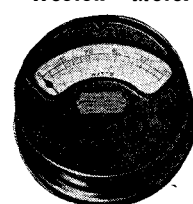
A few 60 in. slightly used metal mirrors on hand.

## Fire Alarm Equipment

Gamewell Street Boxes	\$25.00
Gamewell Combination Fire and Police (telegraph and phone) Street Boxes	25.00
Interior Fire Alarm Stations	4.50
<b>SINGLE STROKE ELECTRIC GONGS</b>	
Edwards 12" bronze DC 5 Ohm Mech. Wound	\$13.50
Edwards 10" bronze DC 5 Ohm Mech. Wound	12.00
Edwards 6" bronze DC 5 Ohm Mech. Wound	10.50
Schwarze 8" 100 Ohm 32 volt	7.50
Schwarze 5" 18 volt "turtleback" 6 volt Mech. Wound	5.00
Gamewell 12" Bronze "turtleback" 6 volt Mech. Wound	18.00

Also limited amount Faraday bells.

## "Weston" Meter



7 3/4" diameter switchboard models  
Watt Meters  
.75 - 1.5 - 7.5 K.W.  
For A.C. & D.C. Choice of above sizes, each **\$20.00**  
Volt Meters 150 volt D.C. **\$12.50**  
Volt Meters 300 volt A.C. **\$15.00**  
Volt Meters Combination D.C. 150. A.C. 300 **\$18.00**  
Ammeters D.C. (choice of scale) **\$15.00**  
Ammeters A.C. (choice of scale) **\$16.50**

familiar primary colors—red, blue, and green. Rotating filters of these colors are placed over the television image tubes at both the transmitter and receiver, the speed of rotation and the relative positions of the color segments being carefully synchronized. Thus the eye of the spectator receives successive images in the primary colors; retention of vision blends these together, giving to the brain an impression of an image seen in full color.

From all this it appears that television is at least beginning to don its swaddling clothes; as it learns to toddle and then to walk (from the public service and not from the laboratory viewpoint alone), a constant flow of improvements may be expected.

## QUIET OFFICES

APPLICATION of noise-insulating mountings to a wide variety of office machines has been found to go a long way toward eliminating the distracting noises in offices which result in so much loss of energy to employees and hence increased costs to employers. These devices, of rubber and metal, called Vibro-Insulators by the manufacturer, the B. F. Goodrich Company, insulate not only noise but also vibration.

The company reports that the mountings have been successfully applied to key operated punches, alphabetical duplicating and printing punches, gang punches, reproducers, interpreters, automatic checking machines, multiplying punches, and all numeric and alphabetic printers and billers, and so on.

## STUTTERERS

Was a Dictum of a Dozen Years Ago Wrong?

DISPUTING the old theory that teaching left-handed children to use their right hands, particularly for writing, is likely to cause them to stutter, Professor Harry J. Heltman, chairman of the School of Speech and Dramatic Arts at Syracuse University, recently declared that in a survey in which about 1600 students entering Syracuse were tested, out of 77 students who had had their handedness changed, only one of them stuttered.

The cerebral dominance theory is based on the findings of early surgeons that one side of the brain

MANHATTAN ELECTRICAL BARGAIN HOUSE, INC., Dept. S. S., 120 Chambers Street, New York City

**MISCELLANY**

is dominant. If a child is right-handed, it is said that the left side of his brain is dominant; while if he is left-handed, the right side of his brain takes the lead. Thus it has been suggested that teaching a left-handed child to write with his right hand is to force the weaker side of the brain to take the initiative and thereby disturb the whole nervous system and cause stuttering.

Professor Heltman summed up the survey with the contention that it is not so dangerous, from the speech aspect, to change a child's handedness, as has been supposed.

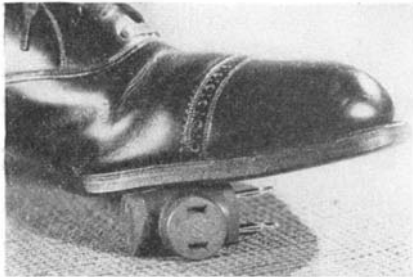
**PLUG**

**All-Rubber Multiple Plug**

**Has Novel Features**

**A**n unbreakable all-rubber multiple-outlet plug that is capable of withstanding extremely heavy pressure also features spring friction blades which provide permanently tight connections.

The plug, as shown in one of our illustrations, is molded of relatively



Metal parts are locked in place

soft rubber in a single unit, after which the metal parts are inserted and anchored by a patented process that locks them into place. The all-rubber construction makes these plugs suitable for use in any situation where multiple-outlet plugs are necessary and at the same time makes it possible to produce them in smaller sizes than ordinary types. The plug, produced by the United States Rubber Company, is scratch-proof and virtually unbreakable in ordinary use.

**DUPLICATING**

**Stencils Give Visibility,**

**Clean Reproduction**

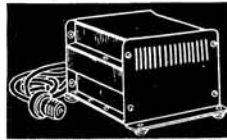
**I**n a new type of duplicating stencil for office use, the visibility of stenciling is the same as that found in typing—namely, light on a dark background instead of dark

**LATEST TYPE INDUSTRIAL & LABORATORY EQUIPMENT FOR IMMEDIATE DELIVERY AT UNUSUAL PRICES**

**Exhaust Fans, Bucket Blade, G. E. A.C. 110 volt motors.**

	RPM.	cu. ft. per min.	Price
9"	1550	350	\$10.50
10"	1550	350	11.50
12"	1750	800	16.50
16"	1750	1800	17.50
16"	1140	1650	25.00
18"	1750	2500	19.50
18"	1140	2100	28.50
20"	1140	2800	30.00
24"	1140	4000	35.50
24"	850	3800	38.50

Other voltages & frequencies available at slightly higher prices.

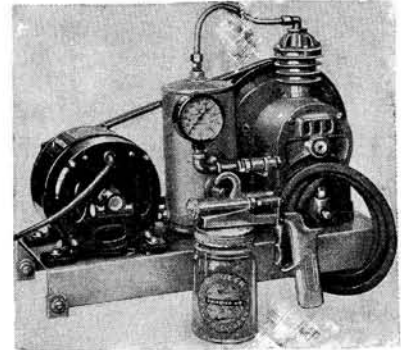


**COROZONE OZONATOR**

An electrical device that converts ordinary oxygen into ozone. Revitalizes and deodorizes the air. Suitable for laboratory, factory, office or home. 110 volt AC. Only 10 watts. **\$7.50**

**Latest Model Compressor**

Suitable for **FACTORY, LABORATORY or HOME**  
*Quiet—Efficient—Powerful*



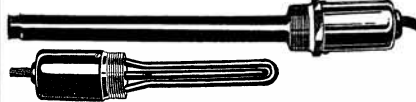
Ideal spraying outfit for all liquids such as paints, enamels, etc. Can also be used for cleaning, tire inflating, and general purposes. Equipped with General Electric, 1/4 HP. a.c. motor. Quincy air compressor, adjustable safety valve, and 100 lb. air gauge. A heavy duty Plummer spray gun with 15 feet of hose. Weighs only 60 lbs. Price **\$39.50** Complete and ready for operation.

**AUTOMATIC CELLAR DRAINER**



Prepare for rainy season. Keep your basement dry at all times. New improved Oberdorfer sump pump. Pump built entirely of bronze, rust proof, long life. Has Thermal Overload Device. Protects motor in case pump stalls. Capacity, 3,000 gallons per hour with 1/4 h.p. motor at low operating cost. Model B-2400 unit complete with 110 v. 60 cycle motor ... **\$35.00**

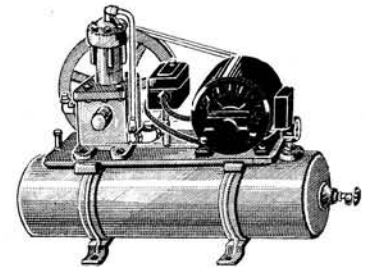
**General Electric Immersion Heaters**



Suitable for heating liquids, tanks, kettles, etc. (1 KW raises temperature 100°F 3 gallons per hour.) Fitted for 1 1/2" iron pipe thread. Can be used as 110, 220 volt or 3 heat 110 volt.

600 Watt	.....\$6.00	1200 Watt	.....\$ 8.75
750 "	..... 6.30	2000 "	..... 10.25
		3000 Watt	.....\$12.00

We have on hand a large variety strip (space) heaters. Quotations on request.



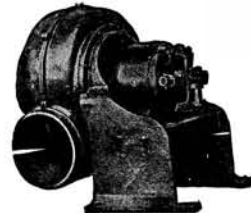
**Air Compressors for Industrial and Laboratory Use**

Complete automatic unit mounted on tank, "V" belt driven by heavy duty motor, with gauge, safety valve, check valve, drainer, etc. Delivers about 1 1/4 cu. ft. air per minute. Can be used for all applications up to 70 lb. Price... **\$29.50** (Complete line of larger units in stock.)

**Synchronous Motors**

New Emerson 100th H.P., 900 R.P.M. 110 volt 60 cycle hollow 25/32 shaft vertical or horizontal mount, no base. Has many applications. ....\$7.50

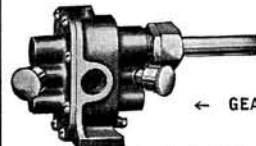
**MOTOR DRIVEN FORCED DRAFT BLOWERS**



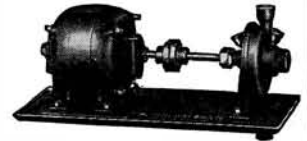
TYPE	H.P.	R.P.M.	CU. FT. MIN.	INLET	OUTLET	PRICE
0	1/20	1750	160	4 1/2"	3 3/4"	\$18.00
0 1/2	3/8	1750	350	6 1/2"	3 3/4"	20.00
1	3/8	1750	535	6"	4 1/2"	25.00
1 1/4	3/4	1750	950	7 1/2"	6"	30.00
1 1/2"	1 1/2	1750	1900	9 1/2"	7"	65.00

PRICES QUOTED ARE FOR A.C. 110 V. 60 CYCLES ONLY. OTHER VOLTAGES ON REQUEST.

