SCIENTIFIC AMERICAN

SEPTEMBER · 1940

Photograph by Robert Yarnall Richie

Vol. 163 No. 3

Freak Battleships — See Page 130

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CARL SANDBURG

IN A RECITAL OF AUTHENTIC
AMERICAN FOLKSONGS FROM HIS COLLECTION

"THE AMERICAN SONGBAG"

Gallows Song ("Sam Hall")
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The Horse Named Bill
I'm Sad and I'm Lonely
Woven Spirituals
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"The vast audience who have heard Carl Sandburg sing these songs at intimate recitals in the colleges and clubs of this country, the students who have studied his poetry, the numberless owners of copies of 'The American Songbag' know how personal is his art. For those who have never heard these songs as Carl Sandburg performs them, we can but list the titles and advise that, no matter how familiar the individual song, you will agree that you have never heard the depths of folk music sounded until you have heard them sung by Carl Sandburg."—Musicraft.

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Album To	*Subscription To*
Name	Name .....
Address	Address .....
City and State	City and State .....

SA

WHEN OIL-WELL drills strike really hard going in rock or tightly packed shale, rock bits, such as those shown on our front cover, get the assignment (see also page 134). These bits consist of rollers which rotate on bearings as the drill pipe spins, the teeth chipping away the rock as they revolve.

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SCIENTIFIC AMERICAN

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NINETY-SIXTH YEAR • ORSON D. MUNN, Editor

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SEPTEMBER • 1940

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50 Years Ago in . . .

SCIENTIFIC AMERICAN

(Condensed From Issues of September, 1890)

EIGHT-HOUR DAY—"The House of Representatives has recently passed a bill ordaining that eight hours shall be considered a day's work for all laborers, workmen, and mechanics, now or hereafter to be employed by the government."

MONEY—"Congress ought to issue a sufficient amount of fractional paper currency to facilitate exchange through the medium of the United States mail. The people found it useful, and it never ought to have been abolished."

SINKING WOOD—"There are 413 species of trees to be found within the limits of the United States and Territories, 16 of which, when perfectly seasoned, will sink in water. . . All the species heavier than water belong to tropical Florida or in the arid West or Southwest."

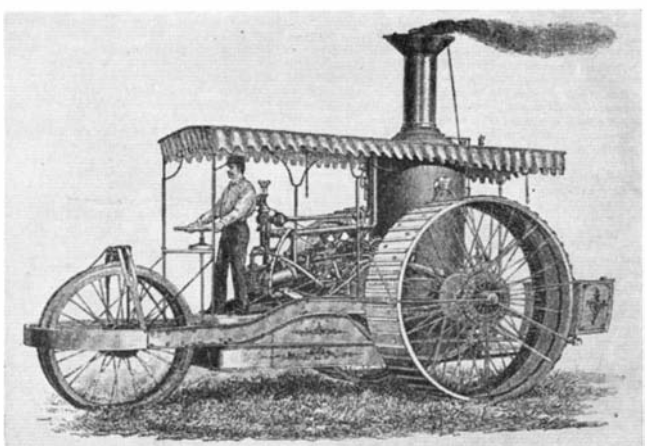
MACHINES AND LABOR—"The successful introduction of typesetting machines into a number of newspaper offices in the United States has greatly stimulated their competitors, and early in the autumn the New York *Sun, Times, World,* and other papers will commence their use. It is also said that the *Herald* will employ them. . . A member of New York Typographical Union No. 6 says: 'Of course, some members of the Union are a little skeptical as to the benefit these machines will be to the followers of the craft, but the whole history of labor-saving machinery teaches us that nothing has yet been invented that has lessened the need of good workmen.' "

COMPOSITIONS—"A new mode of treating hemp, jute, and other fibers for making materials for the manufacture of tiles, slabs, cisterns, boats, and other articles or structures has been described in a recent patent specification."

WATER POWER—"Cataract Construction Company has secured a large area of land (several square miles) on the Niagara River, beginning a mile and a half above the falls, and all rights of way for carrying a tunnel under Niagara Village to a point below the falls. The general plan is to construct a tunnel about 27 feet in diameter from a point below the falls to the upper limit of the secured property. This tunnel will have lateral branches at a depth of about 100 feet from the surface, into which will be sunk numerous vertical shafts at the points where power will be required. . . A system of surface canals will bring the water of the river to the heads of these shafts, and its action on turbines at the lower ends of the shafts will develop about 150,000 horse power. The amount of water diverted for this purpose will be a small fraction of one per cent of that going over the falls."

BROKEN NECK—"Physicians connected with the Presbyterian Hospital are highly elated over the fact of their having successfully mended a broken neck. The patient, aged fourteen years, fell from an elevator, landing on his head and dislocating his neck. When brought to the hospital the case was considered hopeless, but by experiments with extending weights attached to the patient's head and feet the neck was eventually set and kept in place by means of a plaster of Paris jacket. The displaced bones are now properly set and the patient has full power of the neck."

STEAM TRACTOR—"Among the latest machines designed for use on large farms is the new field locomotive of Jacob Price, of Racine, Wisconsin, illustrated herewith. It is said that this machine pulled, near San Leandro, an outfit of twelve 11-inch plows in a dry, adobe soil, traveling at the rate of over four miles per hour in doing so, and maintaining the steam pressure at 130 pounds, without difficulty. It will pull as much as 40 or 50 horses, besides propelling itself. Its weight is only 8½ tons. . . The carrying wheels are about 8 feet high and 26 inches wide. The steering wheel is 5 feet high and 14 inches wide. . . It is adapted for plowing, running combined harvesters,



freighting with wagons, hauling saw logs, or pulling of almost any kind, and is suitable for any stationary work, such as running thrashing machines, sawmills, etc."

SPEED AFLOAT—"The torpedo boat *Adler,* constructed in Germany for the Russian Black Sea fleet, is described by the Russian papers as the fastest war vessel afloat, having attained during its trial trip a speed of 26.55 knots. . . The boat is 150 feet long and 17 feet broad, with a displacement of 150 tons. . . Three gunboats, one of which—the *Narghen* —is finished, are being constructed in German shipyards for the Baltic fleet, and these will be almost as fast steamers as the *Adler.*"

MUSIC FROM AFAR—"An interesting and really notable musical and vocal entertainment was given recently from New York to a very large audience assembled at the Grand Union Hotel, Saratoga, by means of a 'long distance' telephone circuit running a distance of 180 miles from 18 Cortlandt Street, New York, to Saratoga. . . From Cortlandt Street a circuit had been run to the Madison Square Garden, and the concert being given by the Strauss orchestra was taken in alternation with the other numbers of the programme. The orchestral music was listened to at Saratoga by means of sets of hand telephones, and every note was heard distinctly, even to the applause of the audience gathered at Madison Square. . . Some of the songs and solos and the recitation were heard all over the room at Saratoga by means of a single loud-speaking receiver provided with a large funnel-shaped resonator to magnify the sound."

Personalities in Science

DAVID BURPEE

A TRADITION has grown up in the life of David Burpee, internationally known plant hybridist and seedsman—a tradition centering around a 33-year search for a yellow sweet pea. He hasn't found or produced it yet but, oddly enough, has given to the world other improved yellow flowers.

Mr. Burpee was born in Philadelphia, Pennsylvania, April 5, 1893. He was educated at Blight School, Philadelphia; Doylestown High School; Culver (Indiana) Military Academy; and the Agricultural College, Cornell University. His father gave him the choice of Cambridge (England) or Cornell, and young David, who had traveled many times to Europe, paid a special visit to Cambridge before selecting Cornell.

David Burpee started on his career to achieve new flowers for American gardens as a youth of 14 and has contributed much to floriculture. He has been very successful in producing new strains of petunias, zinnias, marigolds, and calendulas, but has not yet achieved that which started his deep interest in horticulture: the production of a pure yellow sweet pea for which his father, founder of the W. Atlee Burpee Company, offered him a reward of $1000. To a young schoolboy, this sum looked like stupendous wealth.

At the Burpee seed farm at Lompoc, near Santa Barbara, California, young David and his brother, whom he had inveigled into joining the search, trudged up and down, row after row of the 400 acres of sweet peas hoping to find that Nature might have done the trick and turned up a yellow break. No luck there, so he avidly read book after book on genetics and plant breeding, obtained seeds of over 150 species of the sweet pea family from all corners of the globe, grew them at his Fordhook Farm near Doylestown, Pennsylvania, and the following summer pollinated hundreds by hand — a back-breaking task. Today, 33 years later, he is still trying to produce a yellow sweet pea.

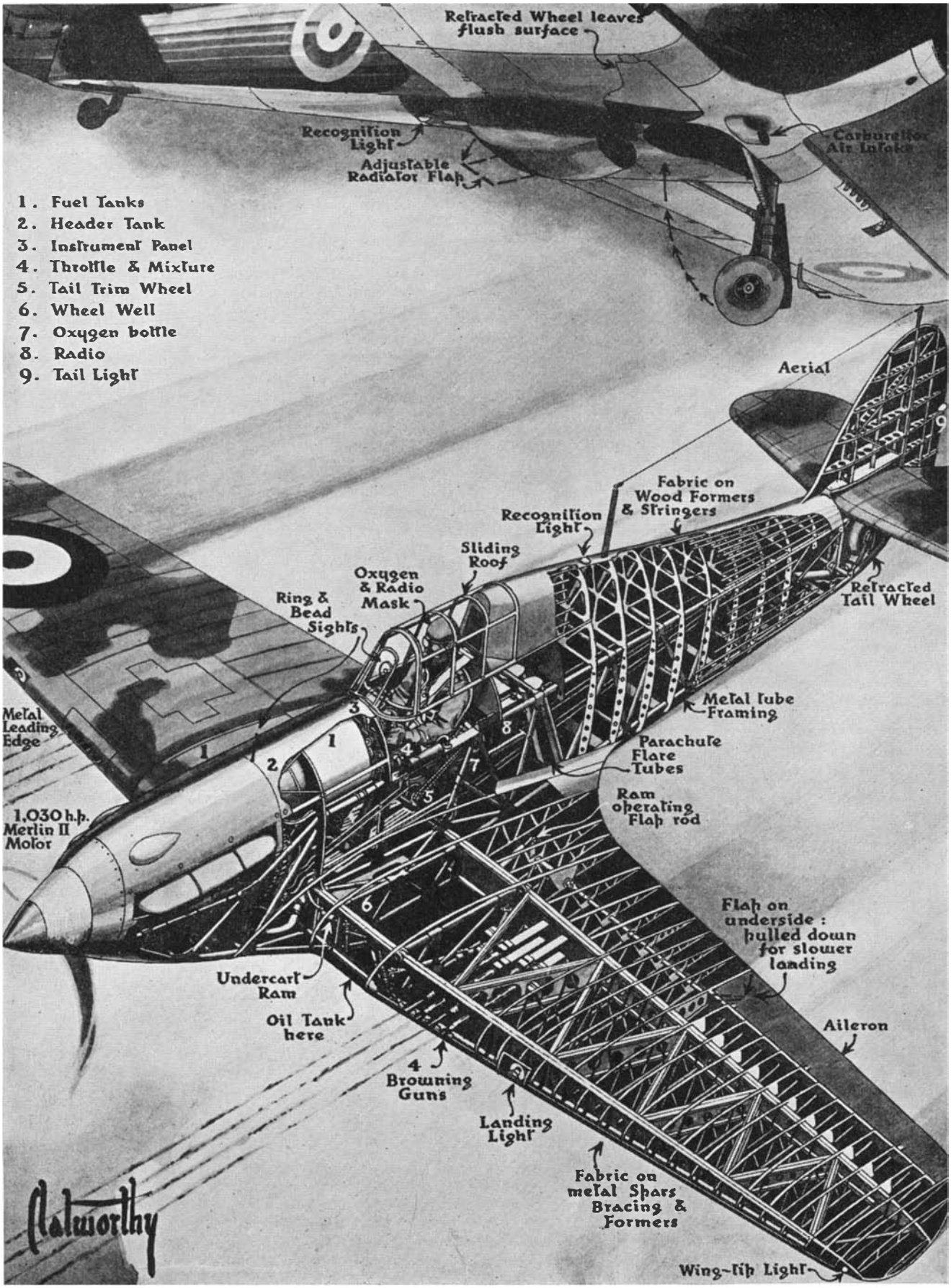
At 21, he was assistant to his father in their seed business and a year later became General Manager. Three years after first joining the company, he became President when it was incorporated in 1917. Among his other interests, he is Director of several banks and trust companies; has served as vice president and president of the American Seed Trade Association; is Vice President, National Sweet Pea Society of Great Britain; Honorary Life President of the Canadian Society of Philadelphia; director or trustee of several hospitals, horticultural societies, and the like, and is a member of prominent clubs.

"Flowers have fashions just like clothes," Mr. Burpee says. "In the old days, gay blossoms forming a hodge-podge of color were the garden vogue but, today, we want color in mass whether it be soft pastel shades or vivid hues, and it is the production of these 'fashion flowers' that keeps the hybridists and plant breeders busy."

David Burpee was the first to produce a big marigold with truly odorless foliage, the first double red hybrid marigold, and the first double nasturtiums in all colors.

The first super-double nasturtium, having 75 petals, was another of Mr. Burpee's floral successes. He purchased seed of the original Golden Gleam, grew them at the company's Floradale Farm, Lompoc, and crossed them with 40,000 other nasturtiums in the hope of producing a new flower. Finally he was successful and the first seeds and cuttings—so heavy was the demand that the supply of seeds alone was inadequate—sold for 10¢ each which was an unheard of price for nasturtiums.

What a vast story of adventure, hard work, and disappointment lies behind each of Mr. Burpee's floral achievements! His aim has always been to work with and produce fool-proof seeds that would grow in any garden rather than to experiment with rarer flowers with which the average gardener would be apt to have great difficulty.



A HAIL OF LEAD FIRE OVER ENGLAND

THIS British "Hurricane" fighter is a formidable opponent. Eight Browning guns, mounted in the wings, are aimed by "aiming" the plane, and fire a total of 2400 rounds in 10 seconds. Speed of the plane is 340 miles per hour (recently increased 10 percent); ceiling is seven miles; and cruising range 600 miles.

COAL TAR BEGAN IT

Vast Increase in U. S. Organic Chemicals Industry

CHARLES M. HACKETT

In 1919, the Committee on Finance of the United States Senate weighed a serious question: should the government "promote the establishment of the manufacture of coal tar products in the United States." Before the group appeared a distinguished witness, Dr. Marston Taylor Bogert, senior professor of the Department of Chemistry at Columbia University.

Dr. Bogert painted no rosy picture. He described organic chemical research in this country at that time as being "on a fragmentary basis." Further, he noted that such a development would have far-reaching consequences in bolstering the national defense.

"Gentlemen," he testified, "I have no hestitation in saying that a well-developed synthetic dyestuffs industry is absolutely necessary for the security of our country."

In two decades the significance of that testimony has re-shaped the American industrial pattern.

Dr. Bogert did not mean that America had no chemical industry. As early as 1865, the value of chemicals produced in this country was about $60,000,000. In 1910, the United States produced three times as much sulfuric acid as Germany, and twice the alkalies produced by England. The value of chemical products in 1914 was quoted by the U. S. Census of Manufacturers as in excess of two billion dollars. Satisfactory progress had been achieved in acids for the steel and fertilizer industries, and other so-called "heavy chemicals."

The noted professor's concern was caused by the fact that the World War, then just concluded, had disclosed a woeful lack of both the knowledge and manufacturing facilities required to produce many essential materials that could only be made by greater knowledge and application of organic chemistry.

The situation described by Professor Bogert led to an intensive program of chemical research which, in less than a quarter of a century, has produced one of the

SCIENCE IN INDUSTRY

greatest organic chemical industries in the world, and which still seeks new knowledge and new ways of applying the products of this industry to the everyday lives of millions of people in this and other countries. Evidence of this continued search may be found in the report that the American chemical industry spent an estimated $20,000,000 on research in 1937, alone. Only the steel and petroleum industries are said to provide for comparable expenditures.

Organic chemistry has synthesized the dyes, textile fibers, pharmaceuticals, flavors, perfumes, and scores of similar products which have caused some to designate the present as the Chemical Age.

This industry is a substantially 100 percent American development. American initiative has directed its course, the methods employed in building it up were American methods, and it has been financed by American capital. This does not mean that we have not profited from foreign developments and foreign experience. We have, and gratefully acknowledge it.

The organic chemical industry now ranks close to the top of American enterprise. It has promoted the growth of new industries and stimulated many older ones. It has brought the good things of life to more people, and it has bulwarked national self-sufficiency.

No one alert to contemporary developments need be told of chemistry's importance. But the *rate* of growth is impressive to the most casual observer.

In 1914, we made only about 10 percent of the dyes we used, and even that small amount was based on imported intermediates. In 1938 we produced some 96 percent of the dyes consumed in this country, and had an export balance of more than five million pounds.

Since 1919, when organic chemicals manufacture was in its infancy here, countless new products have been developed. Of those known in 1919, U. S. production has increased steadily. The average *annual* increase in flavors and perfumes between 1919 and 1937 was 29 percent; in photographic chemicals, 22 percent. Total coal tar finished products showed an average annual rise of 18 percent. In the 17-year period 1921-1937, production of non-coal tar organics—including synthetic methanol and other alcohols, acetic acids, acetone and various amines—showed an average *annual* growth of 685 percent!

Americans past the age of 30 may grasp some idea of the significance of the above figures if they compare the increases with that of the automobile industry, whose products they have seen filling the streets with more and more cars year after year, and for which they have watched broad ribbons of highways built from coast to coast. Yet the average annual increase in automobile production between 1919 and 1937 was but 9.6 percent, as compared with the spectacular rise in various organic chemicals. That the rise has been less noticed may be accounted for by the fact

that the products of chemistry, for the most part, remain hidden and do not add to traffic problems.

With this accelerated production have come price declines as phenomenal as manufacturing increases. The average price of coal tar products dropped between 1919 and 1937 from $1.02 a pound to 41 cents; coal tar dyes from $1.07 to 55 cents. Flavors and perfume chemicals fell from $2.27 to $1.02. Phthalic anhydride, used in the manufacture of alkyd resin finishes and certain dyes, is available today at 15 cents a pound, although it was around $6.00 a pound in 1917. Production of this important industrial chemical during 1939 is estimated at 60,000,000 pounds.

Plant where several well-known organic chemical products are made — du Pont plant at Deepwater, New Jersey. Note many buildings

Certain inorganic chemicals used in making organic products have likewise enjoyed important price reductions. During the 1919-1937 period, sulfuric acid dropped in price about 31 percent; caustic soda nearly 45 percent.

These advances in production and reduction in prices have affected the lives of virtually every American, and have created a high degree of dependence upon organic chemicals. They pervade nearly every aspect of contemporary life, and fundamentally affect our national economy.

This development stretches into the nerve centers of the country's economic system. It has provided jobs directly for thousands of workers—how many thousands it is difficult to compute. Countless additional employment avenues have been opened up by providing raw materials for many new industries. Dyestuffs, pharmaceuticals, and plastics provide conspicuous examples. Some products in these classifications have been made for many years, but in a larger sense they represent new industrial entities.

Plastics of the nitrocellulose type have been known and employed since 1869 (Celluloid), but the modern plastics industry with its versatile performances could not operate without a plentiful supply of organic chemicals. Acetic acid, synthetic camphor, and phenol could be cited. Formaldehyde and urea, a gregarious pair useful either in harness or singly, are found in a variety of well-known plastics.

The industrial importance of camphor may be emphasized by its use in motion picture film, which demands more than a half-million pounds a year. Camphor was controlled by a Japanese monopoly only a few years ago, and under Japanese domination the price of refined natural camphor went to $3.55 a pound in 1920.

TODAY refined synthetic camphor is selling for about 60 cents a pound, while the technical grade used in plastics and photographic film sells for around 35 cents. American chemists have learned to make camphor from southern turpentine. It is of high quality, chemically identical with the product long sacred to the fragrant forests of Formosa. The Du Pont Company is supplying more than half the total domestic consumption of this important material.

Imported urea cost about 57 cents a pound, corresponding to more than $1100 a ton, in 1920. Now urea of equal or better quality derived from carbon dioxide and ammonia sells at the plant for $85 a ton—and a domestic source furnishes practically every pound of urea consumed in this country.

New materials for making wholly new plastics have been found. The sparkling "Lucite" methyl methacrylate plastic with its extraordinary toughness, beauty, and optical properties, is a notable example. In fact, the entire modern plastics industry is the precocious child of organic chemistry.

Still other organic chemicals, synthesized to meet definite specifications, have likewise aided development of new industries. The "Freon" fluorinated hydrocarbons afford an excellent illustration of such made-to-order products. Not only is "Freon" an excellent refrigerant, but it is non-poisonous, non-explosive, and non-flammable. This combination of properties lent great impetus to air-conditioning. This new type of refrigerant is widely used today in the air-conditioning units of theaters, hotels, office buildings, and railroad trains.

Of outstanding importance in the manufacture of rubber goods are the new and improved organic accelerators, anti-oxidants, sun-checking inhibitors, and agents which nullify the destructive influence of slight traces of copper. The fact that today's automobile tires give some 25,000 miles of service in comparison with 5000 miles only a few years ago is due in no small degree to the use of such organic rubber chemicals.

Synthetic rubber-like materials developed within the past few years have been accorded a hearty welcome by fabricators of rubber goods. Although different in composition from natural rubber, the physical properties of certain of these synthetic materials are similar to those of rubber. At least one of these new materials—neoprene —has qualities not found in the natural product, including resistance to oils, greases, chemicals, sunlight, and oxygen. It fills hundreds of needs that natural rubber cannot fill, and this chemical rubber is based on abundant domestic raw materials — coal, limestone, and salt.

Discussion of the role of organic products would be incomplete without reference to rayon. This country produced some 288,000,000 pounds of rayon in 1938; the more recently developed products such as "Vinyon" and the polyamides known as nylon open promising horizons.

The work that organic chemicals have performed in the automobile

industry has become classically familiar, although it often is not thought of in terms of chemistry. Nitrocellulose lacquers, developed about 1921, represent one of the greatest contributions. By cutting down finishing time with orthodox enamels, durability had been sacrificed, but the nitrocellulose lacquers are both quick-drying and durable.

The recent development of polyvinyl acetal plastics has a direct bearing on the automobile industry. For many years safety glass for windows and windshields was made with an interliner of nitrocellulose or cellulose acetate plastic, but last year it was found that an interliner of a certain type of polyvinyl acetal plastic has definite advantages over the cellulose plastics, This new type of plastic is extremely tough and elastic not only at ordinary temperatures, but at low temperatures as well. It is for this reason that the polyvinyl acetals—products of the organic chemical industry—make possible the safest safety glass ever made.

Synthetic organic chemicals find numerous important applications in the manufacture and use of petroleum products. Cracking processes have had the effect of doubling national oil reserves as far as gasoline is concerned. On the other hand, cracked gasoline in storage has a tendency to develop gums which lead to clogging of motor and fuel lines. Certain organic chemicals, however, have substantially eliminated this tendency.

In the manufacture of perfumes, materials known as "fixatives" are used. One of their functions is to make the odor more lasting. Until a few years ago, all fixatives were of animal origin, such as the musk from a species of deer in Tibet. The characteristic ingredient of natural musk, if it could be had in a perfectly pure state, would probably be worth its weight in gold several times over. Within recent years, however, synthetic musks have been developed, and at least one of these new organic compounds is substantially identical with the characteristic ingredient of natural musk. These sell at a fraction of the cost of the natural product.

Stills used in making synthetic camphor from CO_2 and ammonia

To the enrichment of American harvests, the organic chemical industry has made many notable contributions. Urea, a synthetic nitrogenous chemical, not only finds application in plastics, but also as a fertilizer ingredient. Organic mercurials are being used successfully for the control of various plant diseases caused by fungi, and the long-chain alkyl rhodanates are combating the ravages of sucking insects on certain agricultural crops.

Nowhere have organic chemicals played so vital a role as in the prevention and cure of disease.

Not long ago a little girl was stricken with a much-dreaded streptococcus infection. Her terrified parents were astonished to see their physician view the danger calmly.

"Now," he said, "we have a new weapon for such infections—sulfanilamide."

The little girl got well.

Although introduced into the materia medica only a few years ago, this coal-tar derivative has already saved the lives of thousands suffering from "blood poisoning," peritonitis, streptococcic sore throat, puerperal or childbirth fever, meningitis, and other dangerous maladies resulting from streptococcic infection.

Fundamental research in such sciences as chemistry, physics, biology, and pharmacology are believed to hold the key to the great medical developments of tomorrow. Chemotherapy, itself fully as important as the first work of Pasteur's laboratory, is nurtured by the organic chemical industry. A long list of new organic compounds awaits the attention of the research workers in pharmacology and experimental medicine. Pharmacological development will continue to be supported to an increasing degree because of the chemical manufacturing industry's growth.

The research chemist has established the constitution of certain of the hormones. These little-understood secretions of the ductless glands in some degree affect the functioning of the mind as well as regulate the chemical reaction of the body. Some of these "chemical messengers" have now been synthesized in the laboratory. Developments in this field offer promise of cure for certain mental ills which have baffled medical science for ages.

Packing synthetic camphor as it leaves the flaking machine

• • •

Breath of Industry

Oxygen Torches Cut, Condition, and Prepare Steel; Drill Stone and Concrete

HAROLD LAWRENCE

THE air we breathe is being used in some mighty strange places. More particularly, the oxygen of the air supports many industries just as it supports us. Steel is being conditioned with the aid of oxygen. Steel plate edges are prepared for welding by this same gas. Precise shapes are being cut with oxygen, replacing a multiplicity of machine tools. Steel structures are prepared for painting with the oxy-acetylene de-scaling tool. And both concrete

Oxygen flame rapidly cleans steel surfaces for painting

and rock are being drilled in this same manner.

Most of the oxygen being used in these new industrial operations is separated from the air. Yet in some cases where there is an outlet for hydrogen, too, as in the packing industry, oxygen is obtained from water. Whatever the source, the utmost in purity is demanded. The oxygen used for cutting must be every bit as pure as that used in hospitals; 99.5 percent or more pure. If it takes 100 cubic feet of 99.5 percent pure oxygen to do a specific cutting job, it will take 160 cubic feet of 97.5 percent pure oxygen to do the same job. And that's the very reason that causes engineers, cost accountants, and production men to watch the purity of the oxygen with an eagle eye.

One of the most spectacular applications of oxygen has taken place in the steel industry. Here, conditioning of blooms and billets has always been a costly and slow operation. When steel is poured from the ladle into an ingot mold, some splashing occurs. Such splashed steel sticks to the mold walls and leaves a scab on the rolled product. Furthermore, cracks and laps and laminations as well as other surface defects may show up during the rolling of the steel. So just before the final rolling operation, inspectors go over every inch of the steel surface looking for these defects; finding them; and marking them for removal. There on the billet dock—where semi-finished steel is inspected—the skin of the steel is given a beauty treatment.

No doubt few of you have ever stood on the billet dock of a steel mill listening to the roar of hundreds of chipping guns. The roar ebbs and flows and grows until you feel sure that your ear drums will burst. If you have never heard this awe-inspiring sound, you never will. The almost soundless hiss of a small stream of oxygen has silenced the roar forever. Chipping guns have been scrapped. Men's nerves aren't jarred by bucking air-hammers all day long. Steel conditioning costs are down. Production speeds are up. And, despite the tremendous quantities of oxygen being removed from it every day, the air still remains one-fifth oxygen.

Perhaps one might think that the introduction of flame scarfing to replace slow chipping operations on the billet dock satisfied the steel men. No; the increased speed and lower costs made these men eager for more improvements. Out of the oxygen research laboratories they came. No longer did the steel blooms and billets have to cool in endless rows and piles before getting their skin treated. Now the glowing steel thunders from the hot shears to a peculiar looking device whose many-fingered arms nestle into place. A control is operated. Hundreds of jets of oxygen open, bathing the unhealthy skin from the steel.

THE octopus device draws back its tentacles. The steel rolls and bounces down the roll table to the reheating furnaces where it will be reheated for the final rolling operations. Note that the steel can be charged into the reheating furnaces hot instead of cold; the heat locked up in the steel isn't wasted. Thus fuel consumption per ton of steel produced was reduced a little more. The process of removal of slight surface imperfections, known as steel conditioning, was modernized. Production no longer remained at the mercy of the snail-like conditioning operation. Pure oxygen changed all that.

But the steel industry is not the only industry to benefit from research into the industrial application of oxygen. When boiler and pressure vessel manufacturers progressed from riveted to welded construction, old-time boilermakers hung up their riveting guns with a sign of relief. The ungodly clatter was over. A good riddance, too. But along came construction codes such as that sponsored by the American Society for Mechanical Engineers demanding the removal of the unwelded zones between the two sides of a weld, these zones being necessary to hold the molten metal temporarily.

Down came the air-hammers. This time they would be used to drive diamond-point chisels. Back came the racket and the roar—the same unnerving noise that had made such a bedlam of the steel billet dock. But not for long.

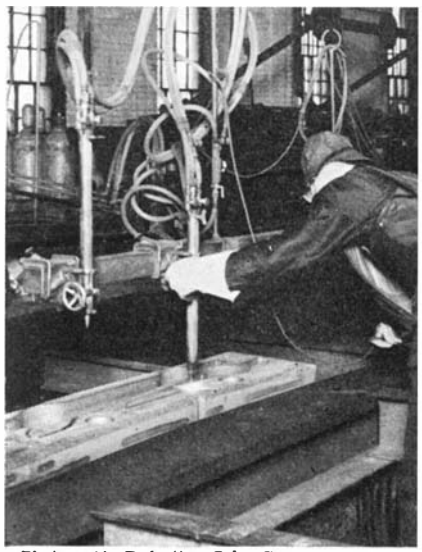
Oxygen men were not ready to ring down the curtain on another possible application of their equipment. So flame-gouging was born. The same oxy-acetylene preheat flames backed up by a low-pressure stream of oxygen, delivered through a special nozzle, would do the work of the diamond-point chisels. Not only would the oxygen *do* the work, but best of all, it would do it both faster and cheaper. So, again, away with clang and clatter! Quiet oxygen would soothe frayed nerves! And lo and behold, overall plant efficiency increased almost 15 percent in one plant—attributable to noise elimination alone.

As the pressure vessel industry grew, demands were made for heavier and heavier plate. Economical welding procedure demanded U-shaped welding grooves. Until quite recently the only tool for making these welding grooves was a plate planer. About the only objection some shops had to the installation of a plate planer was the cost. For a good plate planer costs more than eight times as much as the most expensive oxygen bevelling equipment. Back to their researches went the oxygen men. And out of their work came efficient oxy-acetylene plate edge preparation at a cost within the

Steel is cut cleanly, rapidly with the oxy-acetylene torch

reach of all. When the oxy-acetylene torch completes its work, the plate edges may be placed together to form a perfect groove.

Increasing temperatures and pressures placed great responsibilities upon the shoulders of pressure-vessel manufacturers. To prove the quality of the welds they made, they pressed into service the X-ray. As was anticipated, the X-ray pictures disclosed infrequent defects



Photos: Air Reduction Sales Co.

Using a template guide, an oxygen torch cuts machine parts

in the welds. Such defects were chipped out—a slow and laborious process. Luckily, the same tool that was used for gouging the unwelded portion of a seam and for plate edge preparation, might be used for removing these defects.

For some time, the use of the oxy-acetylene torch for severing steel has been common knowledge. Even the adaptation of this tool to rough-shape cutting has been known by many. But the development of precision tips, that eliminated all other finishing operations involving the use of machine tools, came quite recently. Here the perfection of precision nozzles led to unbelievably close tolerances. How close? Well, from three-thousandths of an inch in one-inch plate to slightly more than three-hundredths of an inch in six-inch plate.

Meanwhile, the men in oxygen research saw another opening for their tools. For many years, the painting industry had been preaching the importance of the proper preparation of steel for painting. Sand-blasting, pickling and chipping had all been used with success. Each process had its advantages and disadvantages, of which the latter were mostly concerned with the slowness of the process. A special tip emerged from the development division to use oxygen in combination with acetylene for rapid and certain flame descaling. By quickly raising the scale on the surface of the steel to a high temperature, the descaling torch turned the trick. Differential expansion of the oxide skin and the steel below caused the scale to fly off. The scale-free dry steel that remained was ideal for painting.

Now we come to one of the most recent milestones on the oxygen road of progress: hole-drilling in both stone and concrete. Rock is quarried by drilling blasting holes in which dynamite is used to blast huge blocks of material out of the formation in which they are found. Heretofore this drilling has been accomplished by cumbersome and expensive machinery. Once more the operators might have struggled along with both heaviness and cumbersomeness if the machines hadn't been so slow. Then along came a special oxy-acetylene torch and tip that drilled the holes in rock with speed. Although speed ruled, I must admit that the lighter equipment and greater economy which were thrown in for good measure helped to swing the balance in favor of the flame process.

Frequently holes must be drilled in concrete. This stubborn and unyielding man-made rock is conquered slowly with a star drill and pneumatic gun. Powdery concrete emerges from the hole so slowly as to tax the most angelic patience. No rapid drilling of concrete was ever possible; that is, not until the advent of oxy-acetylene drilling.

Both stone and concrete contain water. In flame drilling, the concentrated heat of the oxy-acetylene flame turns this water to steam. The steam, trapped as it is on all sides, explodes. And the hole is drilled not only with speed but also with economy. I'm not going to mention speed or economy again. By this time you must know that these two words are synonymous with oxygen processes.

Ever notice a runner at the end of a long race? He is fighting for oxygen to replace that which he has burned up while running. Not so industry. Industry is breathing easier in its oxygen tent. This ubiquitous gas has eased the struggles of industry in many places.

Nothing has been said here about welding, brazing, or soldering with the oxy-acetylene torch. Nor has anything been said about flame hardening or flame softening. But why go on? Even as I write, the oxygen men are putting the finishing touches to developments that will make the story of oxygen even more unbelievable.

• • •

HOT-SPRAY

Lacquer Finishes Applied Faster And at Less Cost

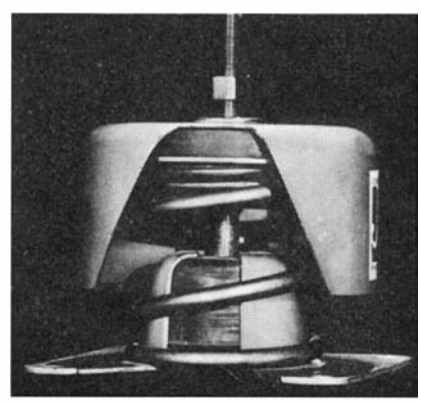
IN virtually every system of surface finishing, the ultimate object is to obtain the greatest degree of permanent protection with the least amount of labor and material. The cost of the finishing process is proportionate to the amount of solids on the surface when the finishing operation is completed.

In strict keeping with these basic principles, the new P&S hot-spray lacquer system produces, in a two-coat finish, the solids ordinarily obtainable in a three-coat cold lacquer finish. The heat employed in this machine gives spraying consistency without the use of thinners or solvents. Consequently, with this equipment, the manufacturer claims economies in amount and cost of material used, application time, drying time, and labor and handling costs.

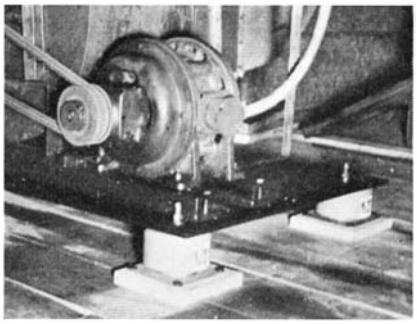
SPRING ISOLATOR

Machine Mounting Damps Noise and Vibration

A NEW, easily installed vibration isolator, designed as an economical means to control machine vibration and reduce the resulting noise, was recently announced by Johns-Manville. This device, known as the J-M Controlled Spring Isolator, was developed for use on the bases of motors, generators, pumps, ventilating fans, and similar equip-



Sectional view, spring isolator



Motor on spring isolators

ment where vibration and excessive motion create noise and tend to wear out machine parts and damage connections as well as to crack the supporting walls and floors.

The working parts of the unit consist of a coil spring and a rubber load pad, which support the equipment and isolate vibration—and an adjustable rubber snubber inside the base, which controls excessive motion

The isolator is built to take care of horizontal and torsional as well as vertical vibration. It is efficient for the low frequency vibrations resulting from slow speeds and from many operations involving reciprocal motion. The load pad is designed to overcome any high frequency vibrations.

The device is made in two sizes: Light duty, for loads from 50 to 190 pounds per isolator; and heavy duty, for loads from 250 to 720 pounds per isolator. Heavy machines may be isolated by clusters of the units. The loaded overall dimensions of the unit are six by six inches by approximately 3¾ inches high. It is enclosed in a metal jacket which protects the rubber parts from oil and light.

FACTORY RUBBER

New Synthetic Useful For Tires

On page 125 of this issue, Philip H. Smith touches upon the so-called synthetic rubbers, indicating that we are not yet in a position to replace natural rubber with the synthetic variety. The newest of these synthetics, which is equal or superior to natural rubber in many of its properties and can be processed and vulcanized like the natural product—in making tires, for example—is claimed by the developers to be capable of radically reducing our dependence upon natural rubber which must be imported. Of course, this factory product is more expensive than latex rubber and only in a great national emergency would sufficient plants be constructed to make it in large quantities.

The basic raw material for this new factory-made rubber, which has been named Ameripol by the B. F. Goodrich Company, is American petroleum. Dr. Waldo L. Semon, its discoverer, explains that the petroleum is broken down by the cracking process to a mixture of simple molecules. From this mixture can be separated a gas which, under pressure, liquefies to give butadiene. This is mixed with other ingredients prepared from natural gas and air and then made into a milky emulsion, using soap produced from American agricultural sources. Upon heating and agitation, these ingredients react to form an emulsion of synthetic rubber, which is similar to the latex obtained from rubber-producing trees. From here on, the process of obtaining a sheeted rubber is quite like that used for natural rubber. The latex is coagulated with acid, producing a curd. This is then sheeted and dried to give the Goodrich synthetic.

PROGRESS

Hand of Research, a Midas Touch on Machines

For the benefit of all those who may be critical of scientific research in any respect, we present an accompanying photograph showing four versions of the lowly washing machine. No women accustomed to the 1940 model would ever be content to use again the 1919 model. Yet despite the significant story told in this group picture of four machines, there are still some people who claim that new models are built solely for catch-penny purposes—to exploit the consumer.

Scientific research made possible the vast improvements shown in this group picture, not the least part of that improvement being the reduction in price by about one half for a modern machine that does better work than its earlier prototype.

MOLDED AIRPLANES

New Pressure Tank Ordered For Production

A super-size molding tank for so-called plastic airplanes and parts has been ordered for the Duramold Aircraft Corporation, a subsidiary of Fairchild Engine and Airplane Corporation. The tank, 10 feet in diameter and 28 feet long, will be installed in the Grand Rapids plant of the Haskelite Manufacturing Corporation, co-owners of the Duramold process. The quick-acting door of the tank alone weighs 13 tons.

The so-called plastic airplanes are not, as is generally thought, made by pouring a plastic into a hollow mold, but rather are made of wood fibers in the form of thin veneers bonded together with plastics under heat and tremendous pressure. [See Scientific American, July 1939.—*Editor.*] By utilizing and preserving the tremendous natural strength of properly arranged wood fibers, a new material is obtained, which is not only stronger and lighter than pure plastics, but one that compares favorably with riveted aluminum alloys. Duramold engineers emphasize the fact that all the raw materials used in plastic airplanes are available in large quantities in this country.

Duramold Aircraft Corporation was the pioneer in developing synthetic materials and processes for molded airplanes and flew a plane,

Courtesy Lincoln Electric Co.

One of many examples of industrial progress brought about by research

with a molded fuselage, over two years ago. Production molded units made by the Duramold process are now in use in the Fairchild Army training plane and on planes of one of the major airlines.

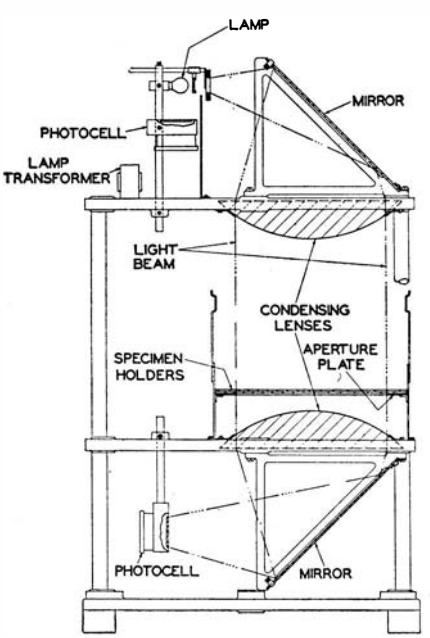
According to *Modern Plastics* magazine, four aircraft companies are now working intensively on the problem of molded airplanes, two major research institutions are investigating various phases of the subject, and the Army Air Corps and the Navy Bureau of Aeronautics are closely watching all developments as well as carrying on tests in their own laboratories.

AREA DETERMINER

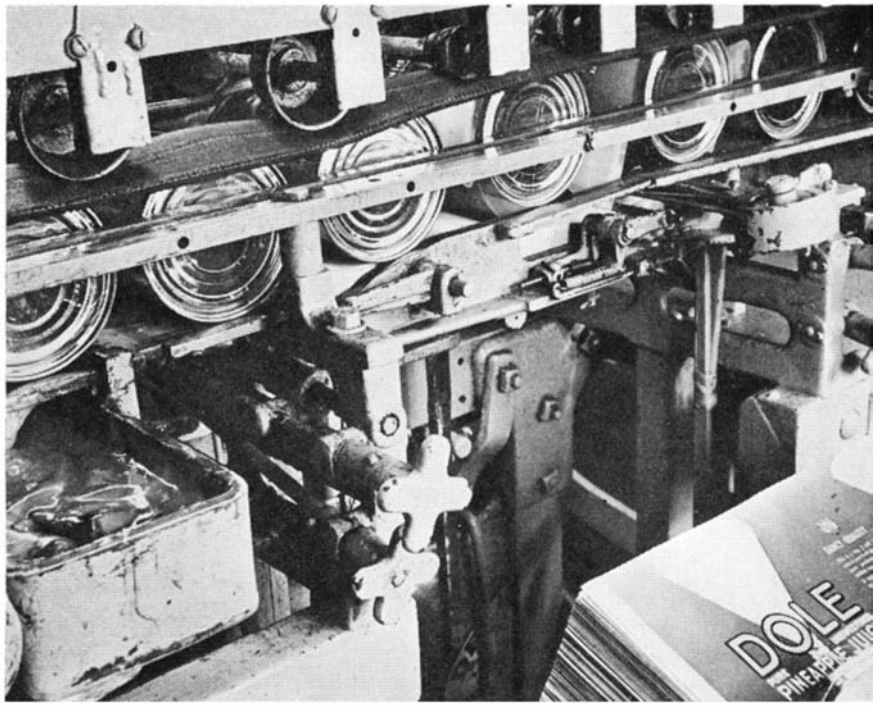
Machine Measures Areas Fast and Accurately

PLANIMETER measurements of areas are slow. While they are relatively accurate, they are not exactly so. A new area determiner developed by the American Instrument Company utilizes a photo-electric cell and accurately ground optical lenses and is, therefore, faster and more accurate than any device depending upon the human senses. It will determine the areas of maps, printed designs, stampings, punchings, engine indicator diagrams, plant leaves, and many other irregularly shaped flat objects that will fit into a 9.93-inch circle. If the object is transparent, it must be temporarily coated with a translucent or opaque material.

Inside the 42-inch high cabinet are two 12-inch condensing lenses, two diffusing screens, two mirrors, and two photo-electric cells. A galvanometer is used for determining the balance point between the two cells. To operate the machine, after plugging it into a 115-volt socket, the dial on the face of the cabinet is first set at zero by balancing the two cells. The flat object to be measured is then placed between glass plates over one of the lenses. The galvanometer deflects and is then brought back to zero by turning the dial. Finally, the dial reading is multiplied by five to obtain the area in square centimeters.



Set-up of area determiner



Can labeler; paste (left), label pick-up (center), label pile (right)

LESS TIN

New Tinning Process Saves Vital, Imported Metal

TIN is one of those vital raw materials which the United States must import. Although this country uses a relatively small amount—about 40,000 tons yearly—to make tin cans, there is not yet a completely satisfactory substitute for it. Therefore, if our imports from the Dutch East Indies and the Straits Settlements were cut off, an enormous canning industry would feel the pinch of the war.

Professor Colin G. Fink, of Columbia University, from whose laboratory many metallurgical and metal plating processes have come, has now developed a process which permits much thinner tin plating on the iron sheet that makes the tin can. According to recent reports, this process would save half the tin now used for this purpose. His new process involves electrochemistry instead of dipping.

RAPID LABELER

1400 Pineapple Cans Labeled Per Minute

THE fact that up to 1400 cans are labeled per minute at the Hawaiian Pineapple Company's cannery in Honolulu is a record made possible by improvements on standard can-labeling machinery. All of the machines were originally standard Knap machines, but have been re-designed to raise the speed as much as 50 percent over that at which the labelers are usually operated.

The Hawaiian Pineapple Company, growers and packers of Dole products, evolved a new design to speed up the operation of the original labeler. The pick-up paste pan has been fitted with two sets of rollers, both machine driven. One rotates clockwise, the other counter-clockwise. One set of rollers is grooved like a pulley, while the other set is pointed and operates within the groove of the first set. The pointed rollers are on a shaft made adjustable to increase or decrease the space between the meshing rollers. This permits the application of either lesser or greater amount of pick-up

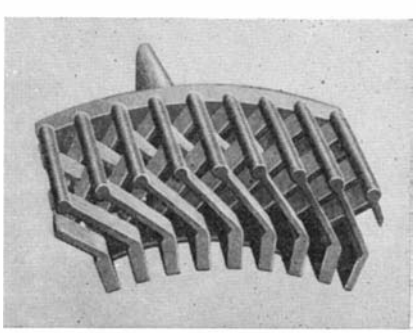
paste. The rollers are self-cleaning.

Another improvement was the introduction of a new method of feeding the cans into this fast moving machine. Trays of cans are upended so the cans roll by gravity onto a belt which passes them in an almost uninterrupted stream across the paste pan rollers. To supply labels to the machine, a slip drawer, which falls back to a slightly out-of-plane position, is filled with labels while the machine is running. When the labels in the machine have been used, this slip drawer is simply pushed forward into the machine after the table has been lowered to receive them. The drawer is then removed and the machine continues its operation with practically no shutdown.

ROTORS

Improvement in Induction Motor Construction

OFFERING the advantage of longer motor life with less maintenance, a new type rotor construction announced by General Electric makes possible the use of cast-aluminum rotors in the larger sizes of double-squirrel-cage motors for high-starting-torque, low-starting-current service. Called the "Valv-amp" rotor, it makes use of a unique shape of rotor slot and a special method of assembling rotor punchings to control the flow of starting current. As a result, without the use of a switch or other moving parts, current is permitted



Section of cast aluminum rotor

to flow in the outer squirrel-cage when the motor is started, thus producing high starting torque. Then, when the motor comes up to speed, current is allowed to flow through the entire rotor "winding," resulting in excellent running characteristics.

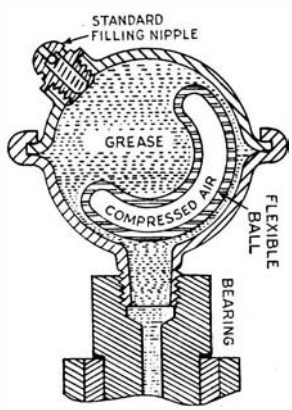
Of the two conventional methods of double-squirrel-cage-rotor construction—that is, casting the conductor bars and short-circuiting rings integral, or joining them by brazing—the former method is by far the more satisfactory because it is a simpler operation, with smaller chance for human error, and results in a more compact, uniform product. However, until the Valv-amp development, it has not been practicable to cast double-squirrel-cage rotors in the larger sizes.

The Valv-amp development, however, allows the construction of larger cast-rotor motors which inherently combine the advantages of the double-squirrel-cage motor, such as high starting torque, low-starting current, and excellent running characteristics, with advantages of the conventional cast-rotor motor—simplicity of construction, long motor life, little maintenance, and permanence of electrical characteristics.

PRESSURE LUBRICATOR

Flexible Ball of Neoprene Uses Compressed Air

A CONTINUOUS, positive flow of lubricant to the wear surface of bearings while they, or the shafts,



are in motion is assured by a new pressure lubricator which is permanently attached to the lubrication passages. This device utilizes compressed air, stored in a neoprene ball, to force lubricant to each individual bearing as it is needed by that bearing.

The lubricator consists of a steel shell, designed to withstand high pressures, inside of which is a hollow, flexible neoprene ball. The shell is equipped with a standard grease fitting and a pipe-threaded outlet that screws into the standard lubrication passage.

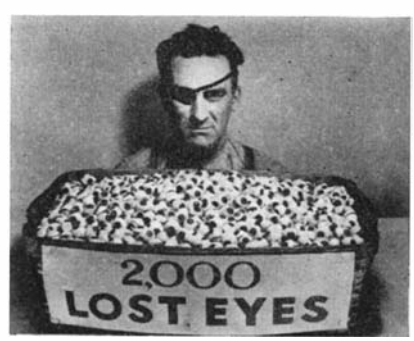
When grease is forced into the lubricator by a pressure gun attached to the grease fitting, it collapses the neoprene ball against the pressure of the air inside of it, thus compressing this air and storing up energy. After the lubricator has been filled under high pressure, the grease flows through the bearing rapidly with a flushing action until the pressure within the lubricator drops to where it balances with the resistance of the bearing to passage of lubricant. When this static condition has been reached, further lubricant is forced to the bearing only when the bearing is in motion. The pressure balance is upset only when the bearing or the shaft is moving, causing loss of lubricant and the consequent need for replacement of the grease or oil.

The flexibility of neoprene and the ability of neoprene compounds to resist the passage of gases were two principal reasons for the selection of this material for the ball. In addition, the use of neoprene was dictated by other conditions of service—the lubricators must be effective in cold and hot weather, and they must handle all types of lubricants without appreciable deterioration of any of the parts necessary for their operation.—*The Neoprene Notebook.*

EYE ACCIDENTS

High Toll of Industrial Eye Accidents

ALTHOUGH safety engineers have long inveighed against the carelessness of workers who will not use the prescribed goggles when doing



dangerous work, that carelessness continues. It takes a heavy toll. The American Optical Company emphasizes the cost with the accompanying photograph, their caption saying: "It would take all the artificial eyes in this basket, and more too, to replace the 2000 eyes lost annually in eye accidents."

Such accidents cost American industry approximately $37,000,000 yearly in medical expenses and compensation.

INDUSTRIAL TRENDS

CONTINUOUS CASTING

REVOLUTIONARY changes are taking place in the hot handling of metals. During the past few years the metallurgist's century-old dream of producing billets, sheets, and strip direct from the molten metal in a single step has materialized. Billets of copper, aluminum, and magnesium alloys are being produced commercially right now and it appears that steel will soon be added. You're unlikely to hear about this because the art develops slowly, without publicity of any kind, and in some instances with absolute secrecy.

Actually, the process is one of continuous casting. In this country and in Europe there are mills casting ingots and billets of ferrous and non-ferrous metals on a 24-hour basis to prove the practical nature of the method. A New England producer is now casting over one million pounds of 7⅞-inch brass rounds weekly with a single machine, and it is possible to cast continuously billets up to 20 inches in diameter.

There are half a dozen systems in operation, commercially and experimentally. They differ as to technical details rather than as to basic principle. The molten metal flows from a holding furnace into molds which are jacketed for cooling; then, as the billet comes from the mold, it is cooled by sprays and passes on down to a cut-off saw or flame which cuts it into desired lengths. While the processes are very simple, there have been many difficulties to iron out, because so much care has to be given to temperature control, operating speeds, and molds.

Speed of production is the great achievement. According to the system, kind of casting, and its size, output may vary from 10 inches to 7 feet per minute, and these speeds are likely to be raised with further experimentation and experience.

IN STRIP FORM

To anyone familiar with rolling mill practice, the production of sheet and strip by continuous casting is more dramatic than the turning out of billets. Instead of employing multiple passes through rollers to reduce a chunk of metal to the form of sheet or strip, a single pass of the molten metal will produce thin strip (about 0.02 of an inch in diameter) of eight-inch width at the rate of 500 and more feet per minute.

There is insufficient space for relating the experiments and heartbreaks leading to ultimate success in continuous casting. It is sufficient to say that it is used to handle non-ferrous metals and more recently has demonstrated the capacity to handle high chrome, high carbon, and spring steels. There's no doubt but that it can produce tin plate, but it has yet to prove that it can outmode the great continuous rolling mill for production of automobile sheet.

Enough experimental data have been assembled to warrant the forecast of further triumphs. It is very likely, for example, that the continuous casting of tubing is not far off. This would be accomplished by inserting a stationary mandrel in the forming mold. It is also likely that the new practice will prove valuable for handling stainless and other high alloy steels because of the reduction in scrap loss.

EVERYTHING BUT THE SQUEAL

Do you recall the time honored phrase that the meat packing industry utilized every part of the hog but the squeal? Well, that's literally true, but that is no indication that the industry has reached the end of the utilization goal. The industry has shown great ingenuity in developing outlets for all the various packing by-products, but the application of science is going to find still more valuable uses and thus create vast changes for the industry and its dependents.

I could tell you that the various glands are used for pharmaceutical preparation of hormones; that the livers of calves are used in the preparation of soluble extracts to combat anemia. It might interest you to know that gall stones, found in some cattle, are shipped to the Orient where they bring as much as $150 per pound for use as amulets, but it is more to the point to tell of recent events and forecast some more.

It has just been announced that the juice of the tropical guaicum tree, used in small quantities, will prevent the oxidation of lard, so that it can be kept without refrigeration and its nutritive values preserved without chemical change. This is a discovery of great value. The lard market has shrunk under the competitive onslaught of the hydrogenated vegetable oils, known to you under various trade names, and more recently the export market has been subjected to fire. It has been vital to the live-stock raisers and to the packers to revive the market.

Lots of work is being done with gelatine. Notably, several universities are studying its fatigue-relieving effects under controlled conditions. Gelatine already has a substantial market to capsule a host of products, but it can benefit from a bigger one. Blood goes into the manufacture of adhesives and has been employed to bond cheap plywood. I venture to say that fundamental studies into the nature of animal blood will be made to give it a value which at the moment is very low. Certainly scientific progress is being made in the packing industry, and I hope to be able to announce another important discovery at an early date.

STRATEGIC MATERIALS

War has unquestionably dislocated trade and shut off the flow of commodities between this country and a large and important section of the world, but as to ultimate effect upon American industry, one man's guess is nearly as good as another's.

Viewing the kaleidoscopic events, this much can be said: Our situation in supplies of strategic materials is much better than it would have been had similar upset conditions existed a few years ago. (See Scientific American, March, 1936). The rubber problem seems pretty well licked by *ersatz* developments, although over-night production in any quantity is out of the question. We could get tin from Bolivia, but we lack the smelters necessary to refine it. It's more likely that the need for tin as a plating agent would be met by substitutes, leaving available supplies for more essential items. A possible substitute is black steel plate, coated with lacquer; another is aluminum, used as a plating.

To these chemical contributions to self-sufficiency can be added substitutes for fulminate of mercury in detonators, chinacrin and plasmochin to replace quinine, and they are talking up nylon to replace silk in powder bags and parachutes.

— *Philip H. Smith*

First Aid For Burns

Application of Tannic Acid is Procedure That Has Received World-Wide Recognition

CHARLES A. McAVOY
Burroughs Wellcome & Co. (U.S.A.) Inc.

THE standard first aid for burns in the United States Navy is an aqueous jelly containing 5 percent tannic acid and 0.5 percent phenol. Tannic-acid jelly was adopted by the Bureau of Medicine and Surgery of the Navy after ten years' successful use of tannic acid in the treatment of burns by the leading hospitals of the world.

Tannic-acid treatment of serious burns was introduced as the result of work by the late Dr. E. C. Davidson of the Ford Hospital, Detroit. Dr. Davidson was searching for a coagulant of proteins and most of his early work was with phosphotungstic acid. His attention was drawn to the fact that, for many centuries, the Chinese had used a strong decoction of tea in the treatment of burns; he replaced phosphotungstic acid with tannic acid and obtained brilliant results.

In 1925, Dr. Davidson announced the results of his work. His paper led to a world-wide adoption of the tannic-acid treatment of burns and much work and study was carried on by others to perfect the technique. Most important was the development of tannic-acid jelly which brought Dr. Davidson's discovery into the field of first aid.

First aid in serious burns, as in other injuries, must be based on the fundamental principle of first aid—"the avoidance of further damage to an injury between the time of the accident and the beginning of medical care."

It is essential, therefore, to consider just what is the most frequent and most serious "further damage" which the first-aid worker must strive to avoid in handling serious burns.

A study of current medical opinion establishes four important facts: the majority of deaths in serious burns ensue from shock and collapse; correct first-aid measures should be instituted immediately after the accident; oily or greasy preparations of whatever type must not be used as first aid; the accepted method of treating burns is the application of 5 percent tannic acid, either as a spray or aqueous jelly.

It is stated that 80 percent of deaths from burns are due to shock and collapse. The first-aid worker should be fully aware of this danger and his efforts should be to prevent or retard the development of shock during the period between the accident and medical care.

In burns, the causative factors involved in shock may briefly be stated as follows: loss of body fluids and loss of blood plasma; extreme pain; toxin absorption. Medical authorities seem in agreement that shock is the most dangerous factor involved in serious burns and that preventive measures should be taken immediately.

SHOCK begins with the injury and the first aid must be immediate in order to be effective. Every minute of the time required to transport a burned patient to a hospital adds to the danger of shock. During the period intervening between a serious burn accident and medical care, symptoms of shock may develop, retarding the efforts of the physician. Tannic-acid jelly should be applied immediately. If the injured person is conscious, some fluid should be given. The body of the injured person, including the burned area, should be kept warm.

The standard procedure in all hospitals is to treat burns with aqueous sprays. Most hospitals use sprays of tannic acid or some modification of tannic acid, while others use aqueous solutions of certain dyes. In all instances, however, the spray solution is aqueous and depends on penetration for its therapeutic value. If preparations containing oils or greases have previously been applied as first aid, the oils and greases must be removed with solvents before the aqueous spray can be used. In cases where the burn covers a large area, or the patient is in shock, the "scrubbing" of the injury becomes a serious factor.

The disaster to the airship *Hindenburg* caused many serious burns to be treated at the hospitals at Asbury Park and vicinity. Dr. O. R. Holter, of Fitkin Hospital, Asbury Park, New Jersey, wrote in the September, 1937, issue of the *Journal of the Medical Society of New Jersey* regarding his experiences with serious burn cases following the wreck. In the course of his article, Dr. Holter said: "The use of oils and ointments of various kinds, home and proprietary remedies, in the treatment of second and third degree burns is to be severely condemned."

The tannic-acid treatment of burns introduced by Davidson has revolutionized both hospital and first-aid procedure in the case of burns. Philip H. Mitchiner, M.D., M.S., F.R.C.S., in his excellent article, "Treatment of Burns and Scalds," (*British Medical Journal*, January 1, 1938) points out that, while the value of tannic acid in burns is due to its coagulating properties, it is important that the solution should have a penetrating action as well. Tannic-acid solutions of 5 percent or less penetrate deeply, so that all of the damaged cells are coagulated and the danger of a superficial coagulum (which permits toxin absorption from the deeper uncoagulated tissue) is avoided.

Treatment with tannic-acid spray, however, must always be under optimum conditions. The patient must be kept warm, the injury kept warm under a heat tent, and the solution sprayed on must be warm. Spraying must be repeated frequently for hours until the coagulum is completely formed.

Sub-optimum conditions, however prevail at the scene of an accident involving burns. Under these conditions, it would not be possible to maintain the patient and the injury warm during the treatment with tannic acid spray, even though there might be an operator trained in the technique.