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Suitable for Marine, Laboratories, Factory, Home, Etc.



No. 1 Centrifugal Pump only, inlet 1/4" outlet 1/2"	Price \$ 6.50	With A.C. motor	\$22.00
No. 4 " " " " 3/4" " 1/2"	" \$13.50	" " " "	\$28.00
No. 9 " " " " 1 1/4" " 1"	" \$16.50	" " " "	\$31.00

**IMMEDIATE DELIVERY**

No. 1 1/2 Gear Pump only 3/8"	Price \$ 9.00	With A.C. motor	\$22.00
No. 2 " " " " 1/4"	" \$10.00	" " " "	\$23.50
No. 3 " " " " 3/8"	" \$11.50	" " " "	\$25.00
No. 4 " " " " 1/2"	" \$12.50	" " " "	\$28.00
No. 7 " " " " 3/4"	" \$15.00	" " " "	\$32.50
No. 9 " " " " 1"	" \$16.50	" " " "	\$45.00
No. 11 " " " " 1 1/4"	" \$48.50	" " " "	on request

**PIONEER AIR COMPRESSOR CO., Inc.**  
120-s CHAMBERS ST. NEW YORK CITY, N. Y.

on a dark background. Thus eye strain on the part of the typist is eliminated and errors are reduced; furthermore, the typewriter type does not fill up as with conventional stencils.

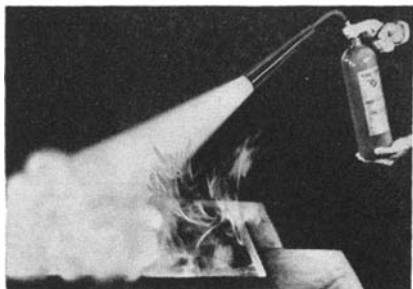
The secret of this new stencil is a tissue sheet placed over the stencil sheet, plus a double thickness backing sheet. The tissue sheet remains in place until the stencil is completely cut so that layouts or tracings can be made in pencil on the tissue to act as a guide to the typist.

After a stencil is cut, the backing sheet next to the stencil can be removed and used as a proof sheet.

## TRIGGER CONTROL

**Fire Extinguisher is Rapid in Action**

**A** HAND-OPERATED fire extinguisher which has a capacity of four pounds of carbon dioxide and is equipped with a trigger control valve has recently been developed by Walter Kidde and Company,



Insures minimum wastage

Inc. The trigger-control valve is an outgrowth of a similar system formerly used on a smaller extinguisher.

In use, this extinguisher is discharged by simply pulling the trigger. This permits the extinguisher to go into action faster and insures minimum wastage of the carbon dioxide gas while the operator is maneuvering around the blaze. When trigger pressure is released the discharge is instantly shut off.

## LEARNING THE CODE

**Combination Radio Receiver Provides Practice**

**B**UDDING hams, Boy Scouts, and others desirous of learning the code will be interested in "Echo-phone Commercial" communica-

tions receiver, Model EC-1. Not only does it provide for reception of both 'phone and code throughout its range of 545 kilocycles to 30.5 megacycles, but in addition has self-contained facilities for keying and code-reading practice.

With a standard telegraph key connected in series with the head-phone the output of the receiver to the headphones will be broken up into dots and dashes as the circuit is keyed. If the receiver is tuned to a broadcast or other steady carrier, and its beat-frequency oscillator turned on, this output will be in the form of a heterodyne whistle. When keyed, the result is



Listen in or practice

a perfect imitation of the sound of regular radio telegraph transmissions.

Group "copying" practice is possible if the headphones are placed on the table and the receiver volume turned up to make the sound audible over a reasonable range. Or, by connecting two keys in parallel it is possible to carry on two-way communication with either participant "breaking in" at will.

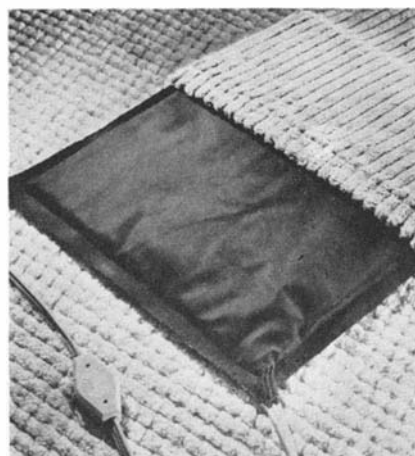
When some degree of speed has been achieved in code copying, then the regular code transmissions of commercial stations can be tuned in for actual on-the-air practice.

## WET-PROOF

**Electric Heating Pads**

**In Rubber-Coated Fabric**

**G**REATER safety in the use of electric heating pads is promised by a new rubber-coated fabric for wet-proof casings developed in the Du Pont laboratories. Since the new casing material is vulcanized, the edges of the pad's covering can be sealed with cement instead of sewn. Hence perspiration, moisture from wet bandages, or spilled water cannot soak through the bag,



Seams are cemented, not sewed

and the danger of short circuits from moisture penetration is eliminated. Careful cementing of the cord to the bag is an added protection.

The rubber-coated product has been approved by the Underwriters' Laboratory, Inc., as the first material to meet their specifications for a thoroughly wet-proof casing. Tests require the material to stand in boiling water for an hour, followed by heating in an oven for 1000 hours at 100 degrees, Centigrade, and then by boiling for another hour.

## GARDEN ANTS

**Simple Treatment Eliminates**

**Prolific Pests**

**A**NTS annually do a lot of injury to lawns and gardens throughout the country. The galleries they form underground disturb plant roots; the earthen mounds which some species make during tunneling operations are unsightly. It is, of course, quite useless to re-seed such areas until the ants have been completely exterminated from every part of their galleries.

There are many different species of these tireless pests. All species can, however, be effectively exterminated, it is claimed, with calcium cyanide, a material that has been thoroughly tested by entomologists and scientific investigators in this country and abroad.

Many different ant-exterminating formulas have been suggested, ranging from home-made remedies to commercially prepared baits and fumigants. By far the most effective is granular calcium cyanide which, on coming in contact with normally moist soil, liberates a gas that quickly penetrates throughout the galleries and kills



all ants present. If ants have infested the house, the line of their march should be traced back to the nest and the fumigant used at that point—*never* in the house.

Calcium cyanide in granular form is sold in metal cans equipped with spout, which serves as an applicator. This fumigant is very economical to use as only as many of the granules as would cover a dime are sufficient to annihilate an entire ant colony. The ground must not be wet, as burning of grass blades would result and it is recommended that the nests be probed with a thin stick to a depth of eight inches so that the Queen ant, living deep in the colony, may be eliminated. As soon as the granules have been injected into the nest, the opening should be closed with soil; in a few seconds all the ants in that nest will be killed.

As the calcium cyanide granules are placed directly in the soil rather than broadcast on the surface, this material offers no hazard to children or pets, especially as there is no poisonous residue after the gas is once liberated.

## IVY POISONING

**Dogs May Carry:**

**How to Prevent**

**M**YSTERIOUS cases of ivy poisoning may often be traced to a pet dog, according to L. W. Kephart of the Bureau of Plant Industry. Dogs brush against ivy plants and bring home the chemically irritating principle on their fur. Whoever strokes the dog may come down with ivy poisoning. Ivy poisoning may also come from handling shoes or other clothes and tools that have been in contact with the plant. Poison ivy is most poisonous in spring or early summer when the sap is most abundant. But dry, dead plants, and especially the smoke from burning plants, can cause poisoning.

Poisoning may be prevented if the irritant is removed from the surface of the skin before it has time to penetrate. Wash exposed skin promptly with baking soda dissolved in lukewarm water and then with a thick lather of strong soap followed by a rinse in warm, running water. Baking soda, washing soda, borax, and photographer's "hypo" are all useful. Several washings in strong soap following the wash in an alkali solution will carry off the poison.



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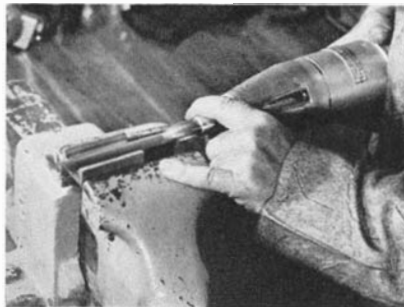
## Industrial Growth

### New Products and Processes That Reflect Applications of Research to Industrial Production

#### PRECISION FILING

##### Reciprocating Hand Tool For Semi-Skilled Labor

**I**n a hand tool specifically designed for filing and recently made available by the H & M Research Company, there is practically no vibration transmitted to the hands



In action—no vibration

of the operator. Because the tool operates with a reciprocating action the operator does not need to move his arms. This eliminates the rocking motion which is a natural consequent of arm movement, even by experienced workers, when filing flat surfaces.

Using this new tool it is claimed that more accurate work can be done by an operator with little training than can be accomplished with an ordinary file in the hands of a skilled mechanic.

These tools are available in two stroke lengths —  $\frac{3}{8}$  and  $\frac{1}{8}$  of an inch.