With the application of tannic-acid jelly, the coagulum forms as the patient awaits medical attention and is complete in 30 to 40 minutes. No skill is required and no time has been lost; the application can be made even under unfavorable conditions and two applications should suffice. This is correct first aid.

Aqueous tannic-acid jelly has

the penetrating and coagulating properties of the spray; it seals the injury rapidly, retards loss of body fluids through the burned area, excludes air and stops irritation of nerve endings, thereby allaying pain. The danger of shock is reduced as the patient awaits medical care. Being water-soluble, the tannic-acid jelly or its coagulum can be removed by the surgeon without undue discomfort to the patient. Tannic-acid jelly not only brings the benefit of the tannic-acid treatment for burns to the field of first aid but, likewise, coördinates first aid with later medical care.

In summarizing, the most important message to the first-aid worker in handling burns is that he act immediately to minimize or prevent shock in the injured. He can best do this in the following manner:

Apply tannic-acid jelly freely over and beyond the burned area. In first aid avoid the use of sprays.

If the patient is conscious, administer some fluid to replace loss of body fluids. Keep the burned area and the patient warm. Do not use any preparation containing oils or greases. Bring the patient under medical care as soon as possible.

• • •

STIMULATING

Modern Version of the "Medical Coil"

RELEGATED to many attics are "medical coils" — induction coils equipped with vibrators—that, not so many years ago, were regarded by many people as "cure-alls." The mild current supplied through handle electrodes was indeed stimulating, but certainly would not accomplish the wonders that were supposed to result.

Modern medical research, however, has found that similar currents do have value in certain cases. Thus, portable muscle stimulating equipment for physicians, a General Electric medical development, is a recent application of one of the oldest facts of electrical knowledge. The purpose is to increase circulation, to hasten, repair, and restore function as soon as possible after enforced rest or immobilization of skeletal muscles following fracture or other injury.

The apparatus, which can be adjusted by use of a vacuum-tube rectifier for either alternating- or direct-current operation, conveys to the patient through the two electrodes just enough electricity to produce a neuromuscular response at the rate of 12 contractions per minute, each simulating a natural contraction in its gradual rise to completion, with a correspondingly gradual fall to relaxation.

The name of the device, a galvanic generator, recalls Luigi

The "medical coil" up-to-date

Galvani, the famous professor of anatomy at the University of Bologna, who about 1791, while preparing frog's legs for his ill wife's dinner, noticed that electricity caused their muscles to twitch and contract.

FAIR EXCHANGE

Men and Women Swap Clothes To Bring Out Suspected Facts

WOMEN are two degrees cooler than men by skin temperature readings but the chief reason the sexes cannot agree about what is a comfortable indoor temperature is that women's clothes are cooler. This was proved to a group of men when they donned women's filmy garments in scientific studies at the Harvard School of Public Health.

The studies were reported to the American Industrial Hygiene Association by Dr. C. P. Yaglou.

"Men dressed in women's summer clothing (weighing 1.8 pounds including shoes, compared with men's summer wear of five pounds) demanded a temperature of 80 degrees Fahrenheit, which was about the same as that preferred by women (79.5 degrees) similarly dressed," Dr. Yaglou reported.

"Reversely, when women wore men's winter clothes (8.3 pounds instead of 2.6 pounds, the average of women's winter garb) the comfortable air temperature was just as low (70.5 degrees) as that preferred by men wearing the same clothes."

If men would wear a coatless and vestless dress with the lightest of underwear in hot summer weather, rooms would not have to be cooled below 85 degrees Fahrenheit for comfort, Dr. Yaglou said. The present standard is from 76 to 80 degrees. With men garbed for a temperature of 85 degrees Fahrenheit in summer, there would not be the trouble now experienced from exposure to sharp temperature contrasts between apparently chilly air-conditioned buildings and the heat outdoors.

In winter, Dr. Yaglou said, a room temperature of about 70 degrees Fahrenheit would be comfortable for both sexes in the coldest weather, if women wore more and warmer clothes and buildings were suitably insulated.—*Science Service.*

POISON IVY

New Method of Protection Excludes the Poison

A VANISHING cream that gives protection against poison ivy has been developed by Dr. Louis Schwartz, Dr. Leon H. Warren, and Frederick H. Goldman of the United States Public Health Service and the National Institute of Health, Washington, D. C. The cream is made by correctly mixing either sodium perborate or potassium periodate with vanishing cream.

Tests on nine volunteers showed that the cream protects against both poison-ivy extract, which is at least 30 times as powerful as any poison ivy leaf, and against the leaves and stems of the plant itself. Two volunteers, one most susceptible and one medium susceptible to poison ivy, after rubbing on the cream, pulled out poison ivy plants by the roots, plucked the leaves, and rubbed them over their skins. Neither volunteer was poisoned.

The cream is made by adding 10 percent sodium perborate, or 2 percent potassium periodate, to vanishing cream. The chemicals come in crystal form and should be ground to powder before mixing. The vanishing cream should be made first and the chemical added. The cream should be freshly prepared for use, to avoid deterioration.—*Science Service.*

Interstellar Gas

More and More, Astronomers are Finding Matter as Particles Between the Stars

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

An unusually interesting discovery has just been announced—namely, that molecules of chemical compounds, as well as isolated atoms, are present in the excessively rarefied gas which is found in the vast "empty" spaces between the stars. The evidence, of course, comes from the spectra of distant stars whose light has traversed long paths through interstellar space.

It has been known for many years that the H and K lines of calcium (absorbed by the ionized atoms of the element) are present in the spectra of many very hot stars, and are very sharp—mere hair-lines across the spectrum—while the other lines are broad and fuzzy. The latter behavior is easily explained as a result of rotation of the stars, and of relatively considerable density in their atmospheres—both of which tend to widen the lines. But the sharpness of the calcium lines indicates that they originate in a gas of very low density, remote from these disturbing effects. A cumulative weight of evidence has convinced everyone that this gas is nowhere near the individual stars, but distributed generally—though probably more or less patchily — in space. The yellow D lines of sodium were next found to appear with the same characteristics in the same stars. Later the ultra-violet pair of sodium was discovered, the red line of potassium, several lines of titanium, and, in a few cases, the strongest line of neutral calcium—though very faint.

It is now evident that interstellar space is by no means empty. Indeed, there is probably a great deal more in it than our spectroscopes can detect.

We may recall that an atom of titanium (for example) can exist in a great many different states characterized by different amounts of internal energy (definitely fixed for each one). An atom in any one of these states will absorb only a definite group of the numerous lines of the spectrum—the others coming from atoms in other states. For some atoms, such as sodium, there is one "ground-state," much lower in energy than any other; so that, in the ordinary metallic vapor in the laboratory only a very small fraction of the atoms are excited into the higher states, and the absorption by the vapor shows only the "ultimate" lines coming from the ground-state. For others, like titanium, there are many states with energy only a little above the bottom, and light passed through a column of vapor in an electric furnace shows absorption from a number of these states.

But the interstellar lines of titanium are those which come from the very lowest state only. The atoms in states of even a little higher energy must have some way of getting rid of it, and falling back to the lowest level. From most energy levels an atom can do this by giving out an ordinary line of the familiar spectrum, and it is practically sure to do so in less than a millionth of a second, but the transitions from the lower metastable states to the bottom are "forbidden"—which means that they will happen only if the atom is left to itself without disturbance for an enormously long time—such as a second—or even several minutes in extreme cases. The interstellar gas is, however, so very thin that its atoms will go weeks, or perhaps months, on the average, between collisions. So they have plenty of time to settle down, and the observed situation could have been predicted.

For many of the most interesting elements, such as hydrogen, helium, carbon, nitrogen, oxygen, neon, magnesium, and silicon, the lines absorbed by atoms in the ground-state lie in the far ultra-violet, and we have no hope of observing them through the ozone in the Earth's atmosphere — which lies like a black pall upon the dreams of the astrophysicist. There does not appear to be much chance of observing interstellar lines of other elements than those already known. The main reason is that the radiation of the stars tends to remove electrons from the atoms and ionize them, and the chance of picking up electrons again from those wandering about in space is poor. The lines of neutral calcium are much fainter than those of ionized calcium; and Dunham calculates that there are 3500 ionized atoms for each neutral one. Even for iron, which is harder to ionize, only one atom in many hundreds should be neutral.

This explains why we do not find interstellar lines of aluminum and iron. The neutral atoms have lines in good observable positions; but those of the ionized atoms are lost behind the ozone.

In view of all this, it is surprising that a number of sharp, characteristic interstellar lines have been observed and not identified. Their positions, which have been accurately measured, do not agree with the ultimate lines of any known element—and our lists of such lines from laboratory observations are undoubtedly complete (in this region of the spectrum, at least). There must be something else besides atoms in interstellar space, to absorb them.

One naturally thinks of molecules: but at first a great difficulty appeared. The spectra absorbed (or emitted) by molecules are extremely complicated, containing thousands of lines grouped together in bands, often so closely that only the most powerful spectrographs will resolve them. How can such spectra reduce to a few isolated lines such as are observed?

An answer comes by applying the principle already revealed by the atomic spectra—that all the absorbing systems (whether molecules or atoms) will be in the lowest levels of their ground-states.

Changes in the energy-state of an atom depend on changes in the configuration of the electrons in its outer regions. This can happen in a molecule, too, but so can many other things. Even in a simple diatomatic molecule, the two atoms may be rotating about their center of gravity; or they may be vibrating, changing their distance on each

side of the mean value. Long series of these vibrational and rotational states are permitted by the quantum rules, and transitions between them give hosts of regularly-spaced lines. When there are only two atoms in the molecule, it is possible, with much labor, to work out just what states of oscillation and rotation correspond to each line. With three or more atoms, the complications are much worse.

Now, when left to itself in interstellar space, a molecule will get rid of its energy (by radiation of forbidden lines), and settle down into a state in which the rotation and oscillation have diminished to the smallest amounts permitted by the quantum laws (which are not always zero). A molecule in this state can absorb only a very few of the host of lines which compose the familiar bands in its spectrum. What is more, the residual line to which the spectrum is thus reduced will not usually be the strongest one in the completely developed band. Which one of the lot it is can be found only when a detailed analysis is made; but for a number of the most important band-spectra such analyses are on record and available.

UTILIZING these data, Dr. Andrew McKellar, of the Dominion Astrophysical Observatory at Victoria, has shown that the interstellar line at 4300.24 agrees perfectly with the residual line of the well known hydrocarbon band, which (mixed with other lines) forms the G band in the solar spectrum. Another line at 3874.61 is the sole survivor of the great cyanogen band; and one at 3934.29 can be attributed to sodium hydride.

The agreement of the laboratory and interstellar wavelengths is so good in each case as to afford strong evidence; but more is forthcoming. There are three more accessible bands of the CH molecule, each of which, under interstellar conditions, should reduce to a single line, at 3878.8, 3886.39, and 3890.23. In the spectrum of Zeta Ophiuchi, which shows strong interstellar lines, Adams at Mt. Wilson has found all three of these, in very close agreement with the laboratory positions, and with relative intensities as predicted. His statement, "The evidence for the presence of molecules of CH in interstellar space seems to be conclusive," is none too strong in the circumstances.

Other lines of CN and NaH are also available for a test, but have not yet been looked up; but there is no reason to doubt their presence also. Molecules of other kinds are presumably present, for there are sharp interstellar lines at 3957 and 4233 which are not yet classified. Their identification may have to wait upon a detailed analysis of other band spectra.

There are also three lines in the red, clearly of interstellar origin, but relatively broad, whose origin is still unknown.

These molecules, whose presence has been detected spectroscopically, all look queer to the elementary chemist. He would expect to find CH_4 (methane) instead of CH, and C_2N_2 (cyanogen gas) instead of the half-decomposed CH. The spectroscopist, however, is not surprised. He knows that complete, saturated molecules such as methane have their strong absorption bands far in the ultra-violet or the infra-red, out of reach of the astronomer. (The methane bands observed in the outer planets correspond to weak absorption, which would not show up at all unless the quantity of the gas was enormously great in comparison to what we have been talking about.) Partly dissociated molecules — chemical radicals—which are too active to remain in the free state in ordinary laboratory experiments, often show absorption in the observable region.

It is highly probable that there are ordinary saturated molecules, too, in interstellar space. Common hydrogen (H_2) and nitrogen (N_2) should be there if CH and CN are, and in addition there may be molecules of oxygen and other things as well.

The chemical equilibrium of such a mixture of gases, containing molecules, free atoms, ionized atoms, and free electrons, affords a complicated and intriguing problem for the theorist. We have already some idea how thinly the atoms are strewn. Dunham, a year ago, calculated that in a typical interstellar region, there is one neutral sodium atom for every 20 cubic meters, and one singly ionized calcium atom for seven cubic meters. The neutral calcium atoms are far less numerous—one to 25,000 cubic meters, or 160 atoms per cubic mile, as against 200,000 neutral sodium atoms. Sodium produces almost the strongest interstellar lines, and neutral calcium the weakest so far observed. The number of molecules of CH per cubic mile is probably a few thousand.

To maintain even this small number of neutral calcium atoms, against the tendency of starlight to ionize them, there must be many free electrons—probably at least one per cubic centimeter, or 40 million billions per cubic mile. These must come from ionization of atoms of some sort—probably mainly from hydrogen. Under the assumed conditions, hydrogen would be about 95 percent ionized, which would leave two million billion neutral hydrogen atoms per cubic mile. Only an excessively small fraction of these enter into the observed hydrocarbon compounds. How much carbon, nitrogen, and so on, there may be we do not yet know—but the amount may be roughly calculable, at least, when the problem of the dissociation of molecules under these extraordinary conditions has been solved.

THE density of the interstellar gas, measured by any ordinary standards is almost inconceivably small, with one hydrogen atom (or free proton) per cubic centimeter. The density comes out 1.7×10^{-24} that of water, or less than two ounces in a cube 2000 miles on a side. Inside a space as big as Neptune's orbit, there would nevertheless be 600,000 billion tons—one ten-millionth of the Earth's mass—enough (if of suitable composition) to make a big comet or a small asteroid. But inside a sphere of radius equal to the distance of Alpha Centauri, these would be 4.7×10^{32} grams, or almost a quarter of the Sun's mass.

The total quantity of matter in this intersteller gas, on these calculations, is then a considerable fraction of that which is concentrated into the stars themselves. These numbers are rough; and may be greatly altered by later and more precise calculation; but, as they stand, they do not appear very favorable to the hypothesis that the interstellar gas has been ejected from the stars—as eruptive prominences are occasionally driven off from the Sun, and hydrogen and other elements continually expelled from the Wolf-Rayet stars. There seems to be too much of it to be accounted for in this way; and most of it may have been "originally" there—whatever this means.

—*Princeton, July 3.*

Build No Freaks

Warships Can Be Better Designed To Meet Needs of Their Own Classes

BROCKHOLST LIVINGSTON

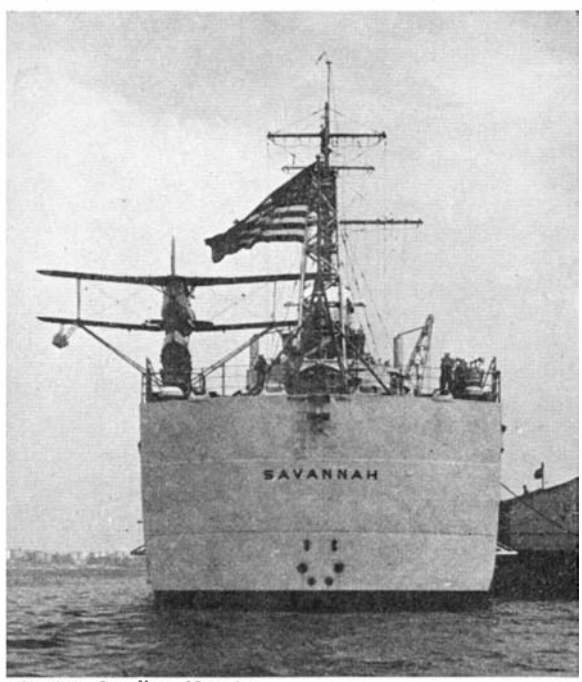
FOR centuries man has sought some revolutionary form of weapon which might overcome all defense. He is still seeking. Both on land and sea, tried forms of warfare have succeeded where novel weapons have failed—no offensive means has ever been discovered that could not be parried. On the sea the ram, the monitor, the dynamite ship, and even the submarine and the airplane have appeared, but defenses against all of these have been developed.

With this nation clamoring for additional defensive equipment it behooves us to move cautiously, to give calm consideration to any proposals for so-called revolutionary weapons. The means we provide for our defense must be the best available but the imaginings of our feature writers should not be permitted to dictate our procurement policy.

In our present quest for the most effective weapons of defense, we are examining, and properly, the possibilities of every type, from tiny motor torpedo boats to Gargantuan battleships. When our studies are completed we shall probably find, as we have in the past, that tried types of weapons both on land and sea must be the backbone of our defenses.

Two schools of thought exist. One has unbounded belief in the efficacy of size; the other in the effectiveness of tiny craft which can dart in unseen, present the minimum possible target, and are capable of rapid production in tremendous quantities. Our real defense undoubtedly lies between these two extremes.

Battleships of 80,000 tons have been suggested. Destroyers have trespassed into the realm of the cruiser. Cruisers, long held within definite limits by naval treaties, are now proposed of a size that gives them the character of the battle cruisers of a few years back but without the strength of such ships. Even submarines have been built so large that they carried armaments greater than that of existing cruisers. Charles Edison, while he was Secretary of the Navy, said that, personally, it did not terrify him to think of a 75,000-ton ship. He expressed his belief that we should provide "crushing weapons with our wealth to protect our wealth."



Courtesy *Our Navy* Magazine

United States cruisers have come in for much criticism during recent years. Note square stern

On the other hand, there are those who claim that one motor torpedo boat, costing in thousands what the battleships costs in millions, can protect us equally as well. Given the proper opportunity, one torpedo from such a small craft can effect the same result as the guns of a many-times more costly super-ship.

In considering what is best for our own defense, however, it must be borne in mind that our problems are not those of any other nation. What may be proper and adequate for others is not necessarily indicative of what we should possess.

The majority opinion is still in favor of the battleship, the most heavily armed and armored vessel which designers can produce. Battleships must be able to protect themselves against every form of attack and, consequently, the torpedo, the mine, the shell, and the bomb are the weapons against which they gird themselves. At one time they had companion battle cruisers, but England's navy, alone, now contains such vessels as a separate category. While the battleship was designed to resist any blow, the battle cruiser was equal in striking power but its higher speed forced a reduction in defensive armament. No ship can be designed to fulfil every requirement of sea fighting, but the battleship, with its relatively slower speed and greater defensive qualities, has heretofore approached closest to the ultimate of ship design.

WHILE we were once content to give our battleships a speed of 21 knots and designed our battle cruisers for around 33, the new 45,000-ton battleships for our Navy are reported to be designed for the higher speed while mounting the same offensive armament of the 35,000 - ton class of 27 knots. Battleships with speeds equal to those of cruisers will almost automatically require that the latter supporting ships be given greater speed if tactical requirements are to be met. Thus we sacrifice some of the primary requirements of the battleship in order to attain the questionable advantage of higher speed.

If every battleship is to be a battle cruiser, then of what is the backbone of a naval force to consist? If it is to be the 80,000-ton ship designed for the greatest possible speed, the heaviest armor, and the greatest striking power, we have arrived nowhere, for such might have been obtained within our 45,000 tons if we had been content with *adequate* speed to fulfil the mission of the type and substituted

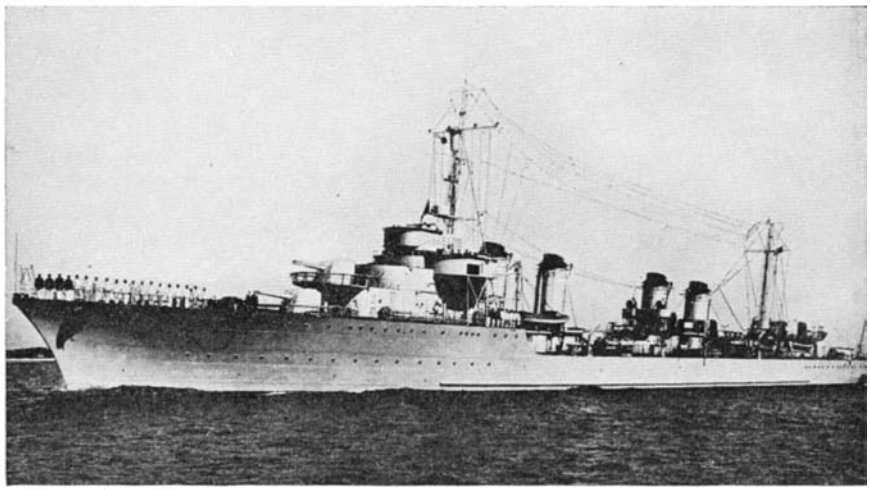
heavier armor for weight of machinery.

Our new 35,000-ton battleships carry a heavier armament than any ship in our Navy, have a higher speed and, presumably, are better protected. Ten thousand additional tons on the larger ships have been used to step up speed. Are we headed in the right direction? Would an 80,000-ton capital ship contain any more *legitimate* characteristics of the type than we have placed on our 35,000 tons? These are questions which must be answered.

While we persistently objected to any reduction in the limitation of 10,000 tons which the naval treaties set for cruisers, we were able to provide greater offensive and defensive strength in our ships of this type than any other nation. Now, with treaty limitations a thing of the past, we are talking of super-cruisers of 14,000 and even 20,000 tons. While our battleships have taken on the characteristics of battle cruisers in the realm of speed, our cruisers are tending toward the battle cruiser type in offensive strength. The clear-cut division between types becomes less noticeable with every new ship designed. This trend indicates that the true purposes of the various types may not be very clearly defined in the minds of our directive personnel.

AFTER many years of consistent belief in the need for 10,000-ton cruisers, we recently laid down four 6000-ton vessels of this type and were planning to start a series of 8000-ton craft. The *Graf Spee* battle caused a halt in our plans and the decision to revert to the 10,000-ton type. This decision was arrived at even in the face of the fact that one lesson to be drawn from the battle in question was the need for quantity in this type. Three British cruisers of small size, light armament, but high speed, forced the heavily armed, but slower, German to its doom. The *Graf Spee* was surely a hybrid if there ever was one, and a 20,000-ton cruiser for our Navy would merely repeat the mistakes of this German predecessor. Such types are not for the major sea powers; they are an admission of weakness.

If cruisers are tending to infringe on the domain of the capital ship, destroyers, by their ever increasing size, are stepping up toward cruiser category. We have tended to copy the French and Italian navies with their special problems, and seem to forget the primary purposes of destroyers. Might we not learn a lesson from one day's war news? On a single day, the Allies lost the 1870-ton British *Afridi*, the 2144-ton Polish *Grom*, and the 2436-ton French *Bison*. While, in size, these vessels approached the cruiser classification, they had only the defensive strength of destroyers, and thus fell ready victims to enemy attack. Our own policy toward large destroyers may perhaps be traced back to the day when we lacked cruisers and were required to use destroyers for cruiser duties. They were unsuited, of course, but our new destroyers seem to have been designed to fulfil those same duties while, actually, they should be designed specifically for the tasks expected of the smaller craft.



Courtesy *Our Navy* Magazine

Too big for its class: the French destroyer *Cassard* approaches cruiser class, with a displacement of 2441 tons, seven torpedo tubes, large guns

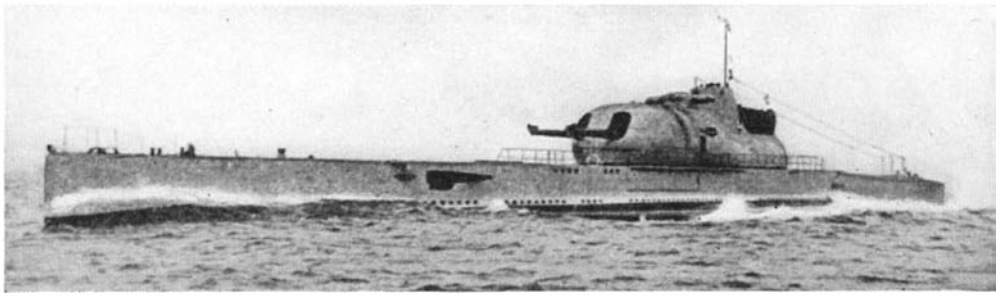
The fleet vacancy left by the increase in size of destroyers—primarily torpedo carriers — has brought forth the motor torpedo boat. This move is a clear indication of the realization that the destroyer in its legitimate role has out-grown itself. Destroyers must be small enough—within sea-keeping limitations—to dash in to an attack. The motor torpedo boat can fulfil this function in narrow waters and within limited ranges. It does not appear suitable for a high-seas fleet such as ours, but there is an intermediate craft between the huge destroyers now building and the tiny motor boats with which we are experimenting that should meet the situation.

In the last war our destroyers were vessels of 1100 to 1200 tons. Now they are of 1630 and 1850 tons. Due to engineering and constructional advances, it is firmly believed that the smaller ship of today could be made the equal of the larger vessels of the last war while retaining the desired characteristics of the destroyer. The continuing search for a small craft to fulfill the true functions of the destroyer is evidence we have learned little about the type during the past 20 years.

ONLY in the submarine classification have we shown any reason. We have actually reduced the size of submarines in recent years. We experimented with gigantic craft carrying 6-inch guns, but we are now building an in-between type which seems to be successful. However, these ships are almost twice as large as those we were building when the last war ended. Two of the latter size, on the other hand, are under construction at present—indicating that we are again inclining to the proper belief that a small submarine, in certain situations, is more suitable. The airplane-carrying submarine, the submarine armed with a 12-inch gun, and other freak types which were experimented with in recent years by several nations have all been abandoned in favor of more generally useful types.

Our greatest weakness in submarines is our almost complete lack of mine-laying vessels of this type. We possess only one submarine mine layer and it is the largest submersible ever built for the American Navy. This is a type which has been tried and found successful, and still we have neglected it. It is high time we made up our deficiencies.

No discussion of this nature would be complete without a reference to the anti-aircraft defense of



Courtesy "Jane's Fighting Ships"

World's largest submarine: the French *Surcouf*. Submerged displacement 4300 tons. Carries two 8-inch guns, besides a number of smaller ones plus many torpedo tubes

ships and fleets. Mr. Edison has stated that airplanes have a temporary advantage over ships under modern conditions of warfare. Even if this be true, that advantage can be overcome by proper defense. Protection must be given the gun crews on all types of ships. In this respect, we are now progressing along the right course. Even our destroyers now have at least some of their guns mounted behind shields. The *Wasp,* however, our latest aircraft carrier, was commissioned with her anti-aircraft guns fully exposed to attack. Since attack from the air is precisely the moment when anti-aircraft weapons should be in use, greater protection must be given their crews. The belief that the top-sides of battleships could be shot away and the ship still operated is no longer completely true since the elimination of anti-aircraft weapons might leave the vessel open to fatal damage from attacking aviation.

While additional anti-aircraft defense in the form of protected guns must be provided on all vessels, thought should also be given to the provision of fighting planes as a part of the aviation complements of the larger ships. Ships operating alone or in small detachments must be provided with their own means of defense against aerial attack.

We are now contemplating the conversion of old destroyers into special anti-aircraft vessels (the British have had them for some time). Any such addition to a fleet's ability to defend itself against attack from the air must be encouraged, but reliance upon special vessels for such protection might find the necessary craft in the wrong positions and leave a fleet open to serious damage. The aircraft defense of ships had best be concentrated on the ships themselves.

Even considering these critical remarks, we may rest content that our ships, generally, are today the equals, if not superiors, of similar ships in any navy. Our desire should be to keep them to their present high standard. Adequate defense cannot be obtained by the adoption of freak types. A well-rounded defense consisting of tried types is our salvation. We cannot expect to build the ship in which the characteristics of every type is embodied. We must revert to a policy of clear-cut divisions between types, giving each the maximum striking and defensive strength suitable to it. We must limit each ship to reasonable size in order to avoid too great a loss to the whole when any one is destroyed. In short, we must continue the beliefs of earlier days and avoid, by all means, any tendency toward freakish types, for they have been found wanting in the past and have always been a sign of a weaker naval power. We cannot afford to be considered that.

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U. S. TANKS

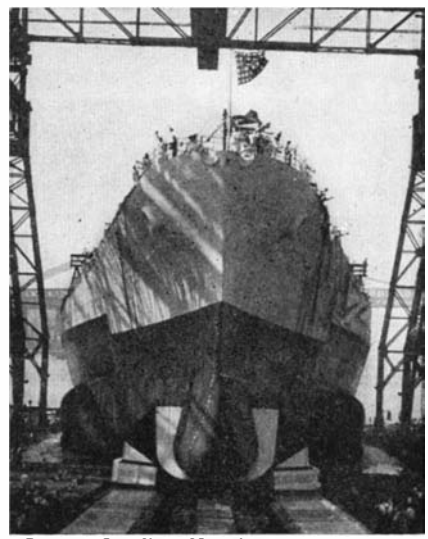
New Armored Corps Modelled After Those of Germany

READERS learned from Captain McInerney's article in the August Scientific American that the tank set-up of the American Army differed greatly from that of the destructively successful German Panzer Divisionen. Since publication of that article, the War Department has announced adoption of tank tactics similar to those of the Germans and the creation of an armored corps of two divisions on an experimental basis. All tanks and other vehicles formally assigned to the infantry and cavalry will be concentrated in the new corps which will consist of more than 18,000 officers and men. The corps will be equipped with 1400 tanks, 600 artillery pieces, and more than 13,000 automatic and semi-automatic rifles, according to reports. This new unit is made possible by a recent appropriation which included provisions for procurement of 3000 tanks for the army. Only about 500 are available at present.

This new, fully mechanized corps will be capable of striking at speeds of 50 miles per hour. It will probably be equipped mainly, according to official comment, with a number of heavy units about twice the weight of present medium tanks. Our Army does not use the 70 or 80-ton monsters such as those in the German and French Armies, and at present there is no suggestion that such tanks might be built by the United States.