#### THERMOSTAT

##### Operates Within Small Temperature Ranges

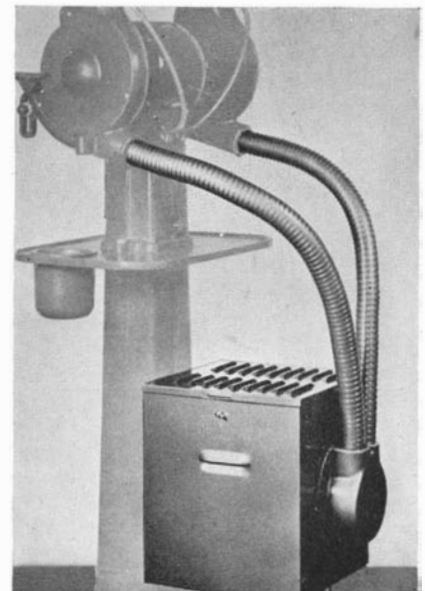
**A** NEW thermostat, which uses a brass bar in place of the more conventional bi-metal unit, depends upon the linear expansion of brass for its operation. This unit, announced by the General Thermostat Corp., is designed for use where accurate control of electric heaters is necessary. Vulcanizers, sterilizers, melting pots, flat irons, electric ranges, and a wide range of similar heating devices are some

of the devices to which this thermostat can be applied. It is claimed that the linear expansion of a brass rod makes possible closer control of temperature than has been found with former types of thermostats. Thus it is stated that the temperature, with bi-metal thermostats, may use to as high as 150 degrees above the temperature setting before the thermostat turns the current off. These brass rod thermostats are available with differential ranges of 5 to 15 degrees, Fahrenheit, plus or minus. The maximum adjustable range of Positrols, as these devices are called, is 375 degrees, Fahrenheit.

#### DUST COLLECTOR

##### Self-Contained Unit Cuts Installation Time and Costs

**D**ESIGNED for use with various types of bench grinders, cut-off machines, polishers, buffers, and so on, a new and compact type of dust collector has been placed on the market by the Aget Manufacturing Company. This device, being entirely self-contained and not requiring connection to a centralized collecting system, may be moved from one machine to another, or a machine and dust-col-



Self-contained

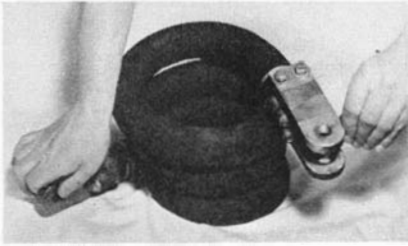
lector may be moved as a unit.

Rated at 600 cubic feet per minute, the Dustkop 600, as this model is called, is equipped with a ¼-horsepower, 110-volt motor. Two types of intake flanges are available to remove dust from machines either singly or in multiple. The collected dust and dirt is removed by lifting the cover of the device, taking out the filter assembly, and lifting the pan in which the dust is collected. The filters employed are of spun glass.

## CABLES

**Welding Cables Are Flexible,  
Have Large Capacity**

**F**LEXIBLE welding cables that make gun handling easier have recently been announced by Progressive Welder Co. In these cables the two current-carrying strands



For easier gun handling

are wound at steep helical angles to increase ease of flexing and to reduce wear. It is claimed that these cables have a capacity 50 percent in excess of conventional cables of the same size and increased life because of the extra heavy insulation employed. The water supply core of the cable is of flexible bronze tubing. Between the outer current carrying strands and the external abrasion-resistant cable covering is space for water circulation.

These new welding cables are available with a wide range of terminals for welding guns of standard make.

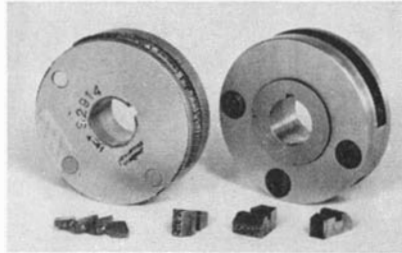
## MARKING TOOL

**Interchangeable Letters in  
Rotary Type Device**

**N**UMEROUS installations of a new rotary or roll-type marking device on screw machines and turret lathes have shown their ability to automatically make clean cut identification marks in high-speed production. This marking tool, introduced by New Method Steel

Stamps, Inc., is designed for rapid marking on cylindrical parts during production. The letters or figures in the tool are interchangeable.

The die is mounted in a holder which has a fine adjustment for



Marking tools, showing interchangeable letters and holders

starting the marking operation when brought into contact with the work. After completing the marking operation, the roll is returned to initial position by a coil spring mounted on the end of the roll shaft to which the die is keyed. The roll is so designed that continuous contact with the part after marking does not cause it to rotate and re-mark the surface. Only a single impression is made, even though the part continues to rotate before the roll is withdrawn from contact.

Various forms of holders are available so that the device can be adapted to most applications where the marking of rotating parts in production is required.

## POLISHING WHEELS

**Impregnated Soft Rubber In  
Wide Size Range**

**H**IGHLY polished surfaces can be produced on any base metal, it is claimed, with a new type of soft rubber polishing wheel in which polishing compounds are impregnated in a special rubber binder. Five different types of compounds are available and, in addition, the wheels contain sufficient cutting grit to remove scratches and grinding marks from the piece being polished.

These new wheels, manufactured by the Chicago Wheel and Manufacturing Company, are available in a wide range of sizes and shapes. Conventional dressing tools are used to dress the faces of the wheels to any desired contour so that irregular shapes can be polished.

The material used in these wheels is not suited for polishing plated work.

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### THIRD DIMENSION PICTURES!

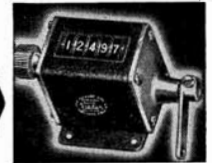


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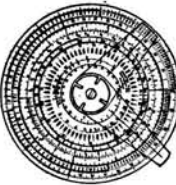
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# PATENTS

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# Helicopter Records

## Rotary Aircraft Operates as Seaplane Or Amphibian Helicopter

### ALEXANDER KLEMIN

Aviation Editor, Scientific American. Research Professor, Daniel Guggenheim School of Aeronautics, New York University.

**A**IRCRAFT designer Igor Sikorsky is continuing his pioneer work on the only single airscrew helicopter in the world with remarkable success. We have previously described this machine in our columns; the VS-300-A is a single-seater, equipped with a 90 horsepower Franklin engine, and with



Hovering aloft near the tree tops, Mr. Sikorsky demonstrates complete control over his single screw, 90-horsepower helicopter

a gross weight of 1290 pounds. It has a three-bladed main rotor 28 feet in diameter and three two-bladed auxiliary tail rotors, each 92 inches in diameter. The pitch of all the rotors is controllable, providing maneuverability in flight. Power is transmitted through a multiple-belt drive so that alterations can be made rapidly and with flexibility. Quite recently

two records have been gained by Mr. Sikorsky.

The first record was a splendid culmination of two years of development work. The craft hovered over an area of less than one acre for one hour, five minutes, 14.5 seconds, after having made a true vertical take-off with no ground run or climb at an angle. The descent and landing at the end of the flight were also truly vertical, and the machine was easily held aloft near tree tops. No matter how gusty the weather, the helicopter can operate from an area less than 50 feet square, although 20 or 30 feet more at the sides of the landing plot help against piloting error. It can be seen what possibilities this opens.

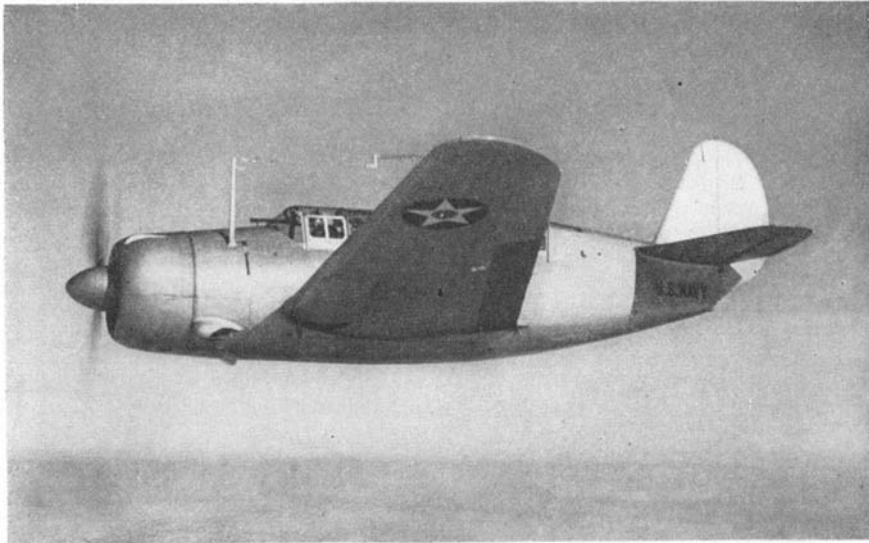
The second achievement lies in the fact that, with three cigar-shaped rubber floats replacing the landing gear, the VS-300-A was able to operate from the Housatonic River, and then to operate from land. Thus it has taken its position both as the first seaplane and the first amphibian helicopter.

The well-founded suggestion that rotary aircraft be provided for convoy work across the Atlantic, rapid progress on the Platt-Le page helicopter, purchase of Pitcairn-Larsen autogiros by the British, and other developments, lead to the conclusion that rotary aircraft is about to come into its own. [On May 6 Mr. Sikorsky exceeded his own record, remaining in the air for one hour, 32 minutes, and 30 seconds.—Ed.]



Wheels replaced by pontoons





Aerodynamically clean—the Curtiss XSB2C-1 dive bomber

## DIVE BOMBER

America Produces Outstanding Navy Plane

**T**HE Germans claim much credit for their dive-bombers and dive-bomber technique. But it was the United States Navy which originated the technique and the Curtiss-Wright Corporation which built the first dive-bomber—the Curtiss Hell-diver, constructed in 1930. Now Navy and Curtiss-Wright together, instead of resting on their laurels, have produced a remarkable “super dive-bomber,” the Curtiss XSB2C-I, which is shown in our photograph with armament carefully blocked out.