"NORTH CAROLINA"

THE photograph below shows the launching of the *North Carolina,* the second of two battleships launched this year, the two marking the first expansion in our battleship force since 1920. The *North Carolina* will be of 35,000 tons displacement and will carry nine 16-inch guns; twelve 5-inch, 51 caliber guns; and eight 5-inch anti-aircraft guns; and four airplanes and two catapults. She will be approximately 35 percent welded instead of riveted, thus saving weight which can be utilized in other ways. Her cost will be an estimated $65,000,000.



Courtesy *Our Navy* Magazine

Launching the *North Carolina,* second of two launched in 1940

"ALL-AMERICAN" WAR

PROPAGANDA is a wondrous thing. It has made of Hitler, according to the welcoming phrases of German newspapers when he recently returned from the Battle of France: "A Genius for Commanding," "The Lord of Battle," "Leader from Darkness to Light." It has made of him a legendary hero of the proportions of a Napoleon and a Caesar rolled into one.

It will, however, help the logical processes of American thinking in developing our national defense if we remember that Hitler is but a man. Hitler does not direct the tactics of the German Army. Men trained in the science of war do the commanding. It is even doubted in some quarters whether it is his decision which unleashes the might of the Nazi columns according to the plans worked out by his military chieftains. Theirs is the knowledge of war; theirs must also be the knowledge of precise timing.

But he has brought to war so many new weapons and methods? Has he? Definitely not. The blitzkrieg is about as old as war, but Sherman's march to the sea is sufficient as an example. Only the speed is new. Tanks in large numbers? Hannibal had his herds of fighting, warrior-carrying elephants. And the tank is but a British adaptation of the commercial tractor developed by Americans. Airplanes are, of course, from an American invention. Dive-bombing is wholly American. Parachute troops? One radio commentator, whose authority we can trust, claims priority for the American Army in that tactic — even over the much-publicized Russian parachute experiments. But, we hear, the Germans are geniuses for industrial efficiency. Are they? They have but followed American technique for industrial planning and organization — a technique in which we lead the world. Indeed, mass production, as a system, was invented by an American: Eli Whitney, of cotton gin fame.

"Plan" is the whole secret of German success in war — plan, organization, co-ordination. And don't forget starvation — the tightened belts that made possible their tools of war. Hitler is not the secret. He is only the figurehead, the angel with wings of propaganda and feet of clay. It is German planning and doing and sacrificing that the world must beat. So far as American national defense is concerned, we *can* beat it hands down — and a dozen times over. Are we going to do it, or sit back, play politics, and say "What's the use? Hitler is invincible"?—*F. D. M.*

HOT OR COLD

WILL hot water freeze faster than cold water? An excerpt from *Science,* printed on the "Browsing With The Editor" page in our August issue, says "No." This answer to an age-old question promises to stir up one of those minor controversies that make interesting speculation.

Offhand, logic would plainly indicate that cold water should freeze faster than hot; both must be cooled to zero, centigrade, and logic dictates that the temperature differential is such that cold water will reach this point long before hot water. But may not this be one of those occasions in which logic is so plain as to lead the logician astray?

Such may be the case. Conflicting experimental evidence has been produced to answer the question both ways: hot water freezes first; cold water freezes first. Plumbers tells us that the pipes carrying hot water in homes will burst (but not necessarily freeze) before the cold water pipes, when exposed to low temperatures over long periods of time. But it has been rather definitely settled that this phenomenon involves the question of differences in quantity of dissolved air in the two systems.

What are the facts when the hot and the cold water are subjected to low temperatures under identical and controlled conditions? The family refrigerator, mixtures of ice and salt, the cold-storage box of the neighborhood butcher — all offer experimental possibilities.

No world-shaking revelations are promised by the answer to the question, but the editor will entertain the thought of publishing submitted results of controlled experiments made by readers. Here is a question that should be answered once and for all, if for no other reason than to prove or disprove the soundness of logic applied to a simple problem.—*A. P. P.*

LIGHT

"PEOPLE'S eyes never were intended to stand the more and more powerful illumination they are using today."

"You've complained of tired eyes, yet now you install a big 100-watt lamp only 18 inches or so above your desk to tire them faster. It isn't intelligent."

The desk really did seem pretty bright with the new lamp in its deep reflector; and it kept on worrying office callers. "Why, that's brighter than the sun," they said.

One day in May, when the sun crept high enough in the sky to shoot a brief noonday pencil of light down through one of New York's canyons and directly on the desk, overlapping part of the lamp's illumination with a sharp demarcated area of its own, the facts came vividly and literally to light: The lamp-lighted area, considered too bright by callers, now seemed only dusky by comparison. It looked like deep shadow.

The sun's light approaches 10,000 foot-candles but take 5000 as something like the natural outdoor level under which human eyes evolved. For regular reading, it is, however, pretty strong.

The science of seeing, according to its ablest authority, Dr. M. Luckiesh, Director of General Electric's Lighting Research Laboratory, reveals evidence that you could read this printed page easiest at 100 to 1000 foot-candles. As a temporary compromise it recommends at least 50 to 100 for difficult reading and 20 to 50 for ordinary reading.

It's easy to underdo working illumination — hard to overdo it. On lighting, the world is steadily learning a new set of values — higher. Ultimately, they'll go much higher, in accord with good science.—*A. G. I.*

Mud, Concrete, and Oil

Drilling Mud, Treated Like a Favorite Child, Makes Possible Wells Miles Deep

ANDREW R. BOONE

IN THE summer of 1858, Col. Edward L. Drake, a former railroad conductor willing to gamble on a strange new venture, started the first test bit into the earth at Titusville, Pennsylvania. He drove down a 36-foot casing and, using a wheezy six-horsepower engine, drilled inside the pipe. At a depth of 69½ feet, the Colonel discovered oil for the first time in history, and shortly thereafter sold his output at 60 cents a gallon.

Across the continent in sun-baked San Joaquin valley, near Wasco, California, a diminutive

Checking specific gravity of mud returned from circulation

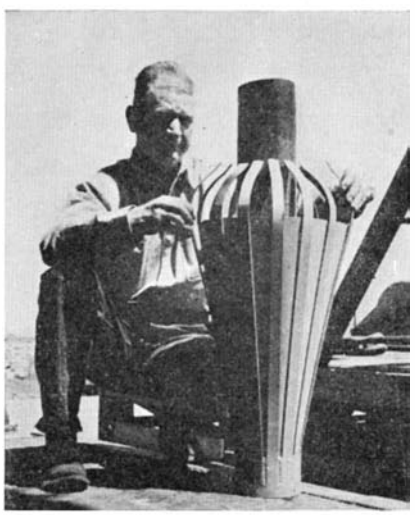
tool pusher named Louie Hopkins recently completed, for the Continental Oil Co., his ninth hole deeper than 13,000 feet. One of the wells drilled by Hopkins, the KCL-A2, hit bottom at the world's record depth of 15,004 feet, 215 times deeper than Drake's discovery. Whereas Drake's "Folly," as envious diehards dubbed the first exploration 82 years ago, barely pricked the earth's surface, in nine tries Hopkins has directed the bit downward a total of some 22 miles. From his deepest well oil is flowing upward more than 2½ miles. Instead of 60 cents a gallon, this oil, brought in at a cost of $300,000, fetches on the current market less than the small sum of three cents a gallon.

Diamond-tough drilling steels, borers ranging from bomb-like structures to rock smashers consisting of cones which rotate within revolving bits, new and more powerful steam engines capable of shoving mud down inside the drill pipe and thousands of feet upward again, basket-like cement plugs and pipe whose threads will not pull apart under the tremendous weight of 500 tons, make it possible to reach deep sands and bring their loads of black gold into production.

MUD testers and cement mixers make possible fast drilling and completion of wells uncontaminated by water and sand. On every deep-test rig you'll find a mud engineer on the job constantly. Drilling mud is a mixture of water and some powdery non-metallic mineral, such as gypsum, often fortified by several chemicals, including chestnut extract and quebrach. It is pumped down inside the drill pipe, out through the bit and up between the pipe and the walls of the hole. It must keep moving, carrying up cuttings, lubricating the pipe, and preventing cave-ins; otherwise the drill pipe will stick and the hole be lost.

Hopkins knows mud and treats it like a favorite child, for this sticky substance has given him an enviable record. He starts it down weighing exactly 95 pounds per cubic foot. After it has mushed through deep shale hot enough to boil water and has picked up a load of gas, he runs it through a series of paddles operating in vacuum, and returns it to a nearby pit to await the next trip down. The agitator removes the gas and reconditions the mud.

When at last the bit penetrates oil sand, cement men drive up with their mixers and prepare to wall off any water which may leak down



Expanding brass baskets keep concrete from below the casing

When concreting a deep oil well, men must work at top speed. The mix must reach bottom and return outside the casing before it begins to set

The wooden blocks that are used when concreting a well

from upper formations. Two plugs and an expanding basket make possible effective shut - offs. The basket is lowered to the bottom, and expands when concrete begins to press against its insides. This prevents the mix from moving down into the oil formation. A wooden block containing a hole through which the concrete may escape slides down the casing, following the basket to bottom. After the block goes a column of concrete, followed by an upper block which separates the concrete and the mud which powerful pumps force down against the upper block.

Not long ago a cement crew slashed open 1400 sacks and forced the mix downward, cementing a California well 11,000 feet deep in 30 minutes, 30 seconds. That was one record. "Shucks," commented the foreman of another crew next day, "we placed 2000 sacks in 24 minutes, 40 seconds." What he meant was, 50 workmen had prepared the mix, and two batteries of pumps had forced the gray slush down more than two miles and up 4200 feet between the casing and rocky walls of the hole in that time. Meanwhile, to prevent a jam, the cables had been picking up and lowering 425,700 pounds of drill pipe in 15-foot steps, as easily as you lift a kitchen chair.

Wells four miles deep are a definite possibility during the next few years. May they go on down farther to unexplored horizons, tapping little-known sediments that were laid down in remote geologic ages?

Colonel Drake little dreamed that his 25-barrel production would multiply by millions. He batted .1000 by bringing in a wildcat when friends and relatives hooted at his wild dreams. Louie Hopkins batted .666 on his nine deepest wells, but the six flowing today came in with 440 times more oil than the colonel found. Louie is ready to try his luck with a four-mile hole. All he wants is a good head of steam, enough pipe to reach bottom and a mixture of mud and chemicals which he knows from experience will keep the rig turning until he gets there.

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Under Mobile River

Vehicular Tunnel Built On Land, Floated Into Place, Shows Engineering Advances

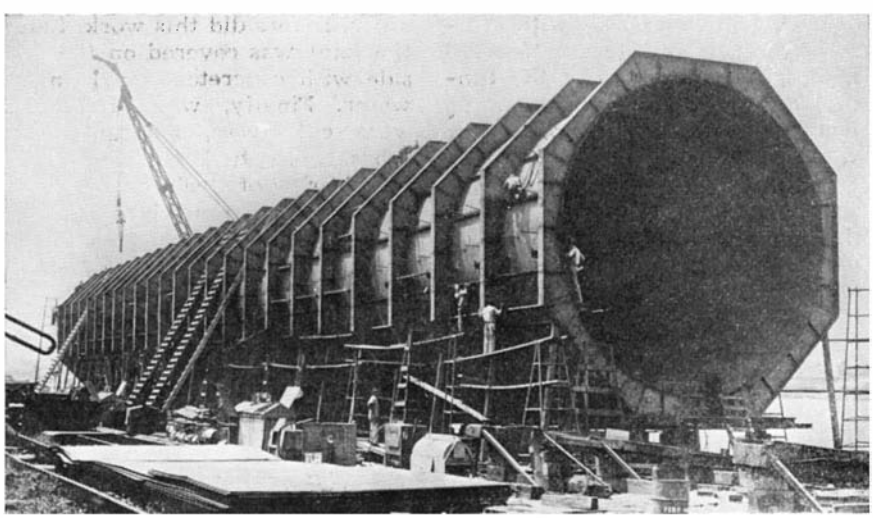
R. G. SKERRETT

MOBILE, Alabama, on the much traveled old Spanish Trail, has built, at a cost of $4,000,000, a different type of subaqueous tunnel for the convenience of automotive traffic. The tunnel will shorten the east and west route by 7½ miles, and will materially reduce heavy traffic congestion.

Mobile is at the mouth of Mobile River and at the head of Mobile Bay at a point 30 miles inland and north of the Gulf of Mexico. The city is Alabama's historic and only seaport. It is on the west bank of the stream, opposite Blakely Island.

Work on the Bankhead Tunnel, as the river underpass is called, was started in July of last year. It links Mobile with Blakely Island and connects with a 10½-mile causeway extending eastward from the island and spanning several narrow water gaps.

The under-water sections of the tunnel were built at a local shipyard, launched one by one, towed to a nearby slip on the west side of Blakely Island, and there brought to a stage of near completion before being moved to and sunk in a deep trench dug in the river bed. Five of the seven sections are each 298 feet long, and the two other sections are each 225 feet long. The under-river structure has a total length of 2000 feet; and near each shoreward end there is a transition section which connects with a rectangular or box-like section of the tunnel. At the Mobile end, an open ramp approach extends downward from the street level to the portal of the western section. On Blakely Island, the steel box section runs right up to



Partly finished steel framework of an under-river section. Steel plating covered the outer octagonal ribs, and concrete filled the space thus made

The top of the outer shell of this tube at Blakeley Island is open so that workmen may install wiring conduits, pour the concrete, and so forth

the ground surface, and is equipped with a steel gate which may be closed, in time of hurricanes, against water piled up on the island. The Bankhead tunnel has a total length of nearly 3390 feet between grade levels, and its roadway is 21 feet wide for two traffic lanes — eastbound and westbound.

The Bankhead Tunnel is similar in principle to the Detroit Tunnel, built in 1930, but differs in a number of particulars which represent engineering advances. Each tubular section of the under-river divisions is made up of an inner steel cylinder 30 feet in diameter surrounded by an octagonal steel tube that has a minimum diameter of 34 feet. The two concentric tubes were tied together by equidistant radial ribs, and the spaces between the two tubes filled with concrete before being finally sunk in the trench and covered. The inner tube of each section is lined with reinforced concrete not less than 18 inches thick. The top of the tunnel, in mid-channel, is about 46 feet below the level of mean low water.

Each end of each tube was sealed temporarily with a watertight steel bulkhead before launching; and concrete was poured into the inter-tubular space to a height of 10 feet to give each section stability when it was first launched. Steelwork was put together by welding; and, before launching, each tube was coated with soapy water and subjected to internal air pressure—any leak promptly blew tell-tale bubbles.

At Blakely Island, openings were cut in the top plates of each inner tube to give temporary access to the inside of a section so workmen could place the concrete lining, the conduits for power, lighting, and telephone circuits, the roadway slabs and the ventilating duct beneath the mid-section roadway for a distance of 400 feet. That done, the access hatchways were sealed, and the sections, starting at Blakely Island, were floated to the trench and sunk.

At the trench, the last of the concrete was poured into the spaces between the inner and outer shells until a section lost its buoyancy. It was held suspended in a sling and lowered deliberately. Succeeding sections were brought together by pulling the newly laid section, with ratchet turnbuckles, snugly against one already installed. A projecting ring on one fitted into an annular recess filled with a rubberized gasket on the other. Divers did this work. Later, the joint was covered on the outside with concrete poured underwater. Finally, when bulkheads were cut away, adjacent inner tubes were tied together by a welded ring of steel.

One ventilation building, on Blakely Island, is equipped with exhaust fans only which suck vitiated air into ports on both sides of the roadway level for 400 feet in the mid-section of the river part. No fresh air is blown into the tunnel, but the action of the fans at the low point is counted upon to draw fresh air inward and downward from both portals and maintain proper circulation. This arrangement is based upon experimental work of the U. S. Bureau of Mines. An unusual feature of the illumination is that, while lights are arranged to give proper illumination at all points in the tunnel, special additional lights are installed near each portal. These latter lights burn only during the day, their purpose being to make the transition more gradual for the eyes of the driver as he enters from the strong outside sunlight.

ROAD PROTECTION

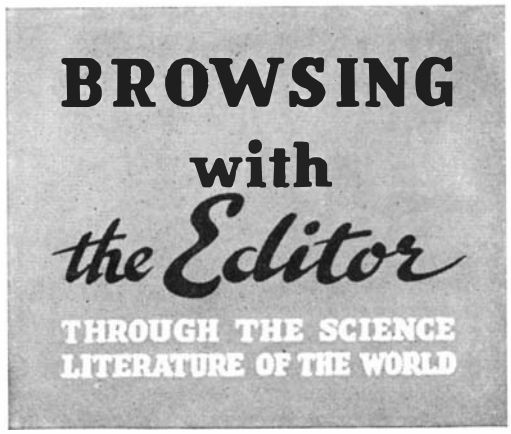
Bags of Green Concrete Laid as Rip-rap

ONE of the most troublesome problems of road building and maintenance is that of protecting slopes against erosion. Where run-off is rapid and in large volume, it is practically impossible to start sufficient plant growth to root the soil in place. In such cases, engineers often resort to use of rock rip-rap. In California, on some sections of highway, engineers are making their "stones" and, in addition, are making them so that they dovetail.

Because of bad wash-outs along highway slopes, and particularly where the water action is of such tremendous power that boulders five to eight feet in diameter are carried away, the slopes are being lined with bags of concrete. As an accompanying picture shows, these bags are filled with green concrete and then laid on the embankment in even, horizontal rows. In their damp state, the filled bags press down, one layer upon the other, so that when they harden, they fit into and hold each other tightly. The finished slope presents a pleasing appearance that could never be attained by use of rough stones.

Engineers are watching the results with this form of slope protection, for it is believed that it will be superior to ordinary rip-rap.

Man-made "stones" protect road



IDAHO WHITE PINE SUPPLY—White pine is being drained from the famous Idaho forest lands two and a quarter times faster than Nature restores it. By replanting now, stopping fires, and cutting timber scientifically, we can make restoration balance use in five decades.—"Forest Increment in North Idaho," U. S. Forest Survey Release No. 18.

HIT BY CARS.—In one group of pedestrian fatalities caused by automobiles in Wisconsin, 81 percent of the victims were unfamiliar with the operation of the vehicle which caused their deaths. Doubtless this condition is general, for Connecticut reports 94 percent of pedestrian fatalities were people not licensed to drive.—*Highway Research Abstracts,* July, 1940.

PLANES BY THE POUND.—The thousands of warplanes Uncle Sam is ordering for defense will cost about $7.50 a pound. The announced goal of 50,000 a year means the production of over half a billion pounds of airplanes, engines, and propellers.—*Science Parade,* July 13, 1940.

LIGHT AND ACCIDENTS.—The National Safety Council estimates that 5 percent of industrial accidents—in other words, $75,000,000 worth—are caused by poor light.—*Industrial Bulletin* of Arthur D. Little, Inc., Number 153.

RENTED AIR CONDITIONING.—An air conditioning system that can be rented by the day or evening, along with the auditorium it serves, has been installed in the Jewish Community Center in Detroit. Ice is used to provide cooling during periodic uses of the system.—*Refrigeration and Air Conditioning,* June, 1940.

FURNACE RECORD.—A blast furnace of the Otis Steel Company has probably achieved the record of operating for the longest period of uninterrupted use ever obtained on a single blast furnace lining. From May 1930 to May 1940 it operated continuously without being blown out, producing in that 10 years 1,735,500 gross tons.—Hill & Knowlton notes, May 17, 1940.

STRAIGHT ROAD.—An Italian "autostrad" across North Africa has one stretch 400 miles long without a sharp turn.—W. C. Lowdermilk, *American Forests,* July, 1940.

SHIP UNLOADING.—Ships that unload themselves with the aid of belt conveyors, which have been in use for more than 20 years on the Great Lakes, are beginning to win acceptance on the Atlantic Coast, where the second ocean-going vessel thus equipped has recently been put into service.—*Oil-Power,* July, 1940.

FOREST FIRES.—It is not improbable that, in the daylight hours, an average of one forest fire is set every two minutes in the United States—probably every minute during the vacation months. This is an indictment of people who are careless in the use of tobacco, because that is the cause of most of our forest fires.—*News,* New York State College of Forestry.

LOCOMOTIVES.—The American railroads have 46,544 locomotives, of which number 45,210 are operated by steam, 882 by electricity and 452 by gasoline or oil.—Association of American Railroads.

CONSERVATION FOR DEFENSE.—Conservation today takes on new importance because of the urgency of national defense. A country's natural resources sustain its defensive and combatant power. This is true of forests no less than oil and other natural resources.—*American Forests,* July, 1940.

ARTIFICIAL RUBBER COST.—The cheapest commercial "synthetic" rubber today costs about twice as much as the natural product.—Lawrence A. Wood, Ph.D., Circular C427, National Bureau of Standards.

SILICOSIS.—During 1939, 91 miners were certified to have died of silicosis and 355 certified to have been disabled by the disease in the South Wales coalfield.—*Nature* (London), June 22, 1940.

AIRPORT PAVING.—The new Washington, D. C., airport will have a total asphalted area, including four huge runways, parking areas, and roads, equivalent to 83 miles of highway 18 feet wide. What is purported to be the world's largest airport, in Newfoundland, has the equivalent of 116 miles of 18-foot asphalted paving.—*American Petroleum Institute,* July 7, 1940.

ON THE 'PHONE.—Americans, person for person, telephone 14 times more often than the rest of the world. Furthermore, this country has about half the world's telephones, and makes something like 1000 calls a second.—*Telephone News Bulletin,* May, 1940.

INDUSTRIAL ALCOHOL.—Approximately 198,467,000 pounds of corn and 202,631,000 gallons of molasses are annually manufactured into industrial alcohol.—*Monsanto Magazine,* May, 1940.

SHOCKING EELS.—An electric eel may discharge as much as 1000 watts of electricity at a voltage of 600. This discharge is at the frequency of 200 or 300 times a second.—*The Lamp* (Standard Oil Company of New Jersey), April 1940.

MORE SOYBEANS.—Soybean production in the United States has multiplied 22 times in the past 15 years, 17 times in the past six years.—*American Chemical Society.*

BULLS SEE NO RED.—The popular idea that bulls fight when they see red has long been exploded. The bulls are color-blind. It is the movement, not the color, that infuriates.—*Science Parade,* May 6, 1940.

EXPLOSIVES BY RAIL.—Railroads of the United States and Canada in the past 13 years have transported billions of pounds of high explosives, including dynamite, black and smokeless powder and explosive ammunition, without accident, death, or injury.—Association of American Railroads.

STOP AND GO.—A mere 15 years ago, a green light on Fifth Avenue, New York City, meant "stop," yellow meant "go," and red meant "caution."—*Science Parade,* May 4, 1940.

AUTOMOBILE EXHAUSTS.—Gasoline burning in automobiles produces enough carbon dioxide in a year to make 160,000,000 tons of "dry ice."—*The Lamp* (Standard Oil Company of New Jersey), April 1940.

Helicopters

Rotating-Wing Aircraft Exhibit Desirable Characteristics for National Defense

ALEXANDER KLEMIN
Aviation Editor, Scientific American.
In charge, Daniel Guggenheim School of Aeronautics, New York University

THE writer of these notes has been criticized for allowing the school of aeronautics with which he is associated to give real attention to rotating-wing aircraft at a time when the airplane is so important as a means of national defense! But is it not possible that rotary-wing aircraft—autogiro or helicopter—will also serve most usefully in national defense? At least a wise and experienced engineer—Igor Sikorsky—is of this opinion, and voiced his views strongly and persuasively at a recent meeting of the Society of Automotive Engineers.

The airplane, by the nature of its design, will always be faster than the helicopter—say 500 miles an hour against a potential 300 miles an hour for the rotating-wing craft. However, for defensive military purposes the helicopter can perform in a number of ways which are impossible for the airplane. Let us quote Mr. Sikorsky.

"For example, to interpose an effective defense against bombers or dive bombers, the helicopter seems to me to be ideal. It can stand still in the air, thus affording a stable gun emplacement from which the gunner can await the moment—which must come either in altitude bombing or dive bombing—when the bomber ceases all zig-zag maneuvering and flies a straight line for its quarry. Then the bomber is comparatively easy to hit. The helicopter, of course, can easily have altitude performance up to 15,000 feet or more and can carry large-caliber machine guns or even cannon."

The helicopter can also remain poised above strategic spots. It can evacuate the wounded, particularly at night. By descending within reach of the ground to pick up man and litter, the helicopter can act as a perfect air ambulance. Again, said Mr. Sikorsky, "once launched from a battleship or cruiser the airplane can be recovered only by alighting on the sea, if it is smooth enough, while the craft is lifted aboard. Obviously, in battle, major units cannot stop to pick up aircraft even if conditions of wind and water make this possible. The helicopter however, would require only a platform or deck space of about 40 feet square from which to take off and on which to land. It could follow every dodging movement of the surface craft, flying backwards, sideways or forward at will and always itself afford a steady firing point for its defensive guns."

Landing gear for the helicopter would be rubber bags rather than wheels and on these bags the machine could use land, water, ice, snow, a vessel, or a building for a take-off or landing. Pilots could be trained to fly a helicopter with relative ease.

Mr. Sikorsky has made a logical and strong plea which should not be forgotten.

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AIRSHIPS

Still Hold Possibilities for Military Purposes

GENERAL opinion, public and aeronautical, is that the airship is dead, that it is too slow and vulnerable for fighting purposes, too slow for transoceanic passenger work when the Clippers can fly three times as fast. The Navy Department does not agree with this view. A special board on the lighter-than-air situation reports to the effect that in spite of all disasters and speed inferiority, relatively small rigid airships should be built.

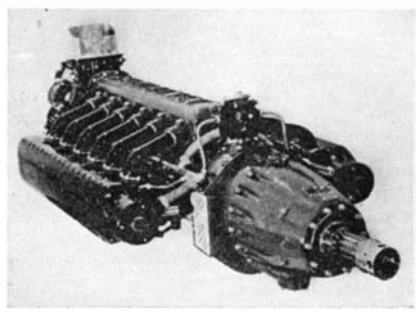
With its ability to carry airplanes, the rigid airship can be best compared with a cruiser or an airplane carrier. The cruiser is capable of about 30 knots sustained speed for three days; the modern airship can deliver 60 knots for six days. The airship can be conceived as an airplane-carrier immune to mines, torpedoes, and submarines, which could well proceed overseas and, lying well off an enemy coast, launch a successful airplane attack. The airship would be most useful in long range observation, scouting, reconaissance.

Of course, we could cite many arguments against further airship effort. But to build a small dirigible of 3,000,000 cubic-feet capacity, at a cost of $3,500,000 for training of personnel and experimental purposes is an idea worth considering. —*A. K.*

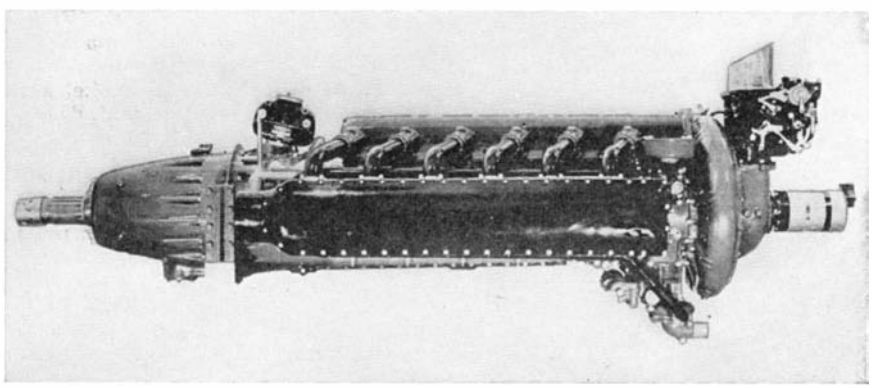
ENGINE

"Submerged" Design Increases Flying Efficiency

AS the drag of landing gear, external supports, and even of the fuselage is reduced, and the airplane approaches the ideal of the "flying wing," it becomes more and more important to eliminate the drag of exposed engine nacelles.



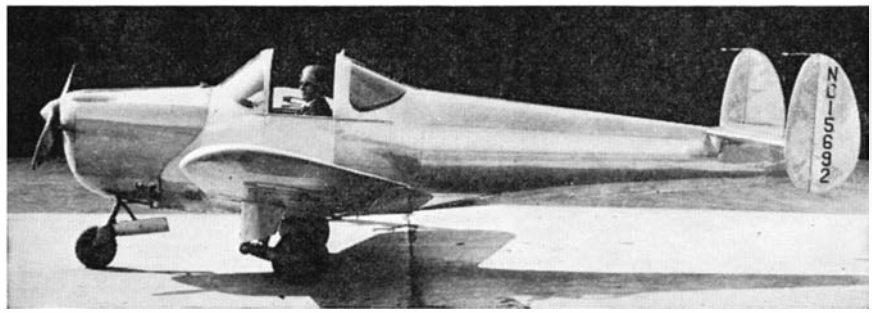
Two views of the "submerged" Lycoming engine for aircraft



Designers advocate the "submerged" engine—that is, an engine which is enclosed completely within the wing—and argue that the hidden engine will decrease fuel consumption and increase speed. Now, the Lycoming engine division of Aviation Manufacturing Corporation has produced a novel "flat" engine which should meet with immediate application in our military and naval aircraft.

The Lycoming flat engine is illustrated in two of our photographs. There are 12 cylinders, six on each side of the crankshaft. The over-all height is only 37 inches compared with the 49- to 54-inch diameter of the conventional radial air-cooled engine. The low frontal area and low height makes it perfectly feasible to house the engine completely within the wing. Of course, the problem of airplane balance has to be met, since the weight of the radial engine is located quite far forward, relative to the rest of the airplane, but designers will meet the situation. Also, the flat engine, being liquid cooled, has to have a radiator. But the radiator can be filled with Prestone which operates at a much higher temperature than water, and hence the radiator can be quite small. Further, the radiator can be ducted or streamlined partially in the under side of the wing.