Aerodynamically, we can note the completely retracted landing gear; cabin with a windshield so low that the resistance of the streamlined fuselage is scarcely increased thereby; flaps to improve landing speed; slots at the leading edge, ahead of the ailerons, to maintain full lateral or banking control at low speeds when landing on the carrier's deck; the most efficient position of the wing relative to the fuselage, namely low mid-wing.

The power plant embodies a 1700-horsepower Wright Cyclone engine (the largest ever placed in a dive-bomber) and a full feathering three-bladed propeller.

Other features include unusually heavy armament; bomb load carried inside the fuselage to eliminate drag; wings that fold upward to facilitate storage on shipboard; and hydraulic operation of controls.

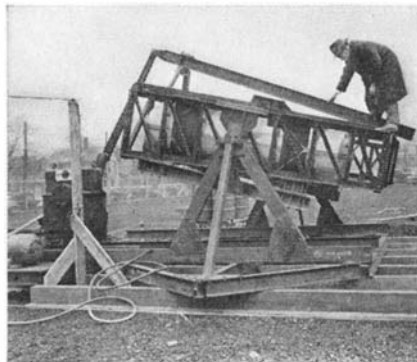
What is its performance? That is a secret, but, says Burdette S. Wright, Vice-President of Curtiss-

Wright: “The new aircraft can carry twice as many heavy bombs as any existing dive-bomber, fly twice as far and attain a maximum speed of 100 miles an hour more than existing models.” — A. K.

## SELF-SEALING

Fuel Tanks Tested by Rough Treatment

**S**ELF-SEALING fuel tanks are provided with a composition which closes the holes made by powerful



Slush tester

machine gun bullets. However, because an airplane of the military type maneuvers so violently that the mere sloshing around of the gasoline inside the tank may cause damage, the B. F. Goodrich Company has developed a particularly rough method of testing such equipment in what is called a “slush tester.” The tank is mounted on a horizontal axis, and an arm, powered by an electric motor, oscillates the tank from 16 to 18 times a minute. A 25-hour test of a 425-gallon airplane container left no sign of damage.—A. K.



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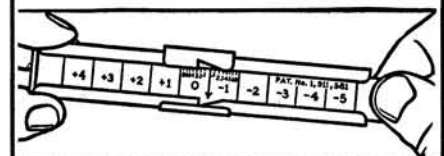
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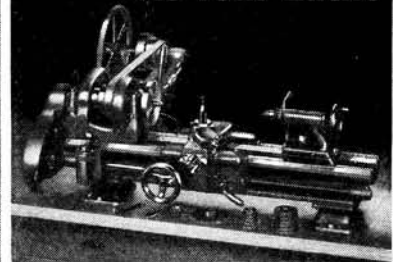
Pocket size, durable (constructed of aluminum and stainless steel); exceedingly smooth in action. Furnished in leather case, with complete directions for using. Price \$2, postpaid, with extra, easily interchangeable scale which enables the instrument to perform extended multiplication and division, 50 cents additional.

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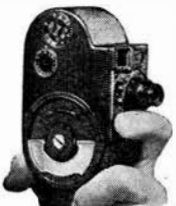
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# CAMERA ANGLES

Conducted by JACOB DESCHIN, A.R.P.S.

## Modernizing the Old Camera

**T**HE story goes that Charles Belden, the cowboy photographer, has had such good success with his old style camera that when it came a-cropper once and had to be sent away for repairs, he insisted on waiting for his

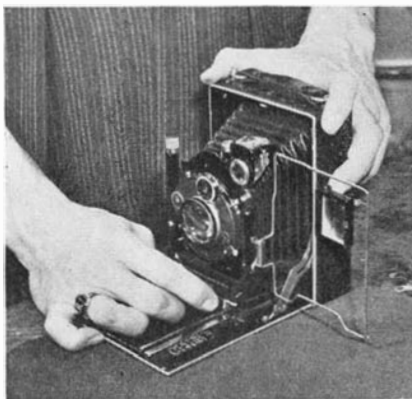


Figure 1: About to go modern

old love and discouraged all attempts to entice him to adopt one of the newer models. That is not as unusual a case as it may seem in these days when there is such a large and attractive array of camera offerings in every size and style. For sentimental and other reasons, the owner just can't

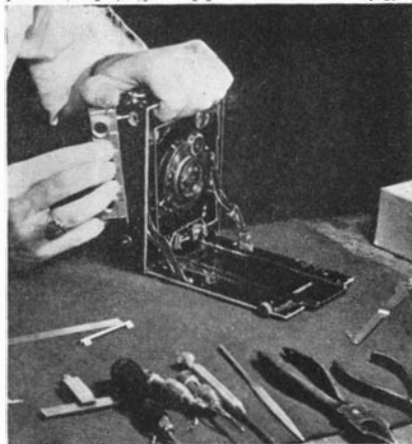


Figure 2: Bed adjustment

why borrow trouble when you can let well enough alone? Okay, brother, but how about bringing your old camera up to date? In this way, you can eat your cake and have it, too.

Among the principal signs of the modern camera is the range finder and the flashgun. Both of these can easily be installed on many cameras, thereby putting your old camera into step with advances in the industry, and making it a more flexible and efficient unit to use in the pursuit of your chosen hobby.

Figure 1 shows a type of camera ideally suited to range-finder installation. There are many varieties,

many sizes, but a little study usually reveals the simple mechanical details required to do the job efficiently. It has been found, in fact, that modernizing the old camera in this way usually reveals that the infinity stop is in the wrong position anyway, so that the range-finder installation procedure becomes a double-edged benefit, a check on the accuracy of the infinity mark, and a correction of it, if a fault exists.

Figure 2 shows the first step involved in the installation of a Kalart range finder, that of coupling the movement of the finder with the movement of the bellows along the bed of the camera. When completed, the range finder will focus as closely as 3½ feet, and will automatically uncouple, or free itself of the camera focusing arm when it is desired to focus at closer distances. In that case,



Figure 3: Range finder goes on

the camera is operated in the normal manner, that is, by means of the camera ground glass or some measuring method.

Incidentally, while it is usually recommended that the range finder be installed by the makers, thus necessitating sending your camera to the factory, the details of installation are so simple that a kit of tools is supplied to make it possible for you to make your own installation. An easy instruction manual tells you just how.

The camera body is prepared to take the range finder and the latter permanently attached, as shown in Figure 3. The operating arm that will allow the range finder to work synchronously with the camera is on the bench near the end of the camera bed, ready for attaching.

In Figure 4, the operating arm is shown being attached in the final stages of the coupling process. Just ordinary care is required to do the job right, such as checking the focus and correcting the position of the in-

finity mark, if this is necessary, as it usually is, we are told. The camera is now ready for use, equipped with a method of focusing that is universally acknowledged to be the most accurate we know today.

The second improvement is the flashgun. Figure 5 illustrates a Master Kalart Synchronizer mounted on a bracket next to the range finder. Because of the precision operation



Figure 4: Coupling the range finder

of the range finder, it is important to have a supporting bracket for the flashgun that is independent of the range-finder mounting. In this particular case a bridge-type bracket has been installed on the camera around the range-finder casing, the bracket being attached to the camera body in such a way that it is absolutely free of the range-finder at all points. Thus, the flashgun mounting introduces no strain or weight whatever on the range finder. When not in use, the flashgun and tripper (attached to the shutter, as shown) are simply taken off, leaving only the bracket as the permanent attachment.

With range finder and flashgun, your old camera becomes as good as new insofar as modern improvements are concerned, and you are equipped to compete on equal terms with the best of the new cameras.

**Efficiency of Light Reflectors**

DESIGNERS and manufacturers of reflectors for photographic lighting units are concerned principally with the shape of the reflector, its precise curvature, which is made to a mathematical formula, and the material used. If the material is inferior from the point of view of efficient reflection, results will be poor. Available materials vary in this respect, some reflecting more, some less light than others. The volume of light reflected from any given surface as compared to the incident light, that which strikes the surface of the material, is called the co-efficient of reflection. For example, if a material is said to have a co-efficient of 80 percent, this



Figure 5: The finished job

means that it reflects 80 percent of the light that hits it. General Electric Company's "Illuminating Design Data" gives the following percentages for various materials:

Material	Co-efficient of Reflection
Glass mirror	80% to 90%
Specular Alzac (also called Alcite)	75% to 85%
Rhodium	70% to 78%
Polished aluminum	60% to 70%
Specular chromium	63% to 66%
Specular nickel	60% to 62%
Brushed aluminum	55% to 57%

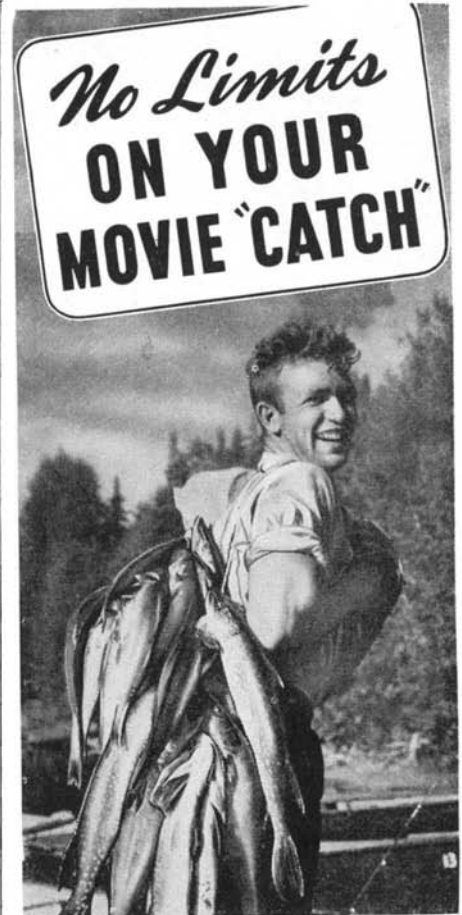
**Temperature Standards**

NEW Agfa instruction sheets designate a revised temperature standard of 68 degrees, Fahrenheit, (20 degrees, Centigrade) for the development of Agfa films and papers. Former recommendations were 65 degrees for films, 70 degrees for papers.