Altogether this is a praiseworthy and promising development, which comes at the right time in the national defense emergency.—*A. K.*



Side view of the Ercoupe, practically spin-proof

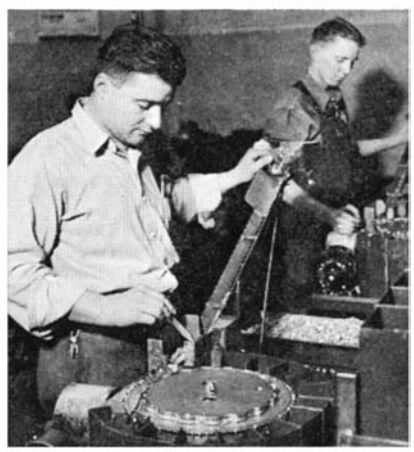
RIVETS

Salvaging Methods Cut Costs in Airplane Assembly

PRODUCTION engineers of the Glenn L. Martin Aircraft Company long ago discovered that it was cheaper to let lie the rivets dropped accidentally on the airplane assembly floor than to have operators take time out to pick them up. The riveter's time is valuable; a skilled worker is expected to drive 1000 rivets a day. Nevertheless, dropped rivets represented a real problem, since a pound of aluminum rivets costs approximately one dollar, and some 60 pounds of the rivets were swept up every day. A team of boys used to sort out the rivets by hand, but it was slow and uneconomical work to separate the round-head and flat-headed rivets and those of varying lengths and diameters.

Now the tool designers have developed a rapid, semi-automatic process. An electro-magnet is passed over the floor sweepings, snatching up extraneous steel and iron material. The residue is chiefly rivets of some 150 different kinds. Next, a series of sifters sort out the rivets for diameter in much the same way as gravel is graded. Then a mechanical device separates the rivets for length; the rivets travel around the perimeter of a wheel until they are knocked off by the length gages. To expedite the process further, a little hand-operated machine has been developed which serves to separate round-heads from flat-heads. The round heads drop out first, the flat heads next.

Obviously, our tool designers will play a not insignificant part in the national defense effort.



Steps in salvaging rivets. Lower left: Sorting for diameter with sifter. Above: Sorting for length. Below: Separating round-heads from flat-heads

UNCONVENTIONAL

Combined Features Make Spin-Proof Airplane

WE have for several years been of the opinion that all the aerodynamic factors required to give us a spin-proof airplane were already available. A new, somewhat unconventional airplane, the Ercoupe, seems to come near to this safety requirement. At least no inspector of the Civil Aeronautics Authority has been able to spin the new machine.

While the wing of the Ercoupe is thick throughout, and is externally unbraced, it is rectangular in plan form — there is no taper. With a sharply tapered wing, the tips stall first. With a rectangular wing it is the center section which stalls first. Moreover, the leading edge of the center section is brought down to a sharp V, and this again tends to make the center stall first. With the center stalling first, there is no tendency to fall off on one wing — an initial step in the spin. Again, the two rudders are quite clear of the fuselage, being carried at the ends of the horizontal tail surface. Therefore, at high angles of attack, with the nose pulled up sharply, the vertical surfaces are not blanketed in any way, and retain their full effectiveness.

But there is still another factor which is a spin safeguard for the novice pilot. The upward travel of the elevator, which of course tends to raise the nose of the aircraft, is strictly limited. Thus the novice cannot readily put the machine in a stalled attitude.—*A. K.*

No Short-Cut Horticulture

Plant Growth Chemicals Require Painstaking Care, Promise Significant Results

PHILIP H. SMITH

THERE is a widespread impression that chemistry is leading horticulture and agriculture into a new era, marked by the abolition of the hoe, the wheelbarrow, and the spraygun. Given a pill or a powder and the novice will become an expert overnight, flowers and vegetables will increase from half-dollar to dinner plate size, and meals will be plucked from fire-escapes. But why go on?—your imagination is as good as mine.

Plant chemicals can accomplish wonders. Some make possible plant growth in water solutions, quite remote from soil; some will stimulate root growth on cuttings; others will make fruit form without pollination. There is one chemical which induces root growth on backward plants, and another which enables the hybridizer to create new varieties which nature might never get around to do.

In reporting these wonders, scientists have given fact, not fancy, and no further confirmation is needed. All fact can be visually substantiated in this or that laboratory. But the layman asks the significance of all this to him. "Can I," he says, "get results with the chemicals? Is water culture commercially feasible? Can grandma's begonia be reproduced by a tyro?"

At the risk of posing as an old meany, I must declare that horticulture is about where it was before the advent of these chemicals, except that there are probably more bugs in the world. But the use of chemicals introduces something new, promising, and anchored in scientific fact. It offers means to experimentation and acquisition of knowledge about plants; it promises little ease and less profit.

Gardening without soil, variously called tank culture, tray-farming, and hydroponics, has developed fast and in a number of directions. There is now great variety in form and composition of tanks, in the constituents of the nutrient, and in the method of feeding. Experimenters seem to favor the system known as gravel and cinder culture. Here, the plants actually grow in gravel or cinders and are fed periodically by sub-irrigation.

Successful tank culture calls for sunlight and air. These elements are quite as essential to growth as in soil culture. Thus an immediate requirement is outdoor or greenhouse location, and whatever the solution fed, it must be properly aerated. Temperature, too, is important and for best results there must be a carefully controlled differential between air and solution temperatures and between day and night temperatures. Once the general procedure has been determined, there remain such technical problems as: character of water used, acidity of the solution, proper replenishment of salts in the nutrient to replace unequal consumption by the plants and losses by precipitation, toxic effect of tanks and beds, and the precise timing of every operation.

Science Service photograph

Colchicine doubled the chromosomes in this peach tree at Beltsville, Maryland

Gravel and cinder culture is recommended as having these advantages: elimination of cultivation, watering, weeding, fertilizing, soil changes, and many soil-borne diseases; control of the type of growth; and virtually automatic operation. However, these advantages must be weighed against the cares outlined in the foregoing paragraph to determine the net gain, even assuming profitable operation. Some people prefer scratching the soil to reading thermometers, minding valves, or keeping accurate records.

The number of persons operating commercially successful hydroponic farms can be counted on your fingers, although the number will doubtless increase. It is a highly exacting and specialized performance and at this stage its costs are such as to limit its practical possibilities to areas where out-of-season crops demand premium prices, where there is lack of good soil, or where the soil is so poor that it takes heavy outlay to keep it at par. Certain geographical sections are unsuited to hydroponics because in off-season, when crops are wanted, the sunlight is inadequate.

DEVOTEES of hydroponics declare that tomatoes have been raised successfully in water solution and the fruit is of superior quality. This is true. But it has not been proved definitely that the same care and control applied to soil culture would not produce a comparable crop. The successful hydroponitian is a man who has acquired an intimate knowledge of the plant he grows—its habits and climatic needs, its mode of propagation, and the control of pests and diseases—usually from previous soil culture.

The uninitiated believe the critical factor in hydroponics to be the chemical formula, but this is secondary to the facts just mentioned. The problem of what to feed has been pretty well solved and formulated chemicals can be bought in the market. Of the several formulas in use, there is little variation. A good all-around composition calls for potassium

phosphate (monobasic), potassium nitrate, calcium nitrate, and magnesium sulfate, to which is added minute amounts of iron, boron, manganese, zinc, and copper. Waters differ greatly as between geographic areas, hence the experimenter must modify basic solutions to obtain proper salt content if he would obtain good results.

Far more interesting than the water-solution chemicals are the hormone-like substances which modify or regulate plant growth. These chemicals are called "hormone-like" because they are substances thought to act like unknown plant hormones. They are not laboratory syntheses as is widely believed. As a matter of fact, those which induce root growth have never been found in plant life. There are some 50 of them known to scientists as being capable of playing tricks on plants, but there are only three in common use today. These are naphthaleneacetic, indoleacetic, and indolebutyric acids. Of these, the last named has proved most satisfactory because it is effective over a wider range of concentrations.

THE root-inducing power of these chemicals is unquestionable. If they are applied to leaves or flower stalks, for example, roots will grow from the places touched. The immediate, practical value of these substances is in the propagation of plants and shrubs from cuttings, either to hasten the process of root formation or to make roots grow on cuttings of species ordinarily non-rooting. Common practice is to dip the basal end of cutting in a solution of indolebutyric acid for 24 hours, or to dust with a powder composed of hormone and talc; otherwise propagation technique remains unchanged.

It would be a serious mistake to assume that these substances are infallible because they have had certain unparalleled success. Combined with the capacity to induce roots, is a like power to retard growth and inhibit bud formation. Sometime the technique may be worked out to take advantage of these added powers, but at present they impose care lest too strong a concentration kill the entire cutting. Root inducers do not eliminate the seasonal factor in propagation, nor will all species respond to their coaxing. Every variety of plant or shrub has its own peculiarities which must be given consideration. In general, leafy cuttings respond much better than hardwood cuttings, whatever the species.

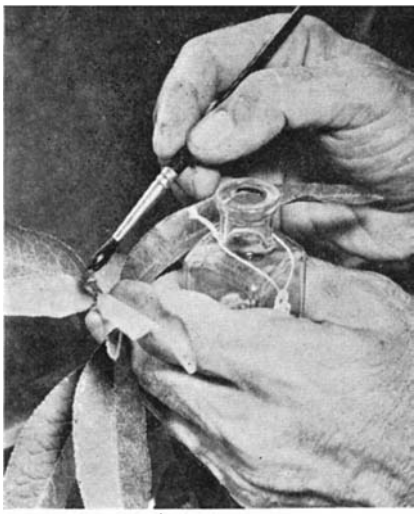
The hormone-like substances can do more than induce root growth. Artificial stimulation of fruit—that is, the formation of fruit without pollination—is one of the achievements. The classic example is the manufacture of red berries on the American holly. When the male tree is too far from the female tree to permit transfer of pollen, no berries are formed from the female flower. Here

Courtesy *Industrial and Engineering Chemistry*

One way of drugging a plant: treating seeds with colchicine

naphthaleneacetic acid comes to the rescue. Spraying the flowers with a solution of the acid will cause berries to be formed. They will be seedless, but who cares at Christmas. The practical value of this treatment is another story. The acid costs more per ounce than gold, and the most economical solution to the production of red berries would seem to be to plant more male bushes. However, this type of experiment hints at the future production of seedless fruits and vegetables—seedless tomatoes, for example, for persons allergic to tomato seeds.

Experimenters report success in the use of these chemicals for restoring the viability of seed. This would be a boon to seedsmen, not to mention the backyard gardener who invariably ends the season with a surplus of packaged seeds and hesitates to use them the following year lest it spell crop failure. Other claims for these hormone-like substances are: acceleration of seed germination, increase of crop yield, inhibiting of fungi growth, particularly of the damping-off variety, increase of



Science Service photograph

Simpler than soaking: painting slit twig-tip with colchicine

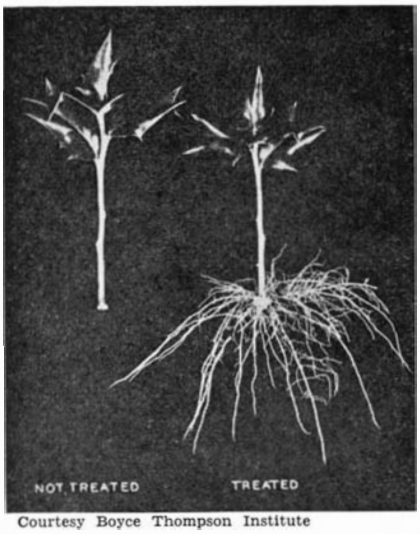
callus formation in grafting, the speeding up of bulb development, and the building of better lawn turf. However, no use of chemicals has reached the "simply add hot water and serve" stage, and until the amateur can maintain a cheerful attitude in the face of failure, he would do well to await more conclusive proof of these last mentioned wonders.

Seed catalog fans have been given a genuine thrill this year by the announcement of a chemically-produced variety of marigold. This is the first commercial offering arriving from the use of the powerful drug colchicine.

THE discovery that colchicine can retard cell division and multiply the number of chromosomes in a plant has occasioned wide speculation. Are we about to see the family-sized vegetable? Is the genius of the laboratory about to produce a Frankenstein monster? Well, there are limits to what colchicine will do. If breeding experiments begin with a squash, they end with one, although the new squash may be bigger and have qualities assembled to the breeder's taste.

Colchicine does put a very valuable tool in the hands of hybridizers and the result will most certainly be a quickening of new variety origination. What the drug really does is accelerate the natural process of breeding, to accomplish in comparatively short time what nature might take generations to do if, and when, she got around to it.

A stumbling block to breeding has been the difficulty in producing hybrids that are fertile, hence capable of reproduction. Sterility



Courtesy Boyce Thompson Institute

Hard-to-root holly. An example of chemically induced roots

is the rule; fertility the exception or the happy accident. These accidents are produced in nature without regard for time, and man's only improvement over the natural process has been to multiply the chances of an accident by mass planting and crossing. Colchicine, while not infallible, increases the number of chromosomes in many plants—doubling, tripling, quadrupling, dropping one chromosome off or adding one—to produce fertile hybrids. Thus the progeny, in turn, become capable of breeding, and the work of crossing, re-crossing, and back-crossing can proceed apace until the desired qualities have been assembled within a single plant.

It is conceivable that hybridizers may be able to use chemicals on annuals and give them a perennial quality. This would eliminate yearly planting. It might be that perennials could be endowed with qualities found only in annuals. There can be breeding to give plants resistance to diseases. This last has been accomplished already by older methods of trial and error, but now it can be done with more speed and certainty. Perhaps colchicine will produce results which never could come about by the happy accident system. If this proves to be true, the potentialities of the drug treatment can hardly be estimated at this stage of development.

The most recent chemical to be put before the public is Vitamin B-sub-one. Extraordinary claims are made for it, but very few can be substantiated. Certain species, notably camellias, orchids, and gardenias, are said to profit greatly by its use, probably because the plants cannot themselves produce enough of the vitamin for proper growth. All plants must have the vitamin, but most plants manufacture it and most soils have it in sufficient quantity. If the humus content of a garden is adequately maintained, use of the vitamin is superfluous.

If one tracks down to its source a tale of great success with Vitamin B-sub-one, it will be found very generally that the user has neglected to establish controls. Unless untreated stock is planted side by side with treated stock, no valid conclusions can be drawn. "Bigger and better" must always be qualified by reference to some controlled standard.

All this work with chemicals has great significance. It is widening our knowledge of plant life and opening new vistas for scientific exploration. Scientists and hybridizers will carry the work forward, but even the layman, if blessed with bright green thumbs, can make a contribution. There are a host of variables and unknowns left to be worked upon in the field and every successful field operation can be a contribution.

But don't forget. Plant chemicals are not labor-saving devices, nor are they panaceas for horticultural ills. If their role is not fully appreciated, there can be bitter disillusionment. If applied commercially at this stage by those who are inexperienced, they afford a quicker way to dissipate a fortune than raising chickens. They are, on the other hand, excellent tools for better and more intelligent plant cultivation, and their use offers the amateur an A1 hobby.

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EFFICIENT TURBINES

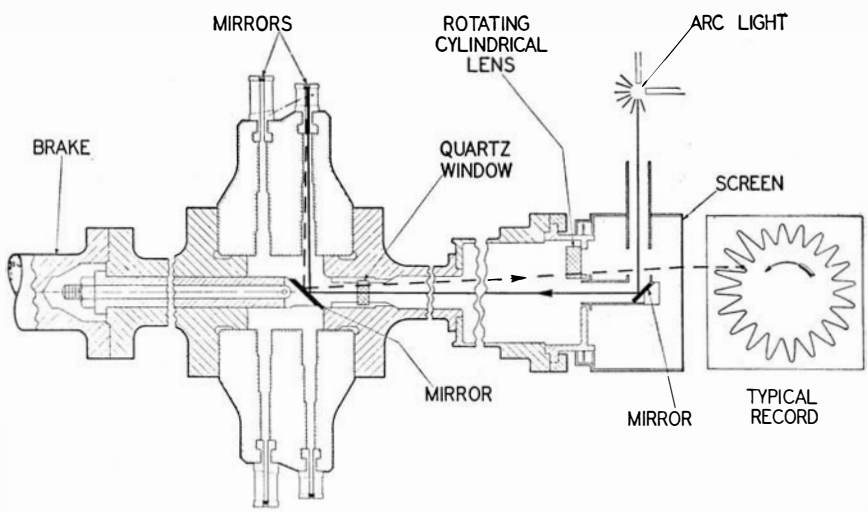
Cheaper Electricity Should Come From New Installation

MORE efficient and safer steam turbines, meaning cheaper electricity for everyone, should come from the new, full-sized but completely experimental turbine installation displayed recently at the Schuylkill Generating Station of the Philadelphia Electric Company.

The man behind this research, expected to furnish the bedrock of experience for tomorrow's sources of power, is F. T. Hague, engineer of the Westinghouse Electric and Manufacturing Company. In his laboratory studies he had pushed turbine steam operating characteristics up to 1250 pounds pressure and temperatures of 900 degrees—hot enough to melt lead. What he needed for a final test was a life-sized installation and a plant boiler capacity which could create the 125 tons of steam needed, each hour, to run such an installation. The plant of the Philadelphia Electric Company provided such capacity.

Moreover, this installation had to have some means of looking inside it and seeing how the turbine blades were vibrating under the extreme shock. "To form a mental picture of this shock," Mr. Hague explains, "imagine a turbine blade moving 350 miles an hour abruptly entering a steam jet density moving 1200 miles an hour." Oscillations at the rate of 126,000 times a minute occur in the blades, or 181,440,000 per 24-hour day.

Just as trees sway in a gale, so, too, do the turbine blades sway and



Optical system of the set-up for studying turbines in operation

vibrate under this super-hurricane of hot, "live" steam. If the vibrations are just right the blades enter into what engineers call resonance. Eventually they break off as their sway becomes greater and greater.

While the turbine blades are whirling some 60 revolutions a second around the turbine shaft, an automatic camera takes pictures through a tiny quartz window in the shaft at the rate of two a second.

"With this new apparatus," Mr. Hague explains, "a beam of light is carried through the shaft of the turbine and up into the blade itself, where mirrors reflect it out again, faithfully recording all vibrations. In this manner the harmonic movement of the blade can be recorded on film for any stated condition of operation.

"The light beam, supplied by an arc lamp, is deflected by a stationary mirror into the rotating shaft," he pointed out. "A slanted mirror inside the shaft throws the light beam through a hole in the rotor disk and then through a smaller hole inside the blade, towards a small curved mirror on the end of the blade. This curved mirror sends back the light by way of the slanted mirror in the shaft, to a screen.

"When the turbine rotates without vibration, the light point on the screen describes a circular path. But when the blade vibrates, the curved mirror mounted on the end of the blade deflects the light beam away from this path and waves or notches appear on the circle. The wavy circle described by the light is recorded on film by a specially designed speed camera.

"By study of the resulting pictures the stresses on the blades are deduced directly from the magnitude of the waves by proper calibration. By shifting the mirrors, it is possible to measure side-to-side as well as back-and-forth vibrations."—*Science Service.*

STAR "JACKETS"

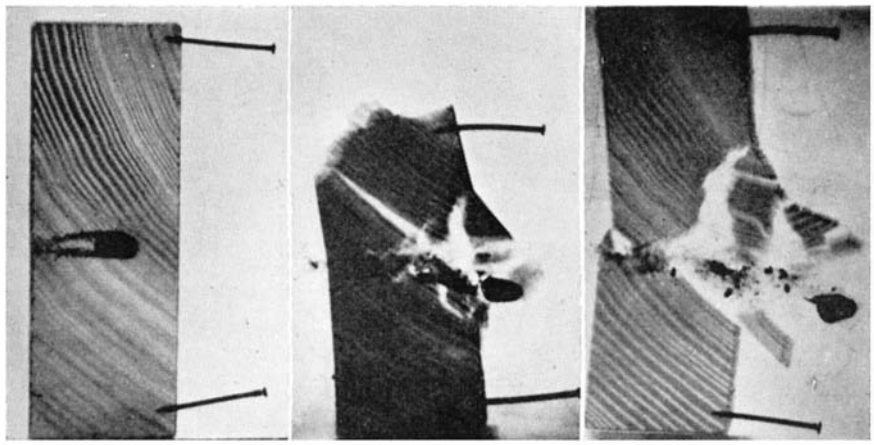
Iron Shells May Yield New Information

FROM iron "jackets" which encase certain stars and give out peculiar kinds of ultra-violet light, incapable of reproduction in laboratories, physicists hope to learn more about the atomic structure of important earthly metals.

Reporting in the *Astrophysical Journal* on researches he has made at the McDonald Observatory of the Universities of Chicago and Texas, Dr. Otto Struve, director of the Observatory and also of the University of Chicago's Yerkes Observatory, declares:

"The importance of this work consists in the fact that it provides information about some of the most common and useful substances, including chromium and titanium as well as iron. Such information can be found only in the stars."

The metallic jackets around these stars are in gaseous form, at temperatures far higher than the boiling point of iron. Subjected to this intense heat, the atoms give off radiations which cannot be produced on earth, partly because there is not enough gaseous iron on the earth, and also because such high temperatures cannot be reached. For this reason, physicists refer to these radiations as "forbidden." — *Science Service.*



Three X-ray snapshots of bullets piercing blocks of wood. In center photo, note trail of lead; in right photo, bullet literally explodes wood

X-RAY SNAPSHOTS

Millionth of a Second With New Ultra-High Speed X-Ray

A RIFLE is fired in the research laboratory, and a bullet tears through a block of wood placed between an odd looking glass tube and a flat aluminum box. A football player boots the pigskin from its strange perch atop the same box. A golfer drives a ball from a makeshift paper tee on the box.

And in one millionth of a second —less than one twenty-thousandth of the time required to blink an eye —the glass tube produces and releases a heavy surge of penetrating X-rays. A few minutes later, on an X-ray film taken from the aluminum box and developed, Westinghouse research engineers can learn exactly what has happened during the millionth part of a second as the bullet plowed through the wood, the football player kicked the ball, or the golfer made his drive.

Development of a new ultra-high speed X-ray tube which enables engineers to make these fast X-ray "stills" was announced recently by Dr. Charles M. Slack, research physicist for the Westinghouse Lamp Division.

Westinghouse engineers believe development of the tube may presage a day when many desirable and hitherto impossible tasks may be accomplished. Machine and motor builders, for example, will be able to study internal strains in rapidly moving parts. Makers of sporting rifles, shotguns, and ammunition may determine any slight deflection of a bullet in its passage through a gun barrel, or observe the distribution of shot at various points in its flight from shotgun shell to muzzle. It is even held possible that X-ray motion pictures may be made of such parts and objects, and many others.

ATOMIC POWER

Released Spontaneously By Uranium

ATOMIC power is released from uranium spontaneously without atom-smashing bombardment with neutrons, two Leningrad physicists report in the *Physical Review,* American Physical Society journal. But the observations of the two Soviet scientists, Flerov and Petrjak, hold out no hope that there will be any practical utilization of this energy from the splitting of the uranium atom. Only six fissions an hour were discovered.—*Science Service.*

Physics In Court

Computations by Which Police Can Work Out Driving Speeds from Skid Marks after Accidents

C. W. SHEPPARD

ALTHOUGH the determination of the minimum speed of automobiles by the length of their skid marks has been known in courts of law for a good many years, it was not until quite recently that it was put on a systematic basis. Since 1938 such cities as Evanston, Illinois, and Pasadena, Calfornia, have been keeping a systematic record of all skid marks left on the street after traffic accidents, and in the later city, due to the unceasing efforts of Police Physicist William W. Harper, such evidence has become of increasing value in convicting law violators.

Let us consider a typical case which recently came before a western court. A man and his wife were crossing the street. It was after dark, and in a section of the city which is not too well lighted. A driver ran into them, inflicting severe injuries. Measurements showed that the car skidded 65 feet after the driver applied the brakes. From simple calculations based on this evidence, his speed was shown to have been at least 40 miles per hour and, even in the absence of eye witnesses, he was convicted of exceeding the speed limit, on a basis of the skid alone.

The computations involved in such a case are simple. Those who can recall their elementary physics will know that the distance d, which a body of velocity v will travel under a deceleration, a, is given by the formula $v^2=2ad$. This formula can be changed slightly to be more useful. If v is given in miles per hour, d in feet, and a is expressed as K (its percentage of the acceleration of gravity) the equation becomes $v^2=30Kd$. To illustrate, let us suppose that a car has a braking power, K, of 70 percent. This means, that, during a stop, it will have a force on it equal to 70 percent of its weight, which will slow it down at the rate of 22.4 feet per second every second. This would be approximately the conditions encountered on dry pavement with ordinary tires.

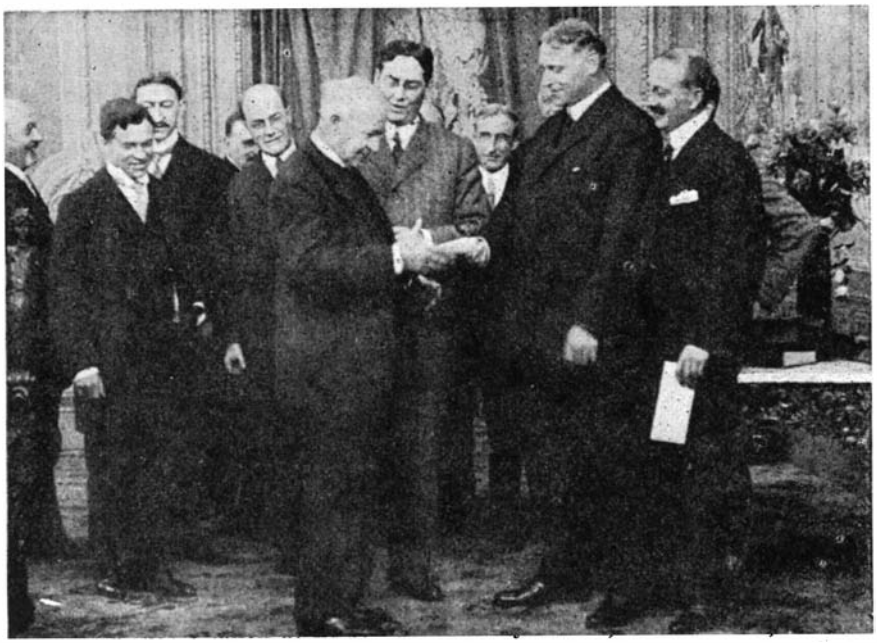
The value of K is known for a good many types of tires and road surfaces, but, unless it is impossible to do so, calculations are based upon test skids made with the car itself. This method makes use of the fact, as seen from the formula, that the length of a skid increases as the square of the speed of the car. One must remember that, once the car begins to skid, the length of the skid becomes a matter of tire and road surface, independent of the effect of the brakes. Any wheel which is not skidding will be so close to skidding as to be under substantially identical forces. The procedure is as follows: Assuming that the car is not severely damaged after the accident, three trial skids are made at a speed of 20 miles per hour and under carefully controlled conditions. From the known law of skid distance, the minimum speed of the car before the accident may be found by simple arithmetic or by the use of a chart devised by Mr. Harper.

These charts, on especially prepared cross-section paper, permit speed in miles per hour to be arrived at quickly, and include allowances for varying co-officients of friction. They also serve as a permanent record of the several factors entering into the skid-speed test of the car.

Making skid tests requires that the car should not have been badly damaged. Nevertheless, in the case of severe damage it is still frequently possible to estimate the speed of the car by the quite accurate information now available as to the friction of tires on various kinds of pavement. Estimates of this type can be made by an experienced man and, though not quite as accurate as in the case of skid tests, they nevertheless often show conclusively that the car in question was exceeding the speed limit. In one recent case a car left skid marks 145 feet long and was demolished in a collision in which five people were killed. When a K of 70 percent was assumed, a minimum speed of 55 miles per hour was given. To this was added the conservative figure of ten miles per hour for the velocity absorbed in the collision damage, showing that the original speed was clearly greater than 65 miles per hour.

AS one might expect, courts have been slow to accept skid-mark evidence as conclusive. Judges have sometimes consented to witness tests of the reliability of the method. One such test was made in Pasadena. In Mr. Harper's absence a skid was made at 33 miles per hour. He then was permitted to

Skid marks 60 feet long, left by a car at the scene of an accident. Marker boards are shown laid on the pavement at ten-foot intervals by the police



Mr. Edison left of center; Mr. Smith (see article below) second from left

measure the marks and calculate the minimum speed. With little apparent difficulty he quickly determined the speed as being greater than 31 miles per hour.

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EDISON

One of His Co-Workers

Supplies An Anecdote

RECENT interest in the activities of that Grand Old Man of Inventors, Thomas A. Edison, engendered by two motion pictures built around his life, gives added value to the photograph reproduced on this page. This picture, taken from a Mutoscope movie made in 1909, is claimed to be the first motion picture for which Mr. Edison ever posed.

For the reproduction of this illustration we are indebted to Mr. Albert E. Smith, now of Hollywood, California, and formerly associated closely with Mr. Edison. The occasion on which this movie was made was one of Mr. Edison's anniversary dinners, given on Monday evening, December 20, 1909.

"Every year the moving picture producers of that day," writes Mr. Smith in a letter to the editor, "gave Mr. Edison an anniversary dinner at the Plaza Hotel. On this particular occasion, before we went to the Plaza, we went to the old Vitagraph studios in East 14th Street and D. W. Griffith took the picture.

"I was very well acquainted with 'the Old Man,' " continues Mr. Smith. "He was called this affectionately by all who knew him. Usually at these dinners I would sit on Edison's right, not as a seat of honor, I think, but because my voice was high pitched and penetrating and the right was his better ear.

"Of the many stories told me by Mr. Edison is one that I think will bear re-telling. It regards the sale of his first patented invention—the duplex telegraph system. A group of men in New York had offered to buy the invention. Mr. Edison talked it over with his wife and they agreed that he should ask $3000; if the buyers would not pay that amount he would come down to $2000 but that was to be the lowest.

"Mr. Edison met the group in New York and after some small talk they asked him if he had arrived at a price. Mr. Edison told me that he was so nervous that he stammered and could not get the figure out. A dictatorial man among the group of would-be purchasers of the system broke in with: 'Now, it's no use asking us a big price, Mr. Edison. We have made up our minds what we will pay and we won't pay a cent more. In fact, I may as well tell you that $40,000 is our limit.' Edison told me that he nearly fainted but rallied enough to assent.