"Chief among the reasons for establishing the new temperature standard," says the Agfa announcement, "has been the desire to simplify existing separate recommendations on film and paper development which have in the past been a source of some confusion. Related to this condition has also been the realization that developing solutions can usually be maintained more easily at 68 degrees than at 65 degrees."

**The Camera Goes Fishing**

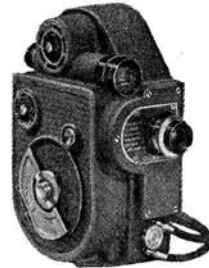
GOOD fishermen, they tell us, don't have much time to use their cameras because they're busy catching fish. But recently we ran across a little pamphlet on "How to Photograph Your Fishing Trip," evidently by a writer who knows his fishing as well as his camera, and it appears that a man can be a good fisherman and still take pictures; you can see for yourself by writing for a copy to Hood Rubber Company, Inc., Watertown, Massachusetts. The booklet was compiled with the assistance of



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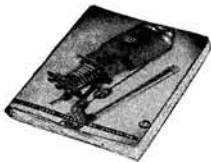
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## CAMERA ANGLES

no less an authority than the photographic editor of *Field and Stream*, and is really a little treatise on taking pictures, its general principles being applicable not only to fishing, which it discusses specifically, but to many other activities as well.

### Cutting Heads Gracefully

**I**F you must cut into heads, because of lack of parallax compensation on your camera plus a too-close viewpoint, or for any other reason,



"Peek-a-Boo!"

you can sometimes get away with it by introducing an idea, as in this case. The tilt of the child's head gives the impression that she is looking out from underneath a low "ceiling" and the idea of "Peek-a-Boo" comes instantly to mind.

### The Baryta Coating

**U**SUALLY taken for granted, particularly by amateurs, the baryta coating on photographic paper is most essential as a protection for the emulsion coating against possible impurities in the paper base as well as to ward against the tendency of the wet emulsion to soak into the paper and thus produce a flat image. The baryta coating is a mixture of barium sulphate and gelatine solution and when applied to the paper forms a smooth surface.

### Too Many Colors Spoil the Picture

**T**HE average photographer, whether amateur or professional, is inclined to bunch a lot of different colors in one shot when attempting color photography for the first time, says Valentino Sarra, prominent American photographer. Speaking at the recent Westinghouse Photographic Lighting Conference at Bloomfield, New Jersey, Mr. Sarra advised simplicity both in the composition and color selection. In fact, he related that he has even gone so far as to use only one color both for subject and background. All

## Over \$1100 in Prizes

### Sixth Annual Scientific American Amateur Photography Contest

**P**OPULARITY of the divisional method of judging photographs in the Scientific American Contests, as determined by the enthusiastic response in past years, has been so great that the method is once more being used for the Sixth Annual Contest. In each of the divisions listed below there will be awarded seven major prizes and five honorable mention awards, a total of 36 prizes in all.

Complete rules of the contest will be found on page 368, June issue, Scientific American.

### Divisions In Which Prints May Be Entered

**Division 1. Human interest, including camera studies of people, animals and so on. Portraits will be grouped in this division.**

**Division 2. Landscapes, including all scenic views, sea scapes, and so on.**

**Division 3. Action, including all types of photographs in which action is the predominating feature.**

## The Prizes

**1st. Three \$125 LONGINES, Coronation Model, Solid Gold, Men's Wrist Watches.**

**2nd. Three \$90 LONGINES, Presentation Model, Solid Gold, Men's Wrist Watches.**

**3rd. Three International Marketing Corporation PHOTO-TRIX "22" Enlargers, complete, less lens. (List price \$54.)**

**4th. Three Burleigh Brooks FOTH-DERBY Cameras, with built-in coupled range finders. (List price \$34.75.)**

**5th. Three WESTON No. 715 Exposure Meters. (List price \$24.)**

**6th. Three ABBEY Vimo Flash Guns. (List price \$13.75.)**

**7th. Three Raygram LEE Timers. (List price \$12.50.)**

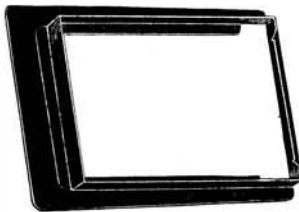
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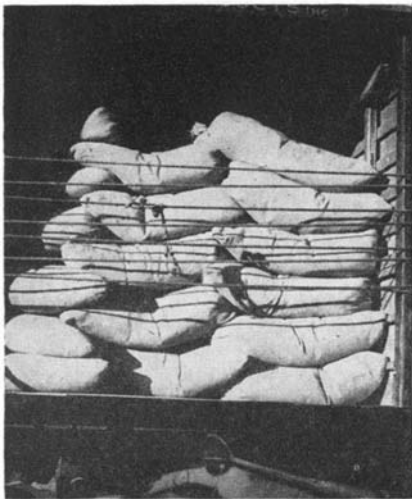


CAMERA ANGLES

the facts of color may be found in books, he advised his listeners, and the worker who essays color photography has three things to do: work hard, be reasonably intelligent, and acquire an appreciation for color values and relationships based on much study and experimentation.

"Red Light" Pictures

ONE way to while away the time of waiting for the red light to change to green so you can proceed motoring on your way, is to use the camera, as we have done in the reproduced illustration. We always carry our



"Red Light" picture

camera by our side so when an opportunity like this faced us, the late afternoon sun shining strongly on a truck load of bags of something or other, we aimed and banged away to get this study in strong contrasts. Often the subject-matter may be more striking, particularly when there is some human interest mixed up in it. It is always a matter of chance, of course, and you are very limited, but there is likewise the alternative of shooting if it looks good and saving your film if it doesn't. It's worth watching for, though, and the only way to make sure to get the good ones is to have the camera handy.

Freezing Out Glare

ASKED once to photograph a silver loving cup, after several other attempts had been made to get rid of the glare shooting out from various points on the subject, John H. Cornwall relates that he overcame the difficulty in a very simple manner. He asked and received permission to borrow the cup for four hours and upon reaching home placed the cup in the ice box. After remaining there for some time, the surface had acquired a nice matt coating, which was ideal for photographic purpose. Immediately after removing the cup from the icebox Mr. Cornwall set it up and photographed it, having previously made lights and camera ready for the

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**CAMERA ANGLES**

shot. The resulting print was so successful that he was able to sell quite a number of duplicate prints, totaling about \$75 for the job.

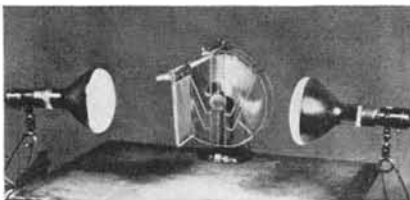
**Dry Negatives by Infra-Red**

WHEN seconds count, the "sealed-silver" infra-red heat lamps now available for drying negatives will do the job within two minutes. Radiating infra-red rays, the Birdseye lamp works without a reflector



Left: Clear glass and (foreground) "sealed-silver" heat lamps.

Below: Set-up for drying negatives using two lamps and a fan



because it has its own built-in reflecting unit in the form of a silver lining sealed inside the bulb. When directed at a wet negative, the rays penetrate through to the base of the film, according to the makers, and start the drying process from within, thus cutting down drying time considerably.

The illustration shows the method. The wet negative is suspended between two lamps placed about two feet apart. An electric fan is placed behind the negative to send a flow of air across the path of the rays on each side of the film.

"Old negatives that have been ruined by watermarks caused by improper drying can be restored," suggest the makers, "by re-soaking them for about 30 minutes in a suitable 'wetting' solution, rinsing them in water, and then drying with radiant heat lamps. The lamps can also be used in the same manner for drying photographic prints, and in many commercial applications such as for drying photographic solutions painted on glass. During the hot summer months especially, when solutions are slow in drying unless in an air-conditioned room, infra-red lamps do the work in a few minutes."

**Channeling Emphasis**

THE unfortunate tendency of many still photographers of trying to take in the whole business instead of concentrating on a portion of it, is to some extent a fault of many movie makers as well. "But I want to tell the whole story, give an idea of the whole works," the movie-maker might say.



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Our reply to that one is: You can tell a better story by picking out a representative segment than by including everything in the camera view. The most effective way of doing this, if you must give a picture of the whole business, is to panoram the many points of interest involved and then channel down to just one aspect and concentrate all your efforts on that one. The story will be much more effective than if you attempt to cover too much ground. Diffusion of interest results and, because emphasis is lacking, the story lacks punch and interest.

**Small Trimmer**

**F**OR general purposes, a trimming board that will accommodate the largest prints you make is, of course, indispensable. However, there are many occasions, as in the case of small contact prints for filing or other uses, when a smaller trimming board will be found more convenient. Every worker knows what a nuisance it is to cut a small strip of paper or trim a small print on a large trimmer. The task seems awkward and cumbersome; with a small trimmer it is easy. A small trimmer costs very little; in view of its handiness, it seems a good investment.

**Folding Prints**

**W**HERE it is desired to fold a print, as in the case of greeting cards, the usual recommendation is to employ one of the "documentary" type papers sold under varying names by the different paper makers. These papers are thin, however; double-weight papers are more desirable for cards. A simple method makes it possible to fold any paper without cracking at the fold. After determining the position of the wanted fold, take a straight edge and a razor blade or other sharp cutting tool. Place the straight edge and then cut carefully through the emulsion. A really sharp blade will do this without cutting too deeply into the paper base itself.



**WHAT'S NEW**

**In Photographic Equipment**

**NEW WABASH SUPERFLOOD BULBS:** Useful life of No. 1 increased from two to three hours, that of No. 2 from six to eight hours. Tests said to show new-type bulbs maintain efficiency better than old type; tendency of flood bulbs to lose considerable light output after prolonged use has been minimized.

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Three combinations: Set 5-A, Filters 1, 3, 5, 7, 10; Set 5-B, 2, 4, 6, 8, 9. Set 10-C, Filters 1 through 10. Filter selected to use over enlarging lens to produce contrast desired. Splitting exposure by using two filters each for half total exposure time extends range of contrasts obtainable.

**LEITZ COVER GLASS PLATES IN LABORATORY PACKING** (\$7): Package contains 600 Leitz Cover Glass Plates. Ground edges permit slides to be made with greater rapidity. New package offered as a convenience to professional and scientific laboratories and others who make large numbers of slides.

**SPEEDGUN MODEL F** (\$25, complete with two-cell battery case with extra segment for third cell, three battery cells, seven-inch adjustable aplanatic reflector and soft moisture-proof bag, L arm for attaching to



The new Mendelsohn Speedgun, Model F

camera, and all-metal cable release): Designed for use with Leica and Contax cameras. Uses L arm attaching-bracket, screwing into tripod socket, leaving accessory clip free for use of finders, and so on. Permits use of side, extension, and accessory lighting.

**EDUCATIONAL FILMS ON SWEDEN,** 16mm (lent free except for nominal handling charge): Distributed by Swedish Travel Information Bureau, 630 Fifth Avenue, New York City. Subjects cover various aspects of Swedish life. Available booklet lists films which are offered to universities, colleges, high schools, and other educational institutions, as well as to clubs, churches, and individuals. "Edited from abundant material received from Sweden," say distributors, the sound films are all provided with adequate and authentic commentary and musical accompaniment. The silent versions are provided with informative titles. All the films are non-political in character and aim only at presenting life in Sweden and the cultural and social development of its people. They are 16mm size and, unless otherwise indicated, are in black and white. They may be borrowed for single showings against payment of transportation costs both ways and a small handling charge to provide for replacements and repairs. Educational institutions are invited to write in regard to purchase copies or long-period rentals.

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(1st Lt. U. S. Marine Corps., Retired)

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**Boots to Fit the River**

**I**N some sections of the United States chest-high waders are the only sensible river apparel for the trout fisherman; in others, maximum satisfaction and comfort are to be found in hip-length boots. And we've seen many times when, whichever we had, we wished for the other, so now, on any extended angling trip where stream wading is a factor in success and pleasure, we take both the waders and the hip-boots. Often that procedure has brought satisfaction and fish which might not otherwise have been ours.

Carrying both waders and hip-boots to a trout stream is simpler than it would have been a decade ago. Modern leg protection in both styles is composed of more flexible material. So flexible are the boots, in fact, that they may be turned completely inside out down to the insole to permit thorough and complete drying, an impossibility with either the old-time, stiff, canvas waders or the board-like bottoms of early-day hip-boots. This pliability and lightness has contributed much toward reduction of fatigue on trout fishing trips. The saving of a pound or two in wader weight during a long day in the stream means as much to the angler as does the lighter field gun to the hunter who tramps hills and swales. Illustrative of this weight factor are the following figures: a pair of "old-time" hip-boots weighed upwards from 6½ pounds; a pair of Goodrich

"Litentufs" weighs 5½ pounds, in the same size; a pair of "old-time" waders, 7¼ pounds; 1941 style Goodrich Wader Top Boots, 6 pounds.

Like the most productive trout flies, the argument on boot-foot waders versus the stocking-foot type, plus wading shoes, goes on unabated and boils down to being largely a matter of personal preference. As we've noted, basic construction of fishing footwear has scientifically advanced



Save a pound—save energy

until today either style offers wearing qualities, comfort, and protection far in excess of the boots of our fathers. River water, however, is still as wet and as uncomfortable as of old, when it trickles down a leg. Today, thanks to his automobile, the fisherman is not restricted to working only one stream, and in a day he may pursue the phantom Lady Luck in many waters of varying conditions. With our pair of "hippers" rolled into a neat 8-inch bundle and tucked away in a corner of the car, it's no trick to change from waders to "hippers" at the stream-side during the heat of the day, or when our angling takes us into shallow waters.

We've an abundant supply of two interesting booklets by Goodrich Footwear Division of Hood Rubber Company entitled "Letters Found in an Old Tackle Box," and "How to Photograph Your Fishing Trip." They're free and full of information on boots and fishing. Want a couple?

**He Learned to Shoot**

**F**ROM C. M. Hawley, of Caldwell, New Jersey, came a note which read: "I am enclosing story of a little experience that came my way and think it may be of interest to



Old and new drying methods



many of your readers. The boy in this story thought he had made a new discovery; it was merely an old truth he had uncovered for himself." We believe Hawley's story so well typifies characteristics of good shooters that we reproduce it, as follows:

I met him one day while hunting for rabbits. A nice looking farm lad in his early 'teens, he was coming down a hedgerow and I could see he had game in his hunting-coat pockets, but no gun or dog in sight, so I stopped for a chat and inquired how he did so well without a gun. He told me he never hunted with anything but a handgun and produced a .22 automatic from a shoulder holster. This was interesting, and to learn more I asked if we couldn't work along together, to which he readily consented. A large brush pile in an old orchard produced a cotton-tail. Out came the Colt and in a flash the bunny flopped over and lay still, as pretty a shot as you could imagine.

In reply to my questions it seems the lad had had determination and not much else to begin with, but he won out over all handicaps. "I live in the country," he said, "and at times it gets pretty monotonous. But I have always had a great love for guns, especially the pistol, and my thoughts turned in that direction for entertainment, so, why not make a game of it? Why not try to become an expert wing shot?"

How to start was his problem. It had to be a way that did not cost much, and that meant an air rifle, and while practice of that sort was not what he had in mind, it would have to do, so he bought the best one he could afford, with lots of BB shot, and went at it for all he was worth.

"Nothing was a target unless it was moving," he explained, "and I think now the air rifle was just the thing at that stage of the game, because when shooting at a tin can against the sky, I could see the shot in flight and it helped to correct my aim so I was registering hits quite often, and that was encouraging.

"I kept this up until I was hitting the target nearly every time—then made the great discovery: I was *not* using the sights of the gun, just pointing and squeezing the trigger. I was tickled pink, for this was what was meant when they spoke of 'shooting by instinct,' the secret of pistol shooting at moving targets. It all made sense. Just like driving the car or tractor, you do not have to keep your mind on hands or feet—they do the thing the brain dictates, by instinct."

Deciding he would now graduate to powder burning, the lad managed the purchase of a single-shot .22 caliber pistol and all the ammunition the pocket book would stand. To take off some of the strain of throwing the targets, he rigged up a swinging target like those in shooting galleries, and as a variation he made a target

of an iron ball, suspended from the spring of an old curtain roller, to give it lots of jump.

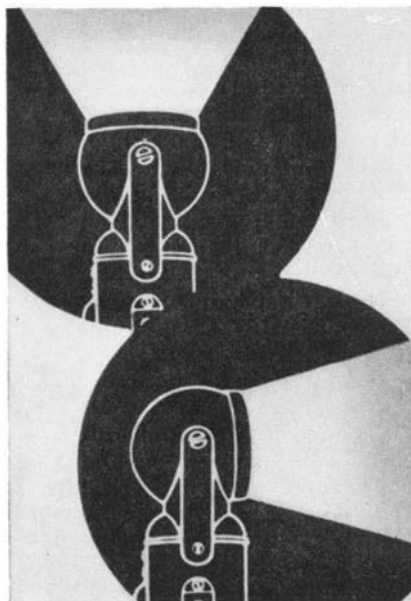
He practiced on all kinds of moving objects, such as rats and mice around the barn and corn cribs. "There's never a dull moment since," he said. "When I had enough confidence in my ability, I invited my father out to see me do some shooting. Well, he was properly impressed, and it cost him money. He bought me a .22 Colt automatic and a case of ammunition. I do all my hunting with this gun and I never shoot at any game that isn't moving."

The art of marksmanship at the present time is an accomplishment. The day may not be far distant when it will be a necessity, so if you like to shoot, get out the old gun, shine her up, and go to it. If you have the determination, you are a sure bet to win.—C. M. Hawley. [Has anyone else a story? Forum is open.—Ed.]



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**M**R. BARRETT is an instructor in photography and Mr. Wyckoff a practicing architect of over 35 years' experience. Such a combination should be enough to commend a book on the subject of darkroom building without any further comment, and a perusal of the book's contents, with its many clear and helpful drawings and photographs, confirms the first impression. Whatever your goal in the way of a darkroom, this book provides an excellent and reliable source for ideas and guidance. How-to-do-it instructions are included for building an apartment darkroom, a built-in darkroom, and making a de luxe photographic installation for both still and motion picture work. Various chap-

—OUR BOOK CORNER—

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## A Monthly Department for the Amateur Telescope Maker

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**P**ORTABLE telescopes are not uncommon but the one in Figure 1 has an uncommon feature—its weight may be shifted from wheels to legs; and, later, when it is desired to trundle it back home or indoors, the weight may be shifted back to the wheels.

W. H. Keister, 415 California Ave., Oakmont, Pennsylvania, is the maker and he says that, when he at first simply attached casters to the tripod legs, they proved too small and did not roll well. The retractable running gear consists of rubber-tired wheels from a boy's coaster, mounted on a U-shaped frame and hinged to the base of the tripod. To shift the weight to the wheels the handle on the U is raised, which also locks the U in position. A tongue for towing the telescope about is attached to the third foot of the tripod. The latter rests at all times on a caster. The telescope is a 6" reflector, of clean, solid design, and it weighs about 200 pounds. The finder is a second-hand, Navy gun sight.