"The contract was drawn up," continues Mr. Smith, "and Edison stipulated that he was to be paid in cash, in $5 bills. One of the men tried to talk him into taking a check but Edison did not trust banks and very plainly said so. On the day of settlement he went to New York, signed the papers, and was paid the money. With the bills stuffed in the pockets of his suit and overcoat, Mr. Edison started home, fearing that every man who looked at him knew that his pockets were full of bills.

"When Mr. Edison arrived home he was in such a funk that he sat up all night near the kitchen stove with a double-barrelled shotgun across his lap. By morning he was nearly exhausted and decided to take the advice that had been given. So he went back to New York and found the man who had previously suggested placing the money in a bank. On Mr. Edison's request, this gentleman took him to a bank and helped him to open an account.

"Edison, in telling me of this experience," concludes Mr. Smith, "said that he then went home and within a month had spent all the money. I was astonished and asked him how he had spent it. His reply was, 'On machinery. I had never before had a machine shop. Then I had a good one.' "

INVENTORS AID

Physics Course Gives

Background Knowledge

INVENTORS and others who lack formal training in the fundamentals of physics, or who wish to review the subject, will be interested in a special course to be conducted this fall and early winter. Held at New York University, under the direction of Joseph H. Kraus, the course will include rudimentary principles of physics and their practical applications in a wide variety of industrial fields.

At each session of the course there will be an open forum for discussion of new inventions, proposed developments, and so on.

FLUXES

Aids to Welding

And Soldering

THE paradox of welding aluminum at a temperature below the melting point of the metal is achieved by the use of a welding flux developed by the Alwarth Chemical Corporation. The new flux is used to coat the ordinary welding rod which contains approximately 5 percent silicon. The weld may then be made

without sweating the parent metal; hence, the area adjacent to the weld retains its full strength and ductility.

Another flux for use on stainless steel, and made by the same company, is said to eliminate the unpleasant fumes ordinarily present in stainless steel soldering.

Still another flux may be used on rusty iron, dirty brass or copper, or, in fact, any metal except aluminum. By its use, retinning of rusted surfaces can be done with a minimum of labor.

AVALANCHES BOMBED

Explosives Break Loose Snow and Ice

WHILE much of Europe has felt the destructive power of bombs in recent months, at least one country has been using these deadly missiles for a beneficial use. Switzerland is

Starting an avalanche

using them to shoot down avalanches under control.

Each year in the Swiss Alps there are many victims of natural avalanches. Mountain climbers are often caught in them, and there is a sad record from the first World War indicating that on a single day in December, 1916, over 10,000 soldiers stationed in the Tyrol mountains of old Austria fell prey to avalanches.

In the Alps, the blanket of snow is now regarded almost as a live thing that can become a deadly menace to humans. Hence the Swiss have established a Snow Avalanche Research Station above Davos — the only one of its kind in the world. This station can foretell avalanches and issue necessary warnings. Furthermore, if the avalanche location can be reached, hand grenades are used to start it moving. If big avalanches are involved, their descent is started by trench mortars.

This work is being carried on constantly to safeguard the lives of skiers, of travelers over alpine roads, and of soldiers stationed in the mountains. The new method eliminates the great danger of the large spring avalanches which formerly, uncontrolled, often destroyed homes, bridges, highways, and roads.

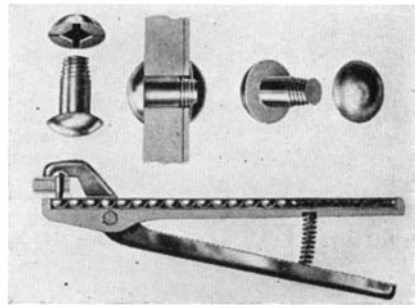
SNAP RIVET

"Bachelor's Button" Fastener For Metals

A NEW spring locking button and fastener stud provides a rivet-type fastener for many uses. This button will substitute for the present speed nuts and screws and other types of nuts, and in exposed places it will have a finished appearance. It is so designed that it will not loosen from vibration. It is an invention of David Hoppenstand and is produced by the Hopkan Rivet Company.

The fastener stud has a head and a shank like the average rivet, but the shank is tapered toward the end and provided with a number of parallel ring grooves. The spring locking button is made of thin sheet steel with locking lugs extending inwardly from the opposite edges of the curved shell. These locking lugs grip the rings on the shank of the stud.

Because of its simplicity and the ease with which it may be installed, this new fastening unit may be used in the automotive, aircraft, and refrigeration fields. It can be made



Snap rivets and applicator tool

from any type of alloy, and the spring locking button can be made in any shape — circular, flat, diagonal — and in any size.

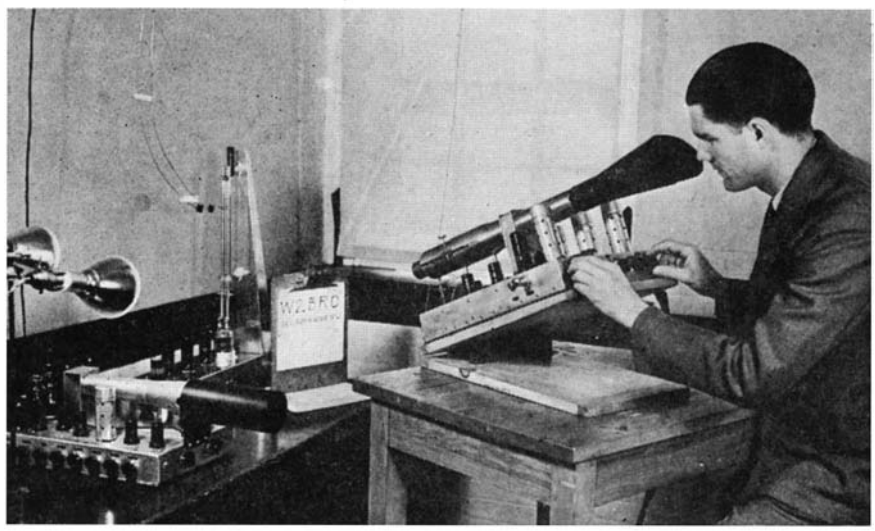
HAM TELEVISION

New Transmitting Tube Now Available to Amateurs

INEXPENSIVE, a television camera "eye" tube which opens the field of electronic television to thousands of American radio amateurs, is a much simplified version of the more familiar "iconoscope" television camera tubes used in studio cameras. It is being placed on the market to sell at slightly less than $25.

With the new iconoscope, it is practicable for the first time for the amateur to build a complete electronic television transmitting and receiving system at a total cost of approximately $300 or less, depending on the equipment which he has at hand. Amateurs who now have 2½-meter transmitters will find it relatively simple to adapt them for sending television signals alternately with sound broadcasts.

The 120-line pictures transmitted by the amateurs' iconoscope,



Radio ham televises his call letters with new transmitter tube

while not of the same excellent quality as the 441-line television images being broadcast in New York, are remarkably clear and sharp, equivalent to newspaper half-tone reproduction. The new iconoscope transmits a television picture about 1½ inches square which may be enlarged at the receiver.

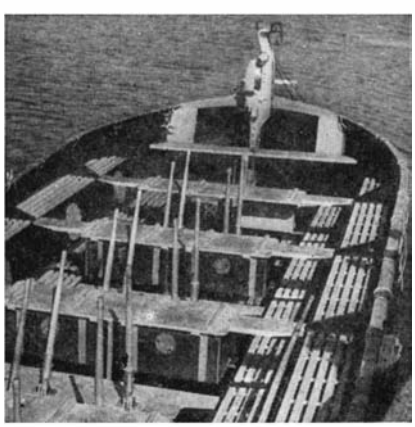
In research and development work on this new unit, RCA Laboratories collaborated with the American Radio Relay League, which has been seeking for several years to make it possible for the amateur radio enthusiasts to enter the television field. All the necessary equipment has been available for some time for amateurs, with the exception of the iconoscope. Television receiving tubes, or kinescopes, have been available in sizes as small as three inches.

It is believed that the opening of the electronic television field to amateurs will serve to widen existing popular interest in the new art, and at the same time accelerate progress in television development. The radio industry today points to a number of important steps pioneered by American amateurs, including the development of new circuits. Radio amateurs were among the first to demonstrate the enormous possibilities of short waves, a region which at the time was not highly regarded for radio purposes.

LIFEBOAT

Oarless, Motorless Boat Has Screw Propeller

READY for service in troublous times, the U. S. liner *America* is prepared for any emergency. Fourteen of her lifeboats, for example, use a manually-operated system of push-pull levers instead of oars or



Push-pull levers in lifeboats

Levers operate a propeller

motor. This method gives passengers something to do, eliminates confusion caused by inexperienced oarsmen.

The propeller to which the levers are geared had to be designed within definite size and weight limitations. The Federal-Mogul Corporation solved the problem in an unusual manner. They adapted their original "Equi-Poise" design, created for the propellers of Gar Wood's famous speedboat *Miss America X,* to the new lifeboats. They then cast the wheels from Lynite, an alloy developed by the Aluminum Company of America, which cuts the propeller weight to one third normal, and has high resistance to salt water corrosion.

Any number of crew or passengers from one to sixteen can operate the simple push-pull levers —and they don't have to work in unison—to move the boat. It has a maximum speed of six miles per hour.

The idea behind these novel lifeboats is that they will provide sufficient speed quickly to carry a large number of people away from immediate danger, and thereafter they can be towed by the *America's* power-driven lifeboats.

WOOD SEASONING

Urea Prevents Drying Losses

CRYSTAL urea is now being used as a chemical seasoning agent to prevent checking, splitting, and such losses as occur in drying lumber in the air or in the kiln. Fresh-cut lumber dries first at the surface, but when treated with a solution of urea, the outer surface remains moist and drying proceeds from within, thus eliminating the stresses that cause trouble.

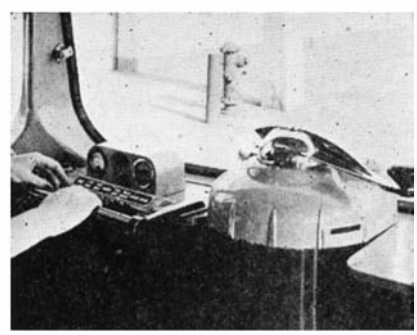
This treatment is easy to apply, permits faster and more severe kiln schedules, thus increasing the plant output. Urea, non-toxic, stable and harmless to the skin, is not corrosive to metals used with wood or to tools or knives employed in dressing lumber. Urea-treated wood is also less flammable and less susceptible to attack by fungi and rot than untreated wood.

Mill-scale treatments on Douglas fir and hemlock in the Northwest and on red cypress in the South are now being made. Tests are in progress on other woods.—*The duPont Magazine.*

STREET CARS

Modernized for Modern Service

ALTHOUGH people generally have the idea that street cars are on the way out, these vehicles continue to be improved so that they render in-



Controls on a modern street car

dispensable service in certain localities. San Francisco, for example, has just put into service a number of streamlined street cars which operate and stop without a jar or jolt, ride smoothly even at rail intersections, and, in fact, give service that is modern in all respects. Our photograph shows the manner in which the motorman's cockpit has been modernized, following in general the design of automobile dashboards.

JAP BEETLES

Yellow Traps Found Most Effective

THE bright yellow color of the Japanese beetle traps set in 1940 by the Bureau of Entomology and Plant Quarantine of the U. S. Department of Agriculture is the result of research developments in tests last season. Most beetle traps had been green, or green and white. The "scouting" traps widely distributed by the Federal entomologists were uniform, but traps on the open market were available in many shades of green, and the

beetle research organization decided to investigate differences in attractiveness, to the beetles, of the various shades of green, as well as of other colors. This investigation showed that traps painted yellow caught approximately 50 percent more beetles than the standard green and white traps. Yellow pigment added to any other color of paint increased the numbers of beetles captured.

PLANT TAGS

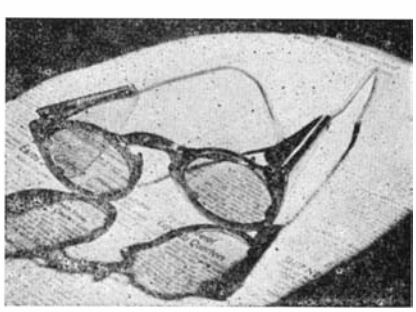
Metal Labels Provide Permanent Identification

A SPECIAL alloy of metal, flexible and resistant to acids and ground chemicals, has solved one of the most annoying problems of gardeners. Professor Aden J. King, who is a gardener as well as a college professor of chemistry, has used this metal to make a plant label. Since it is similar to a very heavy foil, a soft pencil is all that is necessary to print the name of plants or shrubs on this new Perm-A-Tag. The printing makes a permanent impression in the metal. The user may, if he so desires, mount the strips in his typewriter and type the names thereon. After that a tongue and slot arrangement makes it easy to loop the label around a plant or shrub and clamp it firmly without the use of any tools.

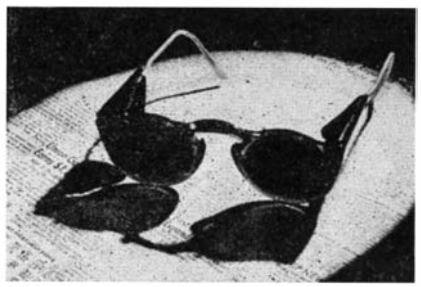
EYE PROTECTION

Variable Sun Glasses Give User Control of Brightness

THE conventional sun glasses with tinted lenses offer only one degree of brightness control for the wearer. Polaroid sun glasses sold in previous years, while they provided better protection for the eyes against the glare of sun, still offered one degree of brightness control. However, the Polaroid Corporation has now developed a Polaroid



Set for maximum transmission



Set for minimum transmission

Variable Day Glass which permits the wearer to control the brightness of the view.

Instead of only one lens before each eye, the new Polaroid Variable Day Glass has two lenses. The front lens before each eye is stationary in the frame while the two rear lenses may be rotated by a convenient button on the bridge of the frame. Simple movement of this button with the finger rotates the rear lenses so that more or less light may pass through, according to the angles between the polarizing material in the front and rear lenses. Thus the wearer may cut down light transmission on a very brilliant day or allow more light to pass through on a duller day. Adjustment of the lenses may always be such as to provide the greatest comfort and efficient vision for the user, regardless of his particular tolerance for excessive brightness.

POST DRIVING

Small Explosive Charge Drives Piling or Posts

OFTEN it is essential to put a pile or post in water or wet ground where a pile driver is not available, or when so few piles are to be driven as not to warrant bringing in a heavy piece of equipment.

A method has been worked out whereby the force of dynamite can be used to transmit a blow which is somewhat similar to the dropping of a pile driver hammer. The pile is stood upright in the location desired, and braced in place—usually with rope. The head of the pile should be sawed off square and the procedure is to put a heavy plate of steel on top of the pile. To give the best results, the plate should be one inch to 1½ inches thick. One stick of dynamite is placed on top of the plate, and covered with mud after the stick has been properly primed with a blasting cap and fuse or an electric blasting cap. When the charge is exploded, the force is transmitted to the plate which in turn transmits it to the pile. The pile is driven into the ground sometimes as much as 14 inches if the ground is soft. The procedure is then repeated until one inch penetration per explosion is obtained.—*Agricultural News Letter* (du Pont).

FLASHLIGHT

Rod-like Gadget Extends Any Flashlight

FOR use in inaccessible places, a flashlight bulb extension has been developed. Made in lengths of from six to 36 inches, the extension's

To get light where needed

plug is screwed into any flashlight; a bulb is in the socket on the other end. Being bendable, the extension can be inserted into intricate mechanisms, or into bores on a lathe. It aids vision down between walls, back behind fittings, inside of models, down among gears—in fact, any place where there is at least one-half inch clearance for the bulb end.

Known as the Sierra Flashlight Bulb Extension, the device is made of special wire encased in aluminum alloy tubing.

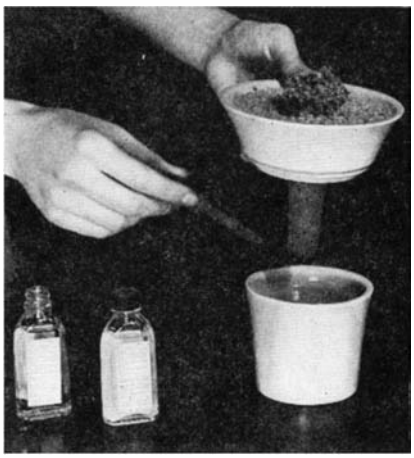
CHEMICAL GARDEN POTS

Home Plants May Now Be Grown in Chemicals

HOME experimenters in chemical gardening who have been handicapped by lack of suitable and attractive containers may now thank Ernest W. Brundin for making chemical gardening pots and gardens available. This large commer-

cial grower of tomatoes in nutrient solution and founder of Chemical Gardens, Inc., has designed glazed, two-compartment, pottery containers in a variety of shapes and colors. Either seeds, seedlings, or mature plants may be grown in these.

Mr. Brundin's containers are made in two parts, the upper one



For feeding plants chemically

fitting into the lower one and making a complete unit of attractive design. The lower one holds the chemical solution in water. The upper is filled with clean, sharp sand. A terra cotta wick extends through a hole in the bottom of the upper section down into the water. Capillary attraction supplies plenty of water and food to the sand bed above.

Two small bottles of plant food concentrates are supplied with the chemical gardens, and last for many months. A quantity of each solution is measured into a given quantity of water about once every 15 days, and the mixture poured into the bottom section. The chemical balance of the prepared liquids is such that changes made by the plant in the silica bed are constantly corrected automatically by the supply coming up through the wick.

INSECT-REPELLENTS

There is no Plant Which Repels all Insects

THE idea that certain plants in the garden will drive away mosquitoes and all other insect pests is attractive, but unfortunately, says F. C. Bishopp of the United States Department of Agriculture, it does not seem to work out in practice. No such plant is known. If any plant were a good repellent, it would probably be because it con-

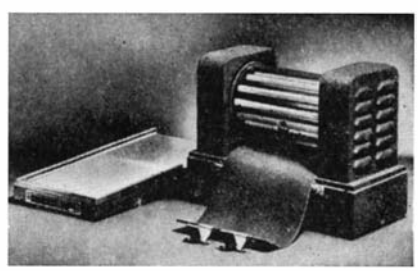
tained some chemical substance offensive to all insects. Scientists have sought such a chemical but never have found one.

There are chemicals effective against certain insects, but differences in sense of smell among insects appear to be as great as among the higher animals, says Bishopp, who studies insects that affect man and animals. Don't put too much faith in chemical repellents or any other single type of protection against all insect pests, he advises.

DUPLICATORS

New Method for Making Employs Photochemical Stencils

A NEW method of making duplicate copies of line drawings in quantity has recently been developed by A. B. Dick Company, makers of the Mimeograph duplicator. The new Mimeograph photochemical printer



Drawing duplicator

makes possible quick, accurate transference of any opaque drawing to a stencil sheet for black-and-white reproduction.

The chief element of the printer is a new cool, brilliant light source, unvarying in intensity, with remarkably low consumption of electricity and dependably constant results. Around the evenly distributed light-tubing is a heavy, unbreakable transparent cylinder, free of blemishes that might affect the exposure of the stencil sheet.

To make the photochemical stencil, it is first made light-sensitive with sensitizing solution. Next, the original tracing and the stencil sheet are exposed to light in the printer. By this exposure the image on the tracing is transferred to the sensitized stencil sheet in a single step. The stencil is then developed on the developing plate and placed on the Mimeograph duplicator for black-and-white reproduction of dozens or hundreds of copies, as desired.

The time of the procedure, from finished drawing to finished copies, is generally less than 25 minutes.

Price of materials for producing the stencil—including the stencil sheet—is less than 25 cents.

Any size drawing up to 7¼ by 14 inches, on paper not larger than 8½ by 16 inches, may be used as an original. The only requirement is that the image on the original be thoroughly opaque and the exact size desired in the finished copies. India ink tracings on translucent cloth or paper are recommended for best results. Typewritten matter cannot be reproduced on the photochemical stencil.

The photochemical printer is portable and may be used in mechanical arts and music departments of schools, engineer's offices, and factories. A few suggested applications are quantity duplication of tracings for engineering, production, and sales engineering departments; erection and installation diagrams; graphic instructions of all kinds; technical illustrations for parts and instructional catalogs.

The printer requires alternating current, 60-cycle, 110 volts.

PAINT DRYER

Infra-Red Lamps Given New Job

MORE and more are infra-red rays being utilized for finish-drying purposes. These heat rays in suitable reflectors have been utilized for several years to dry very rapidly the lacquers on, for example, automobile bodies. Now small infra-red lamps have been given the job of drying many things around the home. At the flick of a switch the housewife may soon turn on lamps to dry the family washing quickly and economically, cook

Infra-red dries paint quickly

food, or heat a room or an entire house in cold weather.

Our accompanying illustration, used through the courtesy of Westinghouse, shows a particularly important use of such lamps for drying interior paints. In such use, household annoyance due to repainting is greatly reduced, or an apartment is made ready more quickly for incoming tenants. Furthermore, the paint is dried so quickly that there is little chance for dust settling on the surface.

NAVIGATION TABLES

New Method Decreases Computation, Simplifies Study

A SIMPLIFIED method of determining the position of a ship or an airplane, eliminating nearly all the involved mathematical computation of older procedures, is now available for ocean commerce and modern, high speed, air transportation.

This new method is based on the use of navigation tables which are being computed and assembled by the Work Projects Adminstration in co-operation with the Hydrographic Office of the United States Navy. WPA workers, under the supervision of the Hydrographic office, have assembled the tables in volumes covering 10 degrees of latitude, usable in both the southern and northern hemispheres. Four volumes of this work are available to navigators, while a fifth will be available this year.

Under ordinary conditions, a training period of at least eight months is necessary to develop facility in navigation. With the new tables, it is estimated that the training period can be reduced to about six weeks. By using this new aid—called "H. O. 214—Tables of Computed Altitude and Azimuth"—a navigator either at sea or in the air can find immediately the altitude angle and azimuth, or bearing, which correspond to his assumed latitude and longitude without having to compute it.

All U. S. Government services, including the U. S. Navy, Coast Guard, Army Air Corps, and the Coast and Geodetic Survey, are now using these tables in their navigation and scientific work while an increasing number of private seamen, yachtsmen, and aviators of all nations are finding the easier method valuable.

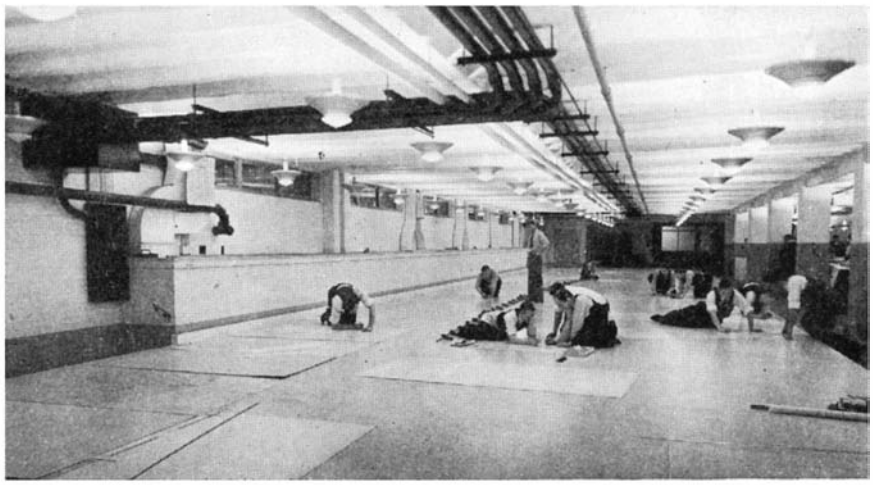
DRAFTING CAMERA

Huge Machine Copies Large Drawings Quickly

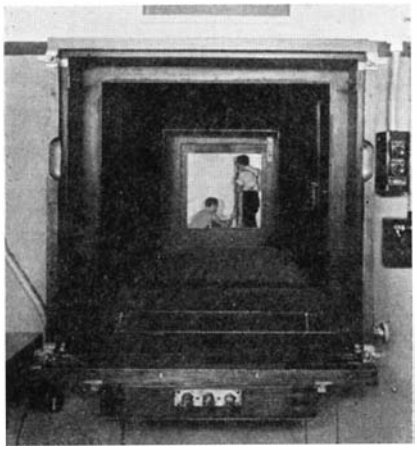
AN important new process by which engineering drawings are directly reproduced, photographically, on nearly any kind of surface (metal, wood, cloth, and paper, to mention a few) has been announced by The Glenn L. Martin Company. This new process is credited with much responsibility for the factory's mass-production methods in building airplanes, and is expected to have wide application in many other industries.

An heroic-scale camera snaps pictures of large drawings, the negatives are developed, and the images projected back to large sheets of aluminum alloy sensitized with a special emulsion. When such a sheet (maximum standard size used is 10 by 5 feet, but it could be larger) is placed in huge developing tanks, the drawing appears in all its preciseness on the surface in exact scale—or in fractional or multiple scales, if so desired.

Thus there can be produced in



Laying out airplane parts drawings, later to be photographed



Looking through the giant camera with which photo prints are made on metal, wood, and so on

a matter of minutes any number of drawings which might have required days in redrafting. The company saved more than $80,000 last year in drafting alone. Engineering work is speeded tremendously. Tool designing and tool making gets under way more rapidly and more accurately. Production preparation starts quicker and changes are made more rapidly. And because there are plenty of the exact-scale drawings available, the whole effort of the several vital departments is co-ordinated, all of which adds up to incomputable savings.

The versatile process has many other uses in the plant. Where an experimental airplane is to be built, the master drawings, absolutely accurate in every detail, can be photographed directly onto the metal of which the ship is to be constructed and the parts cut directly from the material itself. If a wind-tunnel or water basin model of a projected airplane is desired, it is only necessary to call on the camera to scale down the lines instantly from full size to an eighth, or tenth, or any other fraction of the full size. An easy calibration of the camera turns the trick, saving perhaps weeks of redrawing to scale.

SOIL MOISTURE

Simple Test for Water in Farm Soil

A BLOCK of plaster of Paris the size of a match box, some wire, and a small electrical apparatus so simple to operate that no training is required, are all a farmer now needs to determine the amount of water in his soil. The new method of measuring moisture in the ground was developed by the soils section of Michigan State College. A continuous measurement of soil moisture changes can be made by the process without disturbing either the soil or the crop.

In this novel approach to agronomic and irrigation problems, a block of plaster with attached wires is buried in the ground and allowed to absorb water until an equilibrium between it and the soil is established. By using an ordinary piece of electrical equipment known as a Wheatstone bridge, a measurement is then taken of the amount of resistance to electricity offered by the block.

Since water contained in soil readily conducts electricity, the greater the amount of moisture present the wetter the plaster and the less the resistance. If the ground is dry, the block offers greater resistance. Many absorption blocks may be distributed over the growing area at various depths to provide a complete picture of water fluctuations and movements within the soil and to furnish numerous control points.

The lead wires can be buried below tillage depth. When a measurement is desired, the block is connected to the bridge and the resistance can be determined in from 20 to 30 seconds. The electrical apparatus, being portable, can be used with any number of absorption blocks.

When the resistance of the absorption block becomes constant at about 400 to 600 ohms, the soil in which it is imbedded is holding about the maximum amount of moisture desirable for the growth of most plants. On the other extreme, as the resistance of the block passes to 60,000 ohms, soil moisture is approaching a minimum level with regard to plant requirements. Few plants will thrive in this dry soil and most plants wilt if more moisture is lost.

RIVETS

Explosive Forms Heads Without Backing Up

IN constructing such machines as tanks and airplanes it is often necessary to rivet the shell at points where it is impossible for someone to back up the rivet in order to form a head. As long ago as 1937 the German Heinkel concern partially solved this problem by production of a hollow rivet containing an explosive. This rivet was to be inserted in the rivet hole

from the outside and, when heated, it exploded to form a shank inside to hold the plates together. However, the explosive corroded the opposite surface of the plate and the cost was high. Furthermore, Heinkel bombers shot down in England show that such explosive rivets are far from uniform and are used only in unstressed parts.

The DuPont company has improved upon the explosive rivets by developing an explosive powder which gives complete uniformity of explosive force and, therefore, uniformity of the rivet heads that are formed by that force. This powder is said to be non-corrosive and the cost works out at about three cents per rivet. Riveting is done with a simple electric or benzine heating gun, the time for each rivet being about 1½ seconds.

Besides facilitating construction, these rivets may also be used effectively in repair work. A hole made by a bullet or a shell fragment might be trimmed out of a plane wing, a patch fitted in place, and fastened tightly by means of these rivets.

"MAGIC" LANTERN

Visual Aid Throws Stereoscopic Pictures

FOR the first time in the history of the manufacture of visual aids for selling and teaching, an automatic projector for showing glass slides in three dimensions is now being made. It is the Real Life Projector of the Three Dimension Corporation. Slide pictures projected from this machine onto a screen and viewed through Polaroid spectacles give an appearance of true depth.

The machine is entirely automatic in its operation, feeding automatically all the slides in a tray holding 35. When that is empty, it may be instantly replaced with another fully loaded.

"Magic" lantern up-to-date

Business executives interested in showing the true contours of products, the true color of finishes, or the true texture of fabrics and surfaces, might use this device to advantage. In lectures of many kinds and in many fields of education it would prove a welcome aid to the speaker or teacher.

PLUG-IN X-RAY

Portable Machine Has High Capacity

PORTABLE and shock-proof yet having the 80,000-volt capacity of much larger standard machines, a new X-ray machine introduced by

Portable X-ray

Profession Equipment Company promises to perform jobs hitherto impossible because of the bulk of older equipment. It was designed and assembled with the co-operation of C. E. Waltman and Associates.

The new machine is demountable and easily portable in two small carrying cases, the total weight being only 64 pounds. It plugs into a regular electrical outlet.

BATTERY TESTER

Pocket-size for Servicemen

A POCKET-SIZE battery tester to meet the need for a compact, inexpensive unit for correct testing of dry batteries under load, has just been announced. Made by Weston Electrical Instrument Corporation, the new unit will be of particular interest to radio servicemen whose tube checkers do not contain provision for this important new test requirement, or wherever else dry

batteries should be tested under load.