**O**NE more of Walkden's "Richest-field" telescopes, an "RFT" of 6" aperture, made by Fred W. Forrester, 252 Lemon Ave., Arcadia, California, is shown in Figure 2. It has a hexagonal tube made of ¼" plywood. The eyepiece lenses are coated with fluorides, to eliminate the ghosts (optical ghosts, or ghost images). "I think the RFT is great," Forrester enthuses.

**C**LUB: Clyde W. Tombaugh, Lowell Observatory, Flagstaff, Arizona, the amateur telescope maker who found Pluto, in order to obtain 16" Pyrex disks for other amateurs at a relatively low cost, offers to sponsor a "Sixteen-inch Club" which, if it obtains 20 members within six months, will be able to purchase such disks at

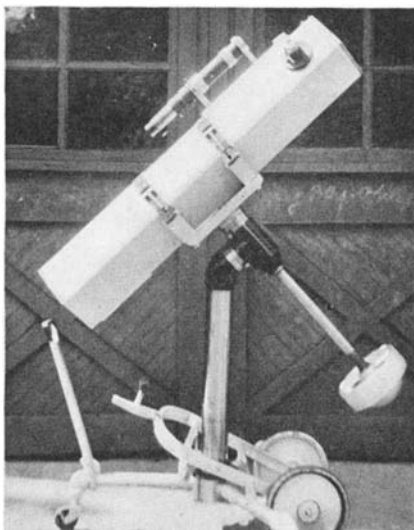


Figure 1: You trundle it

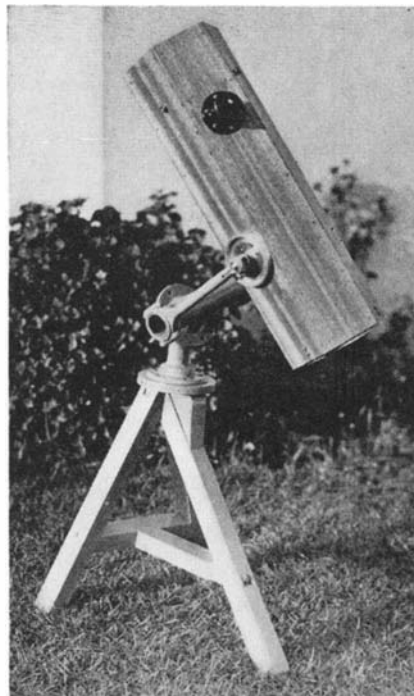


Figure 2: A hexagonal RFT

only \$35 each. Regular price for this size, solid type, where single disks are purchased, has been more than \$100 higher, because the high cost of producing single disks is chargeable mainly not to the glass or to the pouring, but to making the mold. Corning Glass Works, Corning, N. Y., has agreed with Tombaugh, the sponsor, that it will receive checks for \$35 each and hold the funds six months or until 20 orders have come in, then make the disks: failing this, refund the moneys. Three orders are lined up already.

Tombaugh has also ascertained that Pittsburgh Plate Glass Company, will supply 16" tool disks of 1¼" plate, boxed, f.o.b. factory at Ford City, Pennsylvania, at \$7.80 each.

There's a lot of difference between a 16" and a 20", not alone in weight of the disk, where the 20", if worked without a machine, is a real backache, but in bulk and cost of the mounting, for the mass ratio between the two is almost as one is to two (calculating from the cubes of the respective diameters). The 16" size should afford a pretty telescope, big, impressive, powerful, yet not too big. For many, a 20" is.

**S**TELLAFANE convention, Saturday, August 2.

**A**DVANCED amateurs and groups who are planning rather large reflectors will find a cleanly designed 24" described in Vol. VIII, No. 6, of the Publications of the Observatory, University of Michigan. This publication, while not available for general distribution, may be consulted at astronomical observatory libraries. The 24" (Figure 3) was designed by Robert R. McMath and George H. Malesky, of the staff of the McMath-Hulbert Observatory. The former is an amateur telescope maker and astronomer (motor car manufacturer) who turned professional and is widely known for his tower telescopes, his spectroheliokinematograph and other instruments, at Lake Angelus, Pontiac, Michigan, also for his educational motion pictures of the planets and of solar prominences. The new telescope will be used first for doing over these films, with the greater resolution it affords.

The skeleton tube is made of longitudinal struts of 13-gauge steel having box sections. The center ring is made of six pieces welded together in box section. The tube assembly has proved to be very rigid. The tube center section and cell are of 3/16" rolled steel with ring flanges, the assembly welded and thrice annealed.

The 24" Pyrex primary is an  $f/4$  and there are two secondaries of  $3\frac{1}{2}$ " and  $5\frac{1}{2}$ " diameter, to give, respectively,  $f/25$  and  $f/50$ . The primary was figured by Halley Moge, of the Perkin-Elmer Corporation, and tested by Dr. Heber D. Curtis, who reported it an unusually fine surface. The two high-magnification secondaries pre-

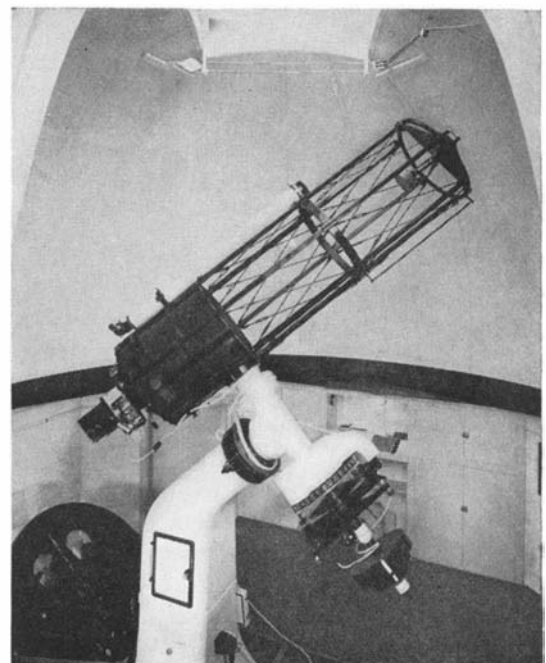


Figure 3: Reflector at Lake Angelus



sented real difficulties and E. L. McCarthy, now optical designer with the Perkin-Elmer Corporation but formerly an amateur (see "A.T.M.", page 389), feeling that the conventional tests were inadequate, proposed a new test which eliminates the combined testing of primary and secondary. This was used by Halley Mogyey to test the secondaries, and proved to be an unqualified success, according to McMath.

This new "McCarthy test," as we suggest it be known, is described by McCarthy as "A New Test for Convex Surfaces," in the *Journal of the Optical Society of America*, February 1941, pages 107-108, as follows:

**W**HENEVER the object or the image point of a reflecting surface is virtual, as in the case of a Cassegrain secondary mirror, testing is more of a problem than it is when both conjugates are real. Ideally, the test should permit a complete view of the surface at a convenient angular size; it should not involve large and expensive auxiliary pieces; it should not depend on slow measurement of zonal foci, but it should produce a simultaneous darkening over all parts of a perfect surface when a Foucault knife-edge is introduced.

"These conditions are reasonably well met by the system shown in Figure 4. Light from an illuminated pinhole passes obliquely through two plane-parallel glass plates to a silvered spherical mirror. Reflected first from the sphere and then from the large plate, the light converges toward the virtual focus of the secondary mirror, which returns it through the plate to a real focus at the knife-edge. These two foci, of course, represent the conjugates for which the secondary mirror is to be free of spherical aberration in actual use.

"Since the large plate has a considerable thickness, it introduces serious aberration into the beams of light diverging and converging through it. It is the function of the two small plates to cancel the unsymmetrical aberrations such as lateral color and coma. To effect this compensation, all three plates are of the same thickness, and the small ones are set at the same angle to the axis as the large one, but in the sense which restores the displaced axis. The longitudinal aberrations, such as astigmatism and spherical aberration, are augmented by the small plates and must be removed in a different manner. If the pinhole is displaced from the center of curvature in a radial direction, either toward or away from the spherical mirror, aberration is introduced of the proper sign to cancel the spherical aberration of the plates. Astigmatism is compensated by displacing the pinhole laterally with respect to an axis of the sphere, since the astigmatism in the field of a concave sphere is of the proper sign to cancel that of the plates.