The pocket-size unit has been designed to fulfil the fundamental requirements for correct battery testing; that is, when the battery shows "good" on the instrument

To test dry cells under load

scale, it will be capable of delivering sufficient potential when under full load.

In order to facilitate new battery sales and replacements, the scale consists simply of a "Replace — Good" indication, uncomplicated by voltage indications, which might be confusing to the layman. Pin jacks are provided for the different battery voltages encountered — 1.5, 4.5, 6, 7.5, 45, and 90 volts.

TRACING PAPER

Better Blue-Prints

From Pencil Sketches

DRAFTSMEN often have occasion to make relatively complete drawings on tracing paper in pencil. When blue-prints are made from these, however, the lines are usually very weak and never completely satisfactory. The Frederick Post Company has developed a new paper called PTM which not only gives greater depth and blackness to the pencil line but also is more transparent than ordinary tracing paper. The surface of this sheet is dull and has a sharp but very fine "tooth."

WAR GASOLINE

IT is figured that one day's operation of a fleet of bombing and pursuit planes necessitates the consumption of an amount of motor fuel sufficient to operate 3000 American passenger cars for a full year!

Data show that 2400 bombers consume about 288,000 gallons per hour, 1600 pursuit planes consume 160,000 gallons per hour. Total daily consumption, on the basis of five hours in the air, exceeds two and one-quarter million gallons of fuel.

Consumption by tanks, trucks, armored cars, motorcycles, and other motorized equipment is believed to be even greater.—American Petroleum Institute.

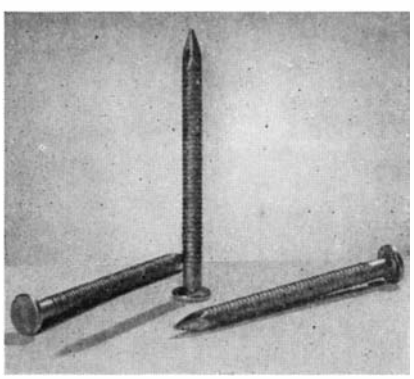
RUST PROOF NAIL

Unique Design For Boats

Out-Holds Screw

A NEW rust-proof nail of odd and unique design, developed for the boat-building industry, has revealed in a series of tests an unusual combination of properties which indicate its value for a wide range of industries where corrosion is encountered. In a special demonstration for naval architects it outheld a screw.

The nail is made of Monel and its holding power is derived from a series of sharp annular rings rolled-on in manufacturing operations. These rings are sharp and set at such an angle that in driving



Annular rings, rolled-on, give nails unusual holding qualities

they won't disrupt the fibers of the wood. The nail can be driven quickly without drilling a pilot hole—even into oak—and it requires no clinching.

Another feature of this new nail is an exceptionally heavy head; in the case of a two-inch nail, the head is 5/16 of an inch in diameter and 1/16 of an inch thick. The heads are two gages heavier than in wire nails of corresponding lengths.

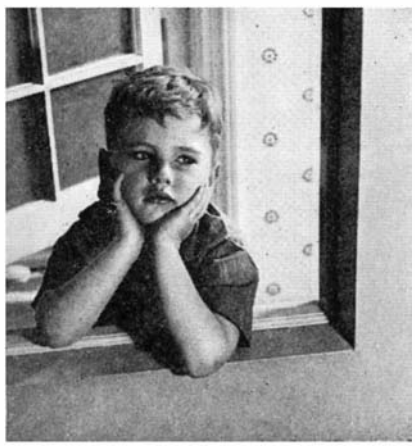
An outstanding property of the nail is that it is permanently rust proof and highly resistant to salt water and other agents of corrosion, including tannic acid. Thus it will not produce a stain to discolor the wood into which it is driven.

CAMERA ANGLES

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

Careers in Photography

HOBBIES frequently lead enthusiasts to full-time trades and professions. This is particularly true of photography, especially since it may often be used in combination with some other activity either in an auxiliary capacity or as the main vocation. Some of the numerous fields in which photography plays or can be made to play an important part were discussed at a recent Conference on Photography held in New York City under the auspices of the Institute of Women's Professional Relations, of Connecticut College. Although slanted from the point of view of the girl graduate in search of a job, most of the speakers described the requirements and opportunities in their several fields as they applied to all beginners without regard to sex.



By Martin Langan, from the Fourth International Leica Exhibit

Professional: Portraiture

More than 20 major photographic fields were discussed by authorities in each field, but the general opinion seemed to be that the photographer who desires to make a success of his chosen profession must have a good technical training, good general background, and a good knowledge of the particular field in which he expects to work. In addition to mastering the technical problems of photography in his field, said Roy E. Stryker, Chief, Historical Section, Bureau of Information, Farm Security Administration, the photographer "must recognize that photography is a product of the intellect rather than a product of mechanical skill." Mr. Stryker, covering the subject of "Photography in Social Science Research," said: "In order for the Farm Security Administration photographers to do their camera reporting they must be something of sociologists, economists, historians. That they be expert camera craftsmen is taken for granted. That they have a good general background coupled with the faculty for acquiring a working knowledge of a variety of subjects is essential."

Nor did the speakers fail to warn prospects that photography is not easy work, particularly in the news-picture field. "Camera work has its share of heartaches and disappointments," said William Eckenberg, of *New York Times* Rotogravure. "One must be ready at any and all times to work 24 hours and more at a stretch and often go without food. News photographers must be hardy enough to withstand all kinds of weather and abuse. Many of them have sacrificed home life and even life itself, in the pursuit of news pictures."

To beginners looking for an opening, Miss Jackie Martin, A.R.P.S., Photographer and Art Director of the Washington *Times-Herald,* speaking on "News Photography and Photo-Editing," gave the following sound advice:

"I should think the best chance for a job would be a small finisher or portrait studio, free lancing for papers or magazines (this very small pickings, however), join camera clubs, submit prints for exhibits, get jobs in photo stores which are hopping up like mushrooms. Develop ability to write and make pictures, for the coming of tabloid type or caption type of story makes that an ideal combination. I think the big thing is to learn about photography, be trained, and the opportunity to work at it will follow."

Although the conference was slated to discuss photography as a means of recreation as well as a profession and an adjunct, only one speaker discussed the recreational aspect. This was Frank Liuni, president of The Photographic Society of America and The Metropolitan Camera Club Council, who described photography as "an indispensable adjunct to a wider enjoyment of life, even if one does not aspire to technical or artistic excellence."

The value of a good working knowl-

Courtesy Devin Colorgraph Corp.

Adjunct: Illustration

edge and scientific background in the particular field chosen by the photographer was patent in the very subjects discussed by the various speakers. These included papers on photography in biology and medicine, by Earle B. Perkins, director, Rutgers University, Department of Biophotography; chemistry, by Wanda K. Farr, director, Cellulose Department of the Chemical Foundation, Boyce Thompson Institute for Plant Research, Inc.; "Photography in Industrial Research," by John Mills, director of publications, Bell Telephone Laboratories; "Cinemanalysis: A Psychological Research Technique," by Dr. Arnold Gesell, director of The Clinic of Child Development at Yale University; "Guidance Through Visual Expression," by Evelyn S. Brown, of Harmon Foundation, New York City; "Cinematography in Graduate Studies," by Robert Chambers, of New York University.

Other subjects covered included: "Aerial Photography as a Profession," by William H. Meyer, Jr., general manager, Fairchild Aerial Surveys, Inc.; "Photography in Advertising," by Walter B. Geoghagen, president of the Art Directors Club; "Civic Documentary History," by Berenice Abbott; "Theatrical Photography," by Florence Vandamm, F.R.P.S.; a talk on photography as a profession by Wynn Richards; "Women's Opportunities in Public Service Film and Photo Agencies," by Arch A. Mersey, assistant director, United States Film Service; "Photography in the Library," by Ralph H. Carruthers, in charge of Photographic Service at New York Public Library; talks on various aspects of museum photography by G. Lauder Greenway, assistant secretary, The Metropolitan Museum of Art; Beaumont Newhall, The Museum of Modern Art, New York; and Iris Barry, curator, The Museum of Modern Art Film Library; "The Teaching of Photography," by Franklin J. Keller, principal, Metropolitan Vocational High School; "Photography in Education," Educational Photography and Teaching Photography," by Adrian Ter Louw, Eastman Kodak Company. Talks by Edward Steichen and Fairfield Osborn were discussed in a previous issue.

Adjunct: Social

Recreation: Hobby

Moral: Use a Stop Bath

IF you allow light to fall on film before it has been fixed, the inevitable consequence is a completely ruined film. At least, that's the way we have all been taught. However, all is not necessarily lost in such circumstances, as witness the experience of a friend who did that very thing and yet saved the day. After developing the film he poured the developer solution out of the tank and poured in the stop bath. Then he was interrupted by visitors and upon returning to the tank forgot that the film was in the stop bath, not the fixer, and opened the tank. He removed the films (he was developing filmpack) from the tank and found the tell-tale milkiness that indicated the films had not been fixed. He washed the films anyway and let them dry. About a week later(!), he attempted to mend matters by immersing the negatives in the fixer even at that late date, since there was nothing to lose and everything to gain. The result surprised him. The films "cleared" and became printable negatives. All thanks, of course, is due to the use of a fresh stop bath, which arrested development and turned failure into success.

Fine Grain, Germain

DESIGNED by Morris Germain, A. R. P. S., "as a foolproof developer for students and serious minded amateur photographers whose efforts in compounding photo-chemical solutions need encouragement," his fine-grain formula, given below, has met with popular favor with amateur and professional photographers alike.

Water (125° F. or 52° C)	32 oz.	or 1000 cc.
Metol	¼ oz.	or 7 gm.
Sodium Sulfite	2½ oz.	or 70 gm.
Paraphenylene-diamine (base)	¼ oz.	or 7 gm.
Glycin	¼ oz.	or 7 gm.

Mr. Germain, who is Technical Advisor for Penn Camera Exchange, New York City, gives the following instructions: "The use of distilled water is preferred. Dissolve the chemicals in the order listed. Use without dilution. For replenisher, use the same formula. Thirty-two ounces of this formula will

develop 12 to 18 five-foot rolls of 35 mm film or its equivalent in area. The developer should be filtered after compounding and again thereafter, each time before use. This will insure against 'pin holes' from foreign matter or normal precipitates that may be present in the developer solution."

Among the advantages listed for this developer are good keeping qualities, maintenance of energy over a longer period of time with consistent use, no extra exposure compensation required. Developing time is 8 to 10 minutes for film having Weston rating under 50; 12 to 15 minutes for Weston rating above 50.

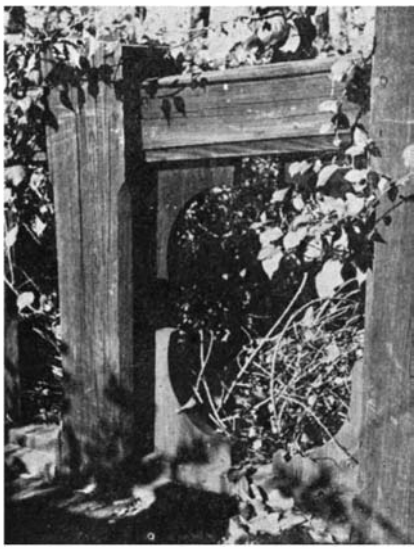
One Subject, Many Pictures

THE most obvious truths of photography have to be repeated now and then because people seem to forget them so easily. As a result, they overlook pictures that are right before their eyes, but take some study to see. One of these truths is that a single subject may offer more than one shot. Mrs. Alterman, of Mount Vernon, New York, may have been thinking along these lines, or perhaps it was simply because she liked the particular spot, when she planned and shot a series of pictures around a certain wood fence.

Two of these pictures are reproduced here. Each one is distinctly different from the other. It was just a matter of changing the viewpoint. Personally, we like the close-up shot better than the "long" shot of the fence. But that is just a matter of opinion. In any event, a series would necessarily call for the inclusion of whole subject in at least one of the pictures, which may then be supplemented by close-up views of details.

In addition to viewpoint, there is also the opportunity of photographing the subject in different seasons. Mrs. Alterman has done this as well, photographing the scene in the fall and again in the winter with snow instead

From one viewpoint . . .



. . . and from another

of fallen leaves to identify the season.

This kind of photography is a sort of exercise which every worker should now and then indulge in even if he never shows the results. It is the kind of experimentation that will stand him in good stead when the "real picture" comes along.

Solution Bottles

RECENTLY we came across some empty gallon size brown bottles used by manufacturing chemists for packaging their chemicals, that struck us as being admirably suited for storing or mixing photographic solutions. The large Bakelite threaded cap is about an inch deep, has a wax coating at the bottom of the cap to preserve the contents of the bottle, and the neck of the bottle is designed with an indenture at the edge to hold the bottle on the rim of the graduate or bottle into which the solution is poured.

If you have a chemist friend by all means get him to let you have one or more of these bottles as he empties them. If he can spare them, of course. They seem ideal for mixing large quantities of solution for distribution among several smaller bottles, or even for storing solutions. One worker mixed a gallon of paper developer in one of these and used the bottle for storage. Although he kept pouring from the bottle occasionally over the course of several months, gradually depleting it, there seemed no evidence of serious oxidation.

Daumier and Candid Photography

COMMENTING on a group of Daumier's sketches as paralleled in the work of some of today's candid photographers, Ralph Steiner, writing in a recent issue of *PM*, remarked on the similarity in viewpoint of the artist and the photographer.

"The candid camera photographer today can catch in a fraction of a second a gesture, an expression or a pose that the painter may labor over for hours," writes Mr. Steiner. "But just because the painter works slowly, he is more likely to choose significant gestures—ones that express the relationship of people to each other, or that express their feelings, thoughts, characters.

"This should be the job of the candid photographer also, but too often today he is interested only in the fact that he can take the picture at a 1/1000th of a second, and catch an accidental gesture, like the politician de-waxing his ear.

"The good candid photographer should play the same part as a recorder of human thoughts and feelings as a painter such as Daumier played for his time."

Kalart Contest

MORE than $500 in merchandise prizes is offered by The Kalart Company, Inc., 915 Broadway, New York, N. Y., for pictures taken with a Kalart Speed Flash, both outdoors by the Synchro-Sunlight method, and indoors. This year's contest, which is wider in scope than in former years, offers a total of 35 grand prizes including an Anniversary Speed Graphic as the First Grand Prize, a Simmon Super Omega B Enlarger, a Solar Enlarger, a Federal Enlarger, a Kalart Lens-Coupled Range Finder, and other prizes.

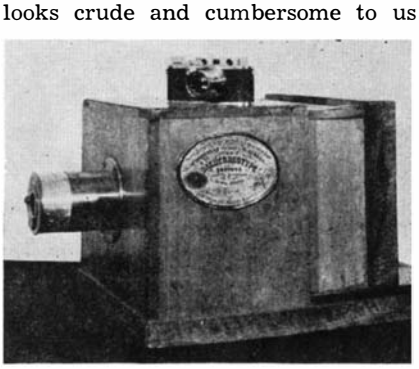
Any number of prints may be submitted, either mounted or unmounted.

In addition to the 35 Grand Prizes, the Kalart company each month will award a case of Wabash flash bulbs and a new Kalart Concentrating Reflector for the best photograph received during each of the following months: August, September, October, and November. All entries received up to and including the last day of these months are eligible for the monthly prizes. Speed Flash photos winning monthly prizes will also be eligible for Grand Prizes.

The contest closes at midnight, December 1, 1940. Entry blanks are available from photographic dealers or by writing to the company.

100 Years of Progress

A HUNDRED years ago and today in photography is strikingly illustrated in this picture, which needs no caption. A Daguerreotype camera that was all the rage a century ago looks crude and cumbersome to us

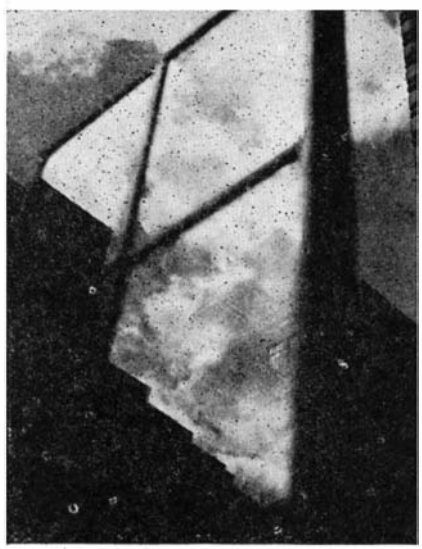


Then . . . and now

today, accustomed as we are to the finest of precision cameras. The implication is, of course, that we feel mighty proud of our accomplishment. But we must consider that had it not been for the Daguerres of yesterday, photography might never have achieved what it enjoys today.

Window Reflections

WHAT you see, you can photograph. This is not always appreciated by the amateur worker as much as it should be. For example, a reflection in an open window of the sky opposite



Reflection

to that part of it which you happen to be facing, can be photographed, as it was in the accompanying illustration. You will notice that the reflected part shows up bright and properly exposed, while the portions faced directly by the lens are overprinted. This is, of course, due to the fact that the reflected buildings were lighted by the sun.

The Lens Club

DESCRIBED as "the most unusual camera club in the world," the Lens Club, whose headquarters are at 165 West 46th Street, New York City, is out for members. The club hopes to serve as the national headquarters for the professional photographer and pioneer in the industry. Its first objective, however, is to help its amateur members to perfect their technique and provide working facilities.

Chief responsibility for organizing the club is credited to Herbert Mitchell, known as the "Photographer of Celebrities," and a list of distinguished names constitutes the Advisory Board.

The club is characterized by its sponsors as "three clubs in one," combining the best features of the camera club, the social club, and the luncheon and dinner club. The clubrooms are the former home of the Motion Picture Club, occupying over 13,000 square feet of space.

When completed, the announcement says, the club's facilities "will include a studio fully equipped for black and white and color work, darkrooms and finishing rooms, lockers and dressing rooms, showers, beauty parlor and barber shop, projection room and library, spacious and comfortable lounge, meeting room and exhibition room, dining room and kitchen, private bar, bridge and backgammon rooms." The formal opening will be September 1st, 1940.

Particulars may be obtained by writing to the club.

Cut Film Sizes

THOSE who use the so-called 2¼ by 3¼-inch cut-film size will be interested in the following letter recently received by this department from Lloyd E. Varden, A. R. P. S., of Agfa Ansco:

"It has come to our attention repeatedly that there exists a general confusion in the two cut-sheet film sizes 2½ by 3¼-inch and 6.5 by 9 cm. These two sizes, although representing a difference of only .06 of an inch in width and .04 of an inch in length, cannot be used interchangeably. This applies both to the sheet film holders and to the film.

"All sheet films are normally cut slightly smaller than their stated dimensions, in order to make them fit easily and smoothly into their holders. The actual sizes are standard among American film manufacturers. Discrepancies that have arisen in sheet-film sizes have been due mostly to camera importations, but no trouble will result providing consumers make sure to get the right size for their particular camera."

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WHAT'S NEW

In Photographic Equipment

DEJUR VERSATILE ENLARGERS: Series will take in negative sizes from 1 by 1 up to 5 by 7. Model now available takes negatives 1 by 1 to 2¼ by 3¼. May be used as enlarger, camera for copying, camera for tabletop photography, camera for photomicrography, camera for portrait and still life photography, for Kodachrome and other three-color work, for transparency projection at any angle. Completely ventilated housing utilizes "Aero-Teck" design permitting only minimum heat to reach negative plane.

LAFAYETTE PORT-O-LAB KIT ($8.89, complete): Complete darkroom set-up for developing and contact printing in handy airplane-style luggage carrying case. Maker suggests its use for developing and printing test prints while "on location," as well as convenience in small apartments where space is at premium. Kit contains Bakelite roll-film tank for all sizes from 35mm to 116 size roll film;

CAMERA ANGLES

printing frame; developing trays; contact paper; darkroom bulb; all chemicals and bottles necessary for complete work. Carrying case measures 20¼ inches long; 13 inches high and 7¼ inches deep; weighs about 14 pounds including materials.

LITTLE TECHNICAL LIBRARY (50 cents per book): A second series of books on various phases of practical photographic work, just issued by Ziff-Davis Publishing Company. Each volume covers a separate subject and is written by a practical worker in the field. The second series begins with book No. 11, "Outdoor Photography," by Samuel Grierson, and concludes with book No. 20, "Darkroom Handbook And Formulary" by Morris Germain, A.R.P.S. The others include No. 12, "Indoor Photography" by Hillary G. Bailey, F.R.P.S.; No. 13, "Flash Photography," by Russ Arnold; No. 14, "Photographing Action," by Victor De Palma; No. 15, "Manual of Enlarging," by Stephen White, A.R.P.S.; No. 16, "Miniature Camera Technique" by Fenwick G. Small; No. 17, "Photographic Lenses and Shutters," by Richard W. St. Clair, A.R.P.S.; No. 18, "Photo Tricks and Effects," by Jacob Deschin, A.R.P.S.; and No. 19, "Selling Your Pictures," by Kurt S. Safranski. Each book is bound in stiff covers and contains about 25,000 words of text matter, illustrated.

GEM FILMOLAC (60 cents): Preservative for cine, still, and reversal film, against scratching, finger marks, brittleness, and curl.

BESBEE CLOSEUP COMBINATION KIT ($3.75): For movie closeups of small objects, indoors and out. Designed to work with any movie camera in making closeups of flowers, small birds and animals, botanical details, insects, and so on. Kit consists of tripod table, which also can be used with camera handle (supplied); adjustable lens holder, universally adaptable to any 8mm or 16mm camera; and two closeup auxiliary lenses, giving sharp closeups of objects at distances of 10 to 30 inches. Additional lens auxiliaries for other distances available in special assortment of six closeup lenses ($4) for distances 7, 12, 15, 18, 24 and 27 inches.

ELKAY FOTO-PURE WATER FILTER ($3.50 complete): Designed to remove impurities in ordinary water. May be attached to any faucet. Outside made of Bakelite. Inside consists of series of five metal screens, plus patented Cellulo fiber filtering disk.

F-R DEVELOCHROME ($.75 per 4-oz. bottle; $.75 per can special developer): Direct color toning developer for prints, created by Anton Bruehl, well-known American photographer. Permits development of print to a colored image in any one of six colors. Variations of obtainable colors endless, is manufacturer's claim, "de-

CAMERA ANGLES

pending only on the ingenuity of the photographer." Available colors: three basic and three additional from which various combinations may be produced. Colors are red, yellow, blue, sepia, sea green, snow blue.

SAYMON-BROWN RANGE FINDER ($15, including installation): Couples directly to lens standard of Speed Graphic, Bee Bee, Linhof, Ihagee, Recomar, Jewel, and similar cameras, as well as many postcard-size roll-film cameras. Design: correct optical balance of mirrors, which are made tarnish-proof and permanent by same process used for observatory telescope mirrors; provides brilliant illumination of images even in adverse light or at night. Center object of amber color to make quick, accurate matching of images for all distances from 3 feet to infinity. Finder measures 3⅛ by ⅝ by ¾ inches; weighs 2½ ounces. Finished in satin chrome. Guaranteed by makers. Installation can be made through regular dealer.

SPEEDGUNS DELUXE "C" JR. AND "C" DELUXE, for Miniature Speed Graphic and larger Speed Graphics, feature completely open bulb clamp, with positive ejector. Head of gun redesigned for proof against rain. Battery case fastened to camera by means of new bracket. Flip of thumb tightens case against improved clip. "Shake it up or down, back or forth—you can't budge it," declare the makers. Flip thumb again and case is free. Other features include positive switch button and safety switch button guard.

HAYNES SHUTTER CHECKER (50 cents): For testing accuracy of between-the-lens shutter. Used with any phonograph turntable. Stroboscopic ring assures correct rate of turn. No calculations required for speeds from one-half second to 1/500th.

16MM FILMO TITLER: For use with all Filmo 16mm cameras. Features "visual centering" arrangement permitting titles to be centered accurately through viewfinder of camera. Titler consists of camera carriage, title-card carriage, two swiveled reflectors, each unit sliding upon connecting track and clamping firmly in any position. Title can be used horizontally or vertically, as an animation stand or to permit filming title actually being written by human hand. Reflectors adjustable and made to take No. 1 Photofloods.

AGFA MEMO WITH LENS *F*/5.6 ($14.50): Memar *f*/5.6 anastigmat focuses from 3½ feet to infinity. Shutter speeds 1/25, 1/50, and 1/100 of a second, plus Time and Bulb. Compact, steel construction. Provides Memo-type rapid film transport mechanism. Loads with standard Agfa Memo cartridge, 24 double-frame size pictures (1-7/16 by 15/16ths inches) per cartridge. Other features include: brilliant, optical, di-

rect view finder; tripod socket, cable release socket; neck-cord eyelets, automatic exposure counter. Accessories available: leather eveready carrying case; filters—yellow, red, and green; sunshade; neckcord; cable release; tripod.

PHOTO-ART DODGER (75 cents): Contains number of apertures of various sizes and shapes which can be further modified by rear plate into many series of patterns. Useful for localized spots, special effects, vignetting. Diameter of dodger 14 inches. Complete instructions printed on upper surface of dodger.

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THE ROUND TABLE

Questions Answered for the Amateur Photographer

Q. What characteristics are lost when an anastigmat lens is "stopped down." I know that the depth of field is increased. Does the lens lose anything if focusing is accomplished by moving the front part of the lens while the back element remains fixed? —E. J. T.

A. Stopping down may cause a softening, that is, slight off-sharpness of the image, as compared with the image when focused at a larger opening, but this is usually of no practical consequence. Besides, the advantage of depth of field, where this is required, far offsets the above disadvantage. Opinion varies concerning the advisability of the method employed on some lens mounts by which the front element is moved back and forth in focusing while the back element remains unmoved. One of the best known cameras of today enjoys a wide popularity both among advanced amateurs and professionals, who usually are very exacting, despite the fact that it employs this method of focusing.

Q. In using an exposure meter it is recommended that it be held near the object. Since the intensity of light varies inversely as the square of the distance I have not been able to figure out why a foot candle reading close to the object is just as applicable in calculating exposure time, and stops, when using the camera close up as it is when using it at several feet distance. Just why is there no distinction made?—G. O. L.

A. The "square of the distance" which you mention has reference to the distance between the subject and the source of illumination and not the distance between subject and camera. Therefore, provided the light remains the same distance from the subject, it would not matter how near or how far you held the meter from the subject were it not for this important factor: an exposure meter covers a wider angle of view the farther it is held from the subject, with the consequence that the resulting reading takes in not only the light reflected from the subject but also that reflected from the surrounding area. If the meter's angle of view could be cut down so narrowly that, even at the position of the camera, only the light reflected from the subject would be included, there would be no necessity for approaching the subject closely, and the reading would be the same, whether held close up or at the camera position.

Q. Please state if the old type Petzval lens is achromatic. I want to use this lens for a terrestrial telescope even though the focal length is 24 inches.—A. T.

A. The Petzval lens is semi-achromatic, not fully corrected for color aberration, but sufficiently so for the purpose you have in mind.

Q. I have been advised to use a Polaroid filter to eliminate reflection. I notice that when the filter is turned in the housing, the field darkens and appears to have a purplish cast. Will this affect the natural colors on Kodachrome Type A film? Also, how effective is the filter for the purpose, and what changes in exposure time will be required?—S. A. R.

A. The darkening of the field is caused by a reduction in the amount of light admitted, and will not affect the color rendering of Kodachrome. The effectiveness of the Polaroid filter in eliminating glare and reflection has been proved by many workers who have used this screen, as it is more properly called, both with Kodachrome and regular black and white film. Because the light is cut down, the exposure time should be twice that required without the screen.

Q. Is there any type of successive flash equipment that would enable me to get several shots of wild life in the woods after dark within about 15 to 30 seconds?—G. W. T.

A. By operating very quickly, you could probably get a few shots within this period with regular flash equipment and provided the camera film advance is of the automatic type. If your flashgun head is of the bulb ejector type, speed would be facilitated. There is soon to appear on the market a multiple flash gun taking as many as a dozen G. E. No. 5 "Midget" bulbs, which may be fired successively one after the other in synchronization with successive films. This will probably be most useful for your purpose.

Q. Can you furnish information on home development of movie color film?—R. S. M.

A. The only motion picture color film that may be processed at home is Dufaycolor. Details may be obtained by writing to the manufacturers, Dufaycolor Co., Inc., 68 West 48th St., New York City. A drum recently placed on the market called the Graphic Reel can be used for processing. It has a capacity of 32 feet of 16mm or double 8mm film.

YOUR FIREARMS and FISHING TACKLE

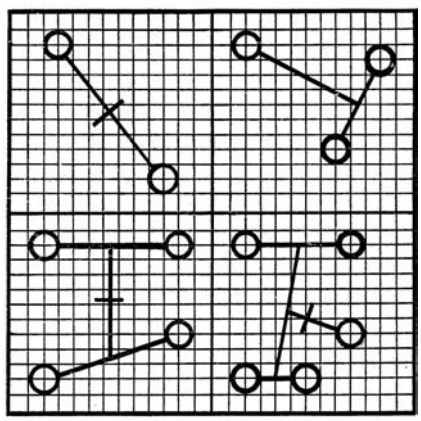
Conducted by A. D. RATHBONE, IV

INTEREST IN FIREARMS *is traditional with American men; fishing tackle is a requisite of one of the world's oldest occupations. Scientific development of guns and tackle, in the use of which millions yearly find sport and recreation, fathers this monthly department which welcomes correspondence from readers.*

Center of Impact

IN the belief that many shooters have wished for a simple, easy formula for locating exactly the average point of strike, or "center of impact," of a group of shots when targeting a rifle or pistol in sight alignment, Walter T. Gorton, of the Springfield Armory, Springfield, Massachusetts, sent us a suggestion accompanied by drawings. Mr. Gorton has so ably expounded his idea that we'll let him tell it in his own way, with our sincere thanks for his interesting contribution.