"Obviously the conditions will be



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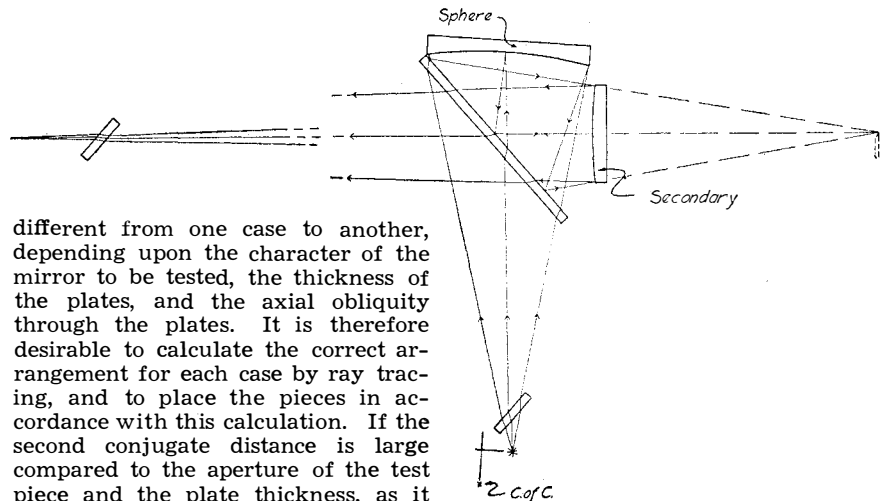


Figure 4: The McCarthy test

different from one case to another, depending upon the character of the mirror to be tested, the thickness of the plates, and the axial obliquity through the plates. It is therefore desirable to calculate the correct arrangement for each case by ray tracing, and to place the pieces in accordance with this calculation. If the second conjugate distance is large compared to the aperture of the test piece and the plate thickness, as it usually is in a Cassegrain, no calculation is necessary. Instead, the adjustments may be made by trial until the beam of convergent light reflected from the large plate is shown by the knife-edge test to be homocentric. In such a case, of course, the secondary to be tested is temporarily removed in order not to interrupt the beam. This method of adjustment assumes that the final passage through the large plate will introduce no appreciable aberration, and it is justifiable in the case of a slender emergent beam. Whether it is good enough for a particular case may be tested by examining the effect of the final small plate. If its presence or absence makes no observable change in the character of the final image, other than a displacement, the indication is quite definite that the trial and error method of adjustment is suited to the particular case, inasmuch as the aberrations of a plane-parallel plate are constant, no matter where it happens to be along the axis.

"An illustration is provided by two Cassegrain secondaries made for the McMath-Hulbert 24" telescope. Primary and secondary mirrors were made by Mr. Halley Moge, who also introduced improvements over the original idea of the test. The primary is  $f/4$  with a central hole 4.5" in diameter. The secondaries are 3.5" and 5.5" in diameter, and give magnifications of 12.5 and 6.5 respectively. The combination of large central hole, high magnification, and large unvignetted field made it impossible to see any error on the secondary mirrors when tested by the Ritchey method, even before any figuring at all had been done.

"The test pieces, also made by Mr. Moge, were a spherical mirror of 9" aperture and 24" radius of curvature, a plane-parallel plate of 12" diameter and 0.5" thickness, and two small plates 0.5" thick. The figure of the spherical mirror is required to be excellent; both sides of the large plate may depart from flatness by several waves, but should be parallel within a few minutes of arc; the small plates do not need a good figure. There are two unsilvered reflections, so that a fairly bright light source is necessary.

Either a mercury or a ribbon-filament incandescent lamp has been quite satisfactory.

"To make a Cassegrain secondary accurate to one tenth of a wavelength does not require tenth-wave flatness in the large plate. If its figure is roughly spherical, of very long radius, the astigmatism introduced by oblique reflection and transmission may be compensated in the manner already described for the normal astigmatism arising from oblique passage through a plane-parallel plate. If the figure is generally flat with residual zonal errors, such errors are readily separated from those occurring on the secondary mirror, since the former appear elliptical and the latter circular.

"In the present case, the first small plate was placed 1.5" from the pinhole and at an angle of 45° to the direction chosen as the optical axis. Elimination of astigmatism required an angle of 8.76° between the axial directions before and after reflection from the spherical mirror. A longitudinal separation of 2" between the center of curvature and the pinhole removed the slight spherical aberration. It was found that the last small plate was not required for either of these secondaries.

"In testing larger Cassegrain mirrors, some economies could be introduced. For instance, in the case just described, the test equipment is large enough to show the complete secondary. An arrangement permitting an unsymmetrical view of about two thirds of the surface would involve test pieces scarcely larger than the secondary itself."

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In the course of our search the Committee will welcome sincere and bona fide assistance. Should your interest in the psychic lead you to try to discover for yourself a basic, truthful, scientific explanation, you will wish to follow the reports of the Committee as they appear in ensuing issues of Scientific American. For correlative reading, the books listed on this page will be found informative, helpful, and interesting.

—The Editors

## Books on Psychic Phenomena



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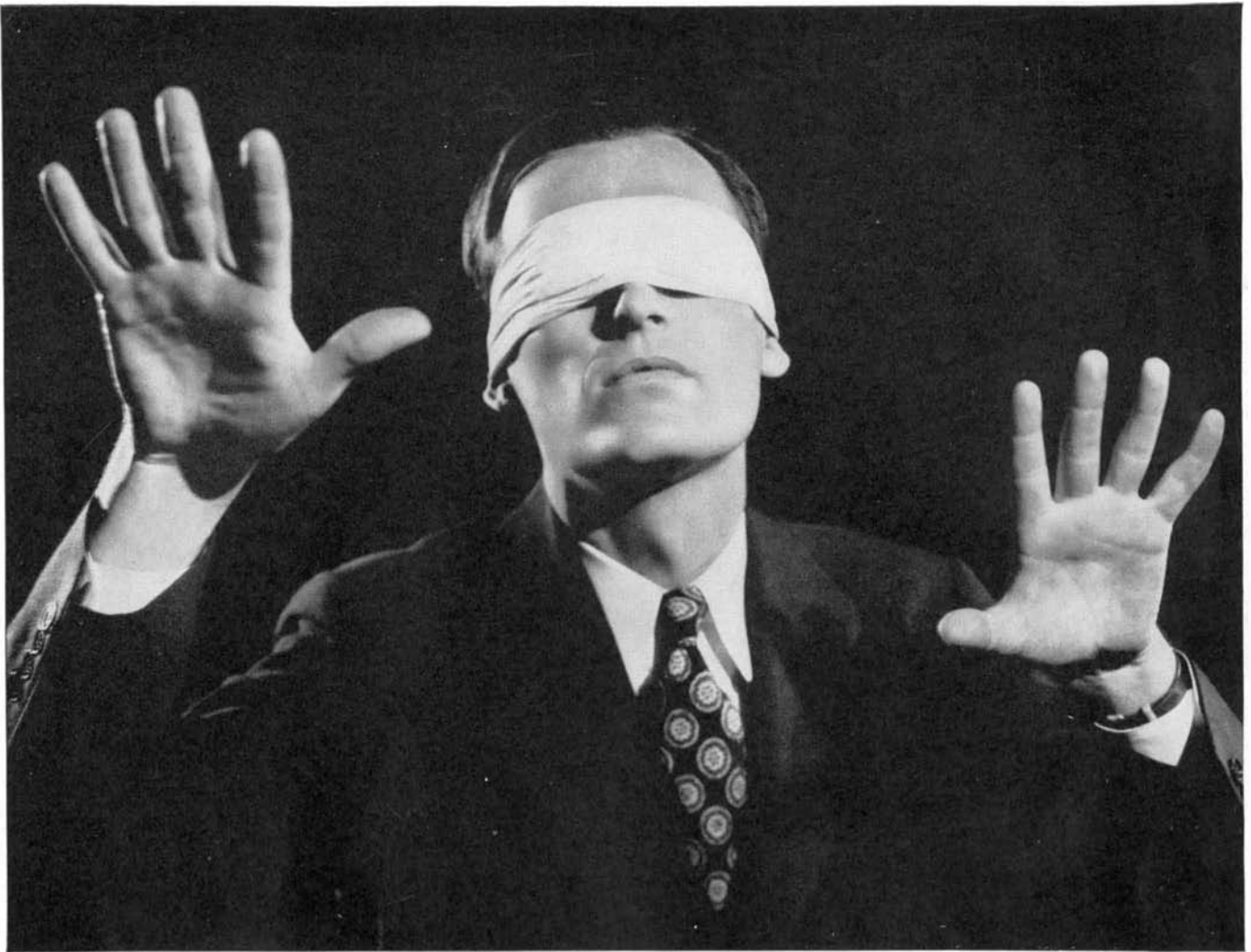
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New York, N. Y.



## WHITE COLLAR MEN ARE STILL A DIME A DOZEN!

**L**OOK around your office. A few men have "arrived". They are the executives, earning big money. The others are what the top men in the company call "white-collar workers"—able, conscientious, hard-working—perhaps with specialized training, but they are nevertheless figuratively worth a dime a dozen.

**WHAT'S THE DIFFERENCE** between the executive and these "white-collar workers"? That's the question being asked by men who have hopes . . . men who want to climb out of the rut and into the top-flight class themselves. The answer is—*there's very little difference!*

Has the man who makes \$5,000 twice as much brains as the man who makes only \$2,500? Has the man who makes \$10,000 twice as much brains as the man who makes \$5,000? Of course not! And it would be amazingly easy for *many men* to transform an average salary into a large salary!

**HOW IT'S DONE!** The difference between success and merely "getting along" lies in executive training. In the old days, successful executives had to gain their ability through

long years of experience. But as business became more complicated, educators became business-minded. Many big universities added schools of business; the Alexander Hamilton Institute was founded—and since then has pointed the way to success to more than 400,000 men!

**HOW YOU CAN DO IT.** The Institute has organized and formulated the knowledge of the country's most successful business men. Co-operating with it are dozens of leaders like Edward R. Stettinius, Alfred P. Sloan and Thomas J. Watson. As a result, the Alexander Hamilton Institute offers you modern, up-to-the-minute training and information you would almost have to give your right arm to gain by any other method!



**CUSTOM-MADE TO SUIT YOUR NEEDS.** Please get this fact clear in your mind. *The Alexander Hamilton Institute offers a PERSONAL service, geared not only to YOUR particular needs, but to your particular needs TODAY—whether you are a young man just earning his first business laurels, or a busy corporation official who wants to keep up with rapidly changing economic conditions.*

**PUT IT UP TO US.** Why not prove to yourself that you have the first quality of an executive—the ability to make a decision? Write us for a free copy of that important little book, "Forging Ahead in Business". For many men this simple act has been a major turning-point in life!

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### Alexander Hamilton Institute, Inc.

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Please mail me, without cost, a copy of "Forging Ahead in Business".

Name . . . . .

Business Address . . . . .

Position . . . . .