"It is not difficult," writes Mr. Gorton. "to determine the location of the center of impact by averaging the horizontal and vertical locations of a group of shots by measuring from suitable vertical and horizontal reference lines, such as the edges of the usual paper target, but this process is rather slow and inconvenient. Since a single shot is not conclusive for targeting purposes, a group of shots is necessary, and the smallest group, of course, is two, which, while more conclusive than a single shot, is still rather small. The center of impact of a two-shot group is very easily found, as obviously it lies exactly half way between the two. (Figure 1)



Upper left, Figure 1. Upper right, Figure 2. Lower left, Figure 3. Lower right, Figure 4

"This principle is easily and conveniently applied to larger groups. Three shots form the smallest group which is reasonably satisfactory for targeting purposes. To get the center of impact of such a group, first find the mid-point of the line joining any two shots. The center of impact for the group lies one third of the way along the straight line from this point toward the third shot. (Figure 2). Three-shot groups will do fairly well, but four-shot groups are better and can be measured quite as readily. Simply join any pair of shots with a straight line, and the remaining pair likewise. The mid-point of the straight line joining the mid-points of these two lines is the center of impact of the group. (Figure 3.)

"The orthodox five shot group also can be measured very easily, so the shooter who must have a group of this size can fire his five rounds cheerfully, letting them fall where they will. To measure the group, first locate the center of impact of any four shots as above described. One fifth of the way along the straight line from this point toward the fifth shot is the center of impact for the whole group (Figure 4), and this method can be applied to groups of any size, by working in successive steps. A geometric principle, the process boils down to this: Consider the individual shots to be small bodies of equal weight lying in the plane of the target. The center of impact of the group is the center of gravity of this system of like bodies. Figures have been drawn on coordinate paper so that skeptics may readily verify the plotted location of the center of impact in each case by finding the average horizontal and vertical locations of the various shots. A graphic check, also, may be made in all but Figure 1 by starting with other pairs of shots."

Back-Woods Are Closer

IF it were not for technological progress in the realm of marine motors, a lot of us who like to angle for the big ones back in the wild country might find ourselves handicapped in fulfilling our piscatorial desires. True, the ancient and honorable method of canoe travel is still to be relied upon and is particularly applicable to the fisherman whose budget is more limited than is his time. The airplane is our modern way of getting into the bush, but it does reverse the aforementioned budget-time premise. Due to scientific advances in outboard motor manufacture, however, we now have a middle-of-the-road method which saves time, costs next to nothing and is as reliable as the powerful motors which wing over forest and lake. Today we can answer "the call of the wild" just as we always have by stowing our duffle into the old canoe. But, by adding only a relatively few pounds to the total weight of our outfit, we can save lame

muscles, blistered hands and many hours—in which to get in more fishing. Here's how it's done.

Let's assume we're headed for the Lake of the Woods sections, or northwestern Quebec, where chains of lakes connected by small streams or short portages will lead to the lair of the muskie, the wall-eye, or the great northern. If we take along an Elto Cub outboard motor, for example, made by Evinrude Motors, we add only 8½ pounds to our load. A special

With an 8½-pound outboard motor and a few gallons of fuel, the hunter or fisherman can save much back-breaking work

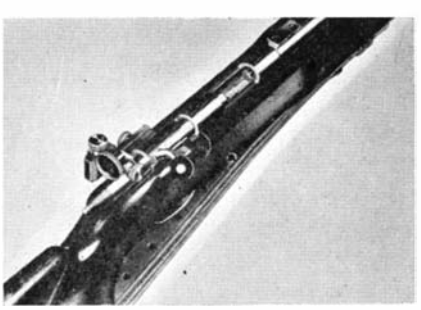
bracket for canoe attachment is a couple of pounds more and packs easily. The motor runs 10 hours on a single gallon of fuel, will propel two men and their duffle in a canoe up to five miles an hour. As a conservative figure let's say we average 3½ miles per hour on lake travel, which comes to 35 miles for our first gallon of gasoline consumption and is probably a greater distance than a couple of city-softened outdoorsmen can hope to cover by paddle on the first day out. Without straining our backs too much we can pack in four extra 1-gallon tins of pre-mixed motor fuel, a total weight at the start of about 32 pounds, and we are assured of a minimum of 175 miles of motorized canoe travel. Based on our own experience of many thousand miles in a canoe, upstream and down, with the wind and against it, we believe a 25-mile-a-day average by paddle is about all two soft-muscled men can hope to accomplish. If we cover the same distance by motor in five days, instead of the seven required by paddle, we'll have two days more in camp, and it has cost us a little over $25 for the motor and about two cents an hour for its operation.

As noted above, the modern outboard motor is a far cry from its early ancestors in power, dependability, and weight. With Evinrude motors, for instance, the "dynamometer test" is used to establish power ratings. To insure absolutely impartial results, Evinrude has all models tested by The Pittsburgh Testing Laboratories, whose results are submitted to The National Outboard Association for final certification before being used by the manufacturer. Dependability and further protection are afforded through a policy of measuring horsepower at engine speeds recommended for constant service, rather than peak horsepower attainable, thereby assuring long hours of continuous and uninterrupted operation. As to weight, anyone who used to strain his back in order to install an outboard of 20 years ago will recognize the portability and adaptability to fishing trip usage of an 8½-pound motor which develops .5 N.O.A. Certified Brake H.P. at 4000 R.P.M. Yes, in these days the back-woods and the big fish are closer, and it costs very little to get there, thanks to American ingenuity and scientific progress in outboard motor building.

POT-SHOTS
At Things New

MARLIN FIREARMS COMPANY answers the country-wide demand for a rifle to use with the miniature clay target games, like Mo-Skeet-O and Targo, by developing a Recess Choked, Smooth Bore .22-caliber single-shot rifle, expressly built for this purpose. With this new Marlin method of boring, it is said that the control of shot distribution gives the best potential target breaking spread at any distance from 30 to 45 feet, with as wide a pattern as possible without holes through which a target could escape. The gun is known as Model 100-SB, Bolt Action, Single Shot Rifle.

REMINGTON ARMS COMPANY announces Model 513T "Matchmaster" bolt-action .22-caliber target rifle, equipped with government type leather sling, adjustable for short or long armed shooters; Redfield front sight with seven interchangeable in-



"Matchmaker" comes complete

serts; Redfield No. 75 micrometer rear sight with ¼-minute adjustments; special target stock and pistol grip of dark finished American walnut with high, thick comb and long, wide beavertail fore-end; 27-inch, heavy, semi-floating barrel, double countersunk at muzzle, bored and rifled for extreme accuracy. "Matchmaster" has anti-backlash trigger stop for crisp, smooth trigger pull; short, fast, firing-pin travel; corrugated trigger; double

locking lugs on bolt and double extractors; firing indicator and positive side lever type safety. Butt plate is sharply checkered; front sling swivel is adjustable to arm length and barrel is drilled and tapped for scope blocks, with plug screws in holes. Detachable magazine box holds six cartridges and rifle is chambered for .22-caliber long-rifle cartridge. Over-all length of gun is 45 inches; taken-down length, 33 inches. Moderately priced, the "Matchmaster" is ideal for four-position shooting.

MOHAWK PRODUCTS, makers of that unique and rather revolutionary "Peep-Scope" we recently told you about, announces a reduction in price from $5.00 to $4.25. It seems the "Peep-Scope," which, through its one-inch length provides a telescopic effect by use of precision ground lenses, has met with such cordial reception from riflemen that increased sales and wider distribution brought about the lower price.

AMERICAN OPTICAL COMPANY presents scientifically designed, streamlined shooting glasses fitted with special Calobar or Noviol lenses to cover all conditions for hunters, marksmen, trap and skeet shooters. For all 'round

eye protection, good visibility, particularly in bright sun, Calobar lenses are recommended as reducing glare, absorbing the tiring, invisible infrared and ultra-violet rays which cause eye strain and fatigue. Noviol lenses are counseled to obtain sharper detail on dull, hazy days and both types can be ground to prescription for defective eyes.

O. F. MOSSBERG & SONS, INC., have a low-cost spotting 'scope to keep company with those fine new rifles we told you about last month. Their 20-power Model A "Spotshot" 'scope is light, sturdy, has achromatic objective lens 38mm in diameter, ground to .00001 of an inch, and is equipped with metal eye caps for both ends. Eye-piece lens is 10mm with micrometer focus adjustment. In black crinkle finish with chrome plated draw tube, it is 17 inches long extended, 12½ inches when closed, weighs 1½ pounds, and has field of approximately 7½ feet at 100 yards. A 2¼-pound folding aluminum alloy and steel stand offers rigid support, has screws for adjustments.

THE PARKER-WHELEN COMPANY, INC., formerly National Target & Supply Company, in presenting its 5th edition of Colonel Townsend Whelen's "Gun Handbook and Catalog," offers to the shooting fraternity one of the most comprehensive and authoritative volumes on firearms we have ever seen. Colonel Whelen, who needs no introduction to American shooters, had as his editorial associates three men whose names have long been synonomous with expert knowledge of guns and ammunition, namely, Colonel Julian S. Hatcher, Colonel H. P. Sheldon, and Major Charles Askins. Each has contributed a fund of factual information from the fields in which he is a nationally known authority. Colonel Whelen wrote the sections devoted to Small Bore Rifles, Game Rifles, Telescope Sights for Rifles, Pistol Marksmanship; Colonel Hatcher has exhaustively handled Revolvers and Pistols; Colonel Sheldon and Major Askins covered the shotgun field and marksmanship with the scatterload. There are also articles on cleaning and cleaning materials; receiver sights and binoculars; reloading tools; clothing and outdoor equipment; gunsmithing, and a particularly helpful article entitled, "Useful Information for Shooters." The book is profusely illustrated, includes prices of all equipment shown and sells for only 25 cents a copy.

SHAKESPEARE COMPANY, which for many year has been supplying innumerable anglers with "what it takes" to take the fish, offers an exceptionally fine 1940 catalog. If you haven't obtained yours, we suggest you do so before the fishin' season is a minute older, and then devote a pleasant hour or so to its perusal. You'll find it enticing, helpful, constructive, and educational, particularly the pages depicting methods used by Tony Acetta, U. S. Amateur Bait and Fly Casting Champion, who really "gets 'em."

THE TANGLEFOOT COMPANY offers welcome relief from mosquitoes and other pests to both angler and hunter through use of its new repellent. A safe, greaseless, non-irritating cream in generous size tube, Tanglefoot MosQUITo Repellent has added virtues of actually being fragrant, lasting, and harmless to the most delicate skin.

BILL DEWITT BAITS offers deep-sea anglers absolute freedom from rust or salt corrosion of hooks through use in their manufacturing process of "Z" nickel, a heat-treatable alloy of approximately 98 percent nickel. (See May, 1940, Scientific American, page 277). Clean barbs, toughness, springiness, and great tensile strength are all provided at low original cost, which, due to rust-free properties, is likewise last cost. From E. S. Russell, of Bill DeWitt Baits, came samples of hooks with invitation to immerse one in strong salt solution. We did. Together with an ordinary hook, it stayed immersed 18 days, came out absolutely clean, fresh, shiny. You should have seen the other hook!

Our Book Corner

THE BOOK DEPARTMENT of Scientific American is conducted, with the co-operation of the Editors, to make available for you a comprehensive book service. Each month the Editors select and review in these columns new books in a wide range of scientific and technical fields. In addition, they are ready at all times to advise you regarding the best available books on any subject. You are invited to use this service freely. Tell our Book Department what kind of books you want and you will be furnished with a list of available titles, including prices. When inquiring about books, please be specific; remember that we can be of the greatest help only when you tell us just what you are looking for.

WE PRESENT TELEVISION

Edited by John Porterfield and Kay Reynolds

PRODUCED in an endeavor to give the non-technical reader a complete survey of the television situation, this book presents a running story, beginning with the technique of television and carrying through studio operation, programs and direction, acting, and the financial problems. The text has been prepared by a group of specialists who are in direct contact with those phases of the work about which they write. (298 pages including a glossary of terms, 6 by 9 inches, illustrated with photographs and drawings.)—$3.10 postpaid.—*A. P. P.*

AMERICAN AVIATION DIRECTORY

IN the early days of aviation, the industry was so small that everyone in it knew everyone else. Now, aviation has grown to such immense proportions that it is impossible for any one person to keep track of organizations, companies, and personalities. The American Aviation Directory will, therefore, render a very valuable service and has been received with enthusiasm. The Directory is in a carefully classified form, covering aircraft manufacturers and their personnel, air lines and their personnel, accessory firms, schools, trade organizations, state and federal organizations, and so on. A useful alphabetical index is provided. Loose-leaf form.—Yearly Subscription, $5.00.—*A. K.*

LIVING LIGHT

By E. Newton Harvey, Professor of Physiology at Princeton University

THERE is a very great deal of scientific information in this book, which is divided into six sections, respectively on cold light, light-producing organisms, types of luminescence, chemistry of light production, physiology of light production, and the physical nature of animal light. Under each section the appropriate subject is developed in a full sweep of detail. A reader who had extracted from this book its whole content would know a great deal about cold light in all its aspects—physical, chemical, physiological, and even engineering. It is not a textbook but in its seriousness it comes nearer one than anything resembling a popularization, yet the language is as simple as possible. No such book, bringing all scattered data within a single pair of covers, has appeared in English in many years, nor is likely to appear in many more. The author, known the world over, is the foremost scientific authority on the subject, which he has pursued as a specialty in the field and laboratory for a quarter century. (328 pages, 6 by 9 inches, 80 illustrations.)—$4.10 postpaid.—*A. G. I.*

PHOTOGRAPHY, PROFESSION, ADJUNCT, RECREATION

Addresses by 24 speakers

DESIGNED to lay before the girl graduate the opportunities for work available in the various photographic fields, a Conference on Photography, Profession, Adjunct, Recreation, was held in New York under the auspices of the Institute of Women's Professional Relations, Connecticut College, New London, Connecticut. During the course of that conference, which was helpful to all young people without regard to sex, 24 speakers discussed almost as many photographic fields. Their addresses were compiled and published in the present work. Those seeking advice on how to make a "go" of photography should find considerable guidance whether one desires to make a profession of photography or to use it in conjunction with some other vocation. (Mimeographed; 135 pages.)—$1.60 postpaid. —*J. D.*

THE WESTERN ANGLER

By Roderick L. Haig-Brown

HERE are two of the finest volumes ever released on the lore, technique, and fascination of angling, and the public necessity for its continuance as a sport. The author's vast ichthyological knowledge enables him authentically to present the history, habits, and scientific development of native and imported British Columbia trout and salmon; to describe their diseases, their enemies and their propagative possibilities from first-hand information. There are a complete index and two appendices, the latter covering respectively British Columbia fly dressings and a formula for determining fish population of lakes. Printed on deckle-edged paper, with nine magnificent color plates of trout, salmon and flies and numerous other halftone illustrations in sepia, these beautifully bound volumes are one of the best buys to reach the mar-

——OUR BOOK CORNER——

ket in a long time. The edition is limited to 950 numbered copies. (Two volumes totaling 391 pages, 8½ by 11 inches.)—$25.10 postpaid.—*A. D. R., IV.*

AERONAUTICAL DICTIONARY AND REFERENCE LIBRARY

By R. Hartley, Jr.

MR. HARTLEY is a man of considerable experience in the production aspects of aircraft and as a teacher of practical aviation subjects. The terminology of aeronautics is constantly growing and outside of a short "Nomenclature for Aeronautics," published by the N.A.C.A., there is no English publication dealing with the terminology of this great new industry. Mr. Hartley's work will meet, therefore, a well defined need and will certainly be a help to students, mechanics, pilots, and many others. The 524 pages of the Aeronautical Dictionary are clearly printed and well arranged. Part I covers definitions, nomenclature, terminology, and phraseology. Part II, entitled "References," gives condensed but useful information on aviation engines and aluminum alloys. It also gives a brief chronological history of aviation.—$4.10 postpaid.—*A. K.*

SEX IN MARRIAGE

By Ernest R. Groves, Prof. Sociology, University of North Carolina, and Gladys Hoagland Groves

FOR the newly married, those about to be married, and those having marital difficulty because of sex adjustment. This book is neither very technical on the one hand nor shallow and superficial on the other, but seems to be aimed about at average people. It contains a good deal of good and sound information. (250 pages, 4¾ by 7½ inches, unillustrated.)—$2.10 postpaid.—*S. S. J.*

INTERIOR ELECTRIC WIRING AND ESTIMATING

By Albert Uhl, Arthur L. Nelson, and Carl L. Dunlap

THE latest principles of wiring for homes, apartment buildings, and factories, including permissible wire sizes, devices, conduits, and the like. Numerous illustrations show the manner in which wires or conduits are installed in any kind of building structure. The section on estimating is especially complete and forms are given to show an actual job of estimating. (342 pages, 5¾ by 8½ inches, numerous illustrations.)—$2.60 postpaid.—*F. D. M.*

THE SOUL OF THE UNIVERSE

By Gustaf Stromberg

AN attempt to erect a ladder between the worlds of physics and biology and a World Soul or God. Mainly the book discusses the former and, separate from the soul thesis which is to follow near the end, it is a competent,

lucid exposition of space, time, matter, and of gravitational and electric fields; also of heredity and genes and theories of the origin and development of life on earth. These lead to a discussion of mechanism, vitalism, and religion, all three of which the author considers valid, and thence through the development of the human mind or soul to a world soul. This book will appeal especially to those interested in science and religion and in the linkage that is built up between the two. The conclusions that the author, a member of the research staff of Mount Wilson Observatory, has reached through his study of the laws of the universe, make the book unusually interesting and worthwhile. (244 pages, 5¼ by 8 inches, three illustrations.)—$2.10 postpaid. —*A. G. I.*

REFINING PRECIOUS METAL WASTES

By C. M. Hoke

BASED on 24 years of experience in teaching jewelers, dentists, and small refiners how to refine their precious metal wastes, this book bears heavily on the practical. Gold, platinum, silver, alloys, iridium, rhodium, low grade wastes, equipment, processes, identifying, the stock pot, repurification, equipment, dealer list—these items selected from here and there in it give the scope of this useful treatise. (362 pages, 6 by 9 inches, illustrated.)—$5.10 postpaid.—*A. G. I.*

THE ROAD TO MODERN SCIENCE

By H. A. Reason, B. Sc.

HISTORIES often are regarded as dull but this is the story, not the history, of science from the crudest beginnings straight through to our own times. It is not, however, a fluffy kind of account but one containing much substance even though written in popular, readable style. (297 pages, 5½ by 8 inches, 76 illustrations.)—$3.10 postpaid.—*A. G. I.*

THE GUN COLLECTOR'S HANDBOOK OF VALUES

By Charles Edward Chapel

OF inestimable value to gun collectors, both amateur and professional, is this newest publication by the author of "Gun Collecting." (Reviewed in our issue of January, 1940.) This is the first comprehensive effort in the English language to catalog and evaluate firearms for the collector; to say it is successful is to put it mildly. Some 2000 antique and semi-modern pieces, over 500 of which are illustrated, are described in detail, and values for "good" and "fine" condition have been assigned. For those who collect old guns, or for those who would like to collect them, this publication is absolutely indispensable. (220 pages 4¾ by 7½ inches, 33 full page plates.)—$3.10 clothbound and autographed, postpaid; $2.10 paperbound, postpaid.—*A. D. R., IV.*

TELESCOPTICS

A Monthly Department for the Amateur Telescope Maker

Conducted by ALBERT G. INGALLS

THING of first importance in a telescope is functional excellence, of course, but it is, however, nearly always possible, without compromising this quality, to combine attractiveness. By attractiveness some may mean decorativeness. This may have its place provided it does not run to over-decorativeness and to "gingerbread." Perhaps, however, the best source of that something which gives beholders an instinctive feeling of satisfaction in any machine or structure is good proportion of parts and of the whole.

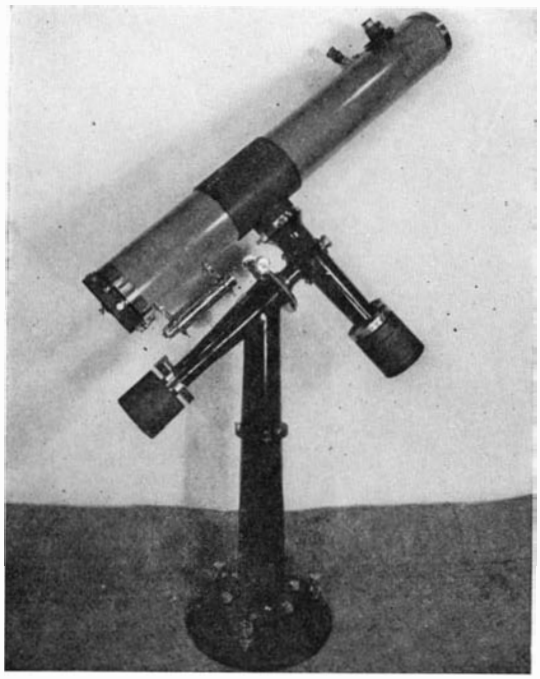


Figure 1: Hopkins' pleasing design

It is a long time since this department has received photographs of so well proportioned a telescope, whether made by amateur or professional, as the one shown in Figure 1. This 6" reflector was made by Edward Hopkins, 431 Fulton St., Elizabeth, N. J., who, according to our advices, is in charge of a machining department in one of the big airplane manufactories.

"The knowledge required to build this telescope," Hopkins writes, "came entirely from the Scientific American books 'Amateur Telescope Making' and 'Amateur Telescope Making —Advanced.' Its base was made from an old traffic sign, to which three leveling screws were added. The pedestal was converted from a truck torque tube. This was cut in two, and two flanges were welded on and machined, to permit the top section to be rotated slightly in order to line up the telescope.

"Atop the pedestal, the axle housing, from a Nash car, is slantingly welded on. The R. A. shaft turns on tapered roller bearings and is drilled through, so that Polaris can be sighted through a ring welded on the declination shaft. The declination shaft also turns on roller bearings mounted in a Model A Ford axle housing.

"The R. A. setting circle is graduated to units of 10′ and has a vernier to read to 1′; the declination circle to 1°, with vernier to 5′.

"The Bakelite tube can be turned in a split sleeve and is guided by two brass rings that were not yet on when the photograph was made. The mirror is Pyrex, of 48" *f.l.*, and is supported in the cell by a split brass ring with a cork insert. It is held by six screws around the edge, and behind by a triangular plate with three cork pads. The prism holder is universally adjustable.

"Accuracy in the working parts was held to a very high degree, the limits held as close as possible with precision measuring instruments.

"The whole thing handles easily and can be carried by a delicate woman, with the help of a strong man."

Not every amateur has access to fine machine tools or has had a chance to learn their use. Yet good proportion does not require these things; in fact, some who have them do not attain to it. Take, for example, the counterweights of this telescope, even though this is not a very vital part. If we were to make these only a few percent fatter and stubbier, or else skinnier and longer, the telescope would seem to one judge, at least, to have lost its fine figure, just as your scribe has. Maybe Hopkins just happened to have metal of these proportions but our guess is that he planned it so, as he did with other details.

Figure 2: Bohm's observatory

STONE is the chief material from which Anton Bohm, a monument maker, Apex Monument Works, 6815 W. 29th Avenue, Edgewater, Colorado, built his observatory (Figure 2). Its granite, brick, and stucco-lined wall is 12" thick and 8′ feet high (including the 2′ part that is hidden). The outside diameter is 12½′. Inside are three stone steps rising 24" to the concrete floor, with a trap door to cover the stair well, thus forestalling broken necks. In front is a low surrounding wall to contain earth for Mrs. Bohm's flowers and vines. Bohm says Mrs. Bohn helped him with the observatory by mixing concrete. The telescope pier goes 8′ below the surface. Absolutely no vibration is noticeable.

The dome is framed with 25/32" lumber and covered with 3/16" building board oiled three times inside and outside with linseed oil. To this, heavy canvas strips were added over the joints and the entire surface was given three coats of white outside paint. The shutters (Figure 3) are self-explanatory, also satisfactory. The acoustics inside the dome is fine; especially for people with squeeky voices, Bohm states.

A lead cable from the residence conducts current for light and drive. A temporary telescope is in use while Bohm patiently proceeds with a 12" reflector whose tube is shown in Figure 4. Each of the eight main struts of aluminum was cast in one piece from patterns previously made and used by Carroll C. Spencer, of the Spencer Laboratories, Denver. "Don't think the foundryman didn't cuss when casting the pattern eight times," Bohm writes. "He had to lie awake nights to figure out a way to prepare the mold so that the castings with about ¾" shrinkage, would not break as they cooled." To clean up these castings, Bohm filed 15 hours on each strut! The rings are 14" brake drums from old Essex cars. The profile of the tube gives a feeling of nice proportion—or have we gone entirely mad on proportion?

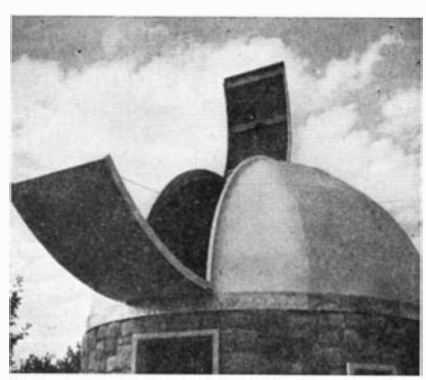


Figure 3: Petal type shutters

TELESCOPTICS

In describing the Goethe Link Observatory, at Brooklyn, Ind., in the June number, Victor E. Maier, Director of the Observatory, mentioned that the Hartmann test of the 36" mirror was reduced by Dr. James Cuffy of Indiana University. Dr. Cuffy writes that, after becoming thoroughly conversant with everything in "ATM" and "ATMA," he was surprised to find that amateurs had almost no appreciation of the value of the Hartmann method of testing. He thinks this may have resulted from the brevity of the chapter on this test in "ATMA," so he wrote up the method as he used it, including shortcuts which he says simplify it enormously. His account, which ought to be in "ATMA," follows:

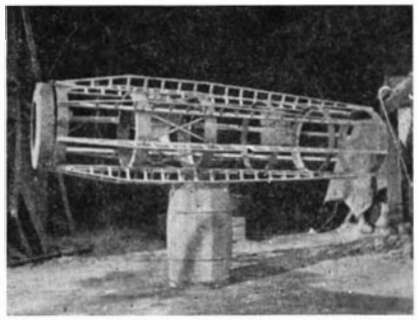


Figure 4: The leg-shaped tube

"The Hartmann method of testing optical surfaces has, apparently, been avoided almost entirely by the amateur astronomer. The avoidance may be due largely to the photographic technique involved, but also, I believe, to the implication ('ATMA,' page 109) that the Hartmann test is one applied to finished mirrors alone. Possibly the following paragraphs will serve to point out its value in testing a mirror at any stage of the figuring process.

"The advantages of the Hartmann method are: 1. Its complete objectivity; there is no judging of equal brightnesses for patches of light separated by considerable distances. The measurement of a radius of curvature is reduced to the measurement of a distance on a photographic plate. 2. The greater number of zones that may be tested at one time. To test numerous zones visually requires time, and fatigues the eye, whereas the Hartmann test gives the radii of as many zones as desired with a minimum of effort. 3. The more detailed knowledge of the deviations of the surface from parabolic, or other required surface, that results from testing many zones of the mirror.

"The disadvantages, as seen by the uninitiated, are the need for large numbers of photographic plates, especially since, in its conventional form, each test requires two plates, and the need for a comparator in measuring the plates. These objections, however, may easily be met. I am confident that, once the amateur has tried the Hartman test, he will be convinced of its superiority over visual zonal testing.

"In Hartmann testing, we place a perforated diaphragm before the mirror. The perforations are customarily placed along eight different axes of the mirror. The diameters of the holes are usually 1/400 of the distance from diaphragm to plate, and the centers of the holes are separated by approximately 2½ times the diameter of each hole. Naturally, it is only when testing for astigmatism that one measures all the axes of the mirror. The geometry of the test is shown in Figure 5. We are interested in obtaining the distances, d_1, from the plane of the photographic plate of the points where the rays from a given zone cross the optical axis.

"The first simplification we may make (see Danjon et Couder, 'Lunettes et Télescopes,' p. 507) is to dispense with one of the plates, and to substitute for it the diaphragm itself (at s_2). Since we have constructed the diaphragm with reasonable accuracy, we know immediately the values of a_2, or the separations of the two holes corresponding to the given zone. d_2 is then the distance of the diaphragm from the pinhole, or, with sufficient accuracy, the radius of curvature of the mirror. Thus, it is sufficient to take only one plate, inside focus, and to compute once and for all the factors d_2/a_2 by which the separations on the photographic plate, a_1, must be multiplied to give the distance from the plate to the intersections of the rays with the optical axis.

"The second simplification lies in the method of measuring the plates. Since the Hartmann pattern is usually only ½" in diameter, we may use an ordinary photographic enlarger to enlarge the particular row of spots in the pattern to be measured up to about 10" long (strips of bromide paper 1" wide are sufficient). We then measure the positions of the spots with a good ruler. The scale of the enlargement must be known, and a simple method of determining the enlargement factor is to place a small piece of scotch tape of known width on the emulsion of the plate near the row of spots to be measured. We may then divide the separations measured with the ruler by the enlargement factor, in order to obtain the desired values of the a's on the plate.

"One could, of course, avoid photographic work entirely in making a Hartmann test by providing himself with an eyepiece micrometer having illuminated cross-wires; thus making settings of the cross-wires on the image of the Hartmann pattern directly without bothering to photograph it.

"It is important that the Hartmann diaphragm be held in a plane as close to the mirror as possible, and that the plate be perpendicular to the optical axis. If the mirror is of high aperture ratio ($f/4$ or less), the value of r for the zone being tested will differ slightly from the value of r measured on the screen, because of the inclination of the rays and the fact that the diaphragm is not in contact with the concave surface. Ordinarily, however, we may use r as measured on the diaphragm for computing the parabolic radii, r^2/R.

"The writer has used the Hartmann test as described above in testing the 36", $f/5$ mirror for Dr. Goethe Link's observatory (Brooklyn, Indiana), and has found the method convenient and accurate. He had, however, access to a good measuring machine.

"Having obtained the values of the radii for a number of zones of a mirror, we may compare them with the computed values for a perfect mirror and predict the performance of the mirror in actual use. Thus, we may compute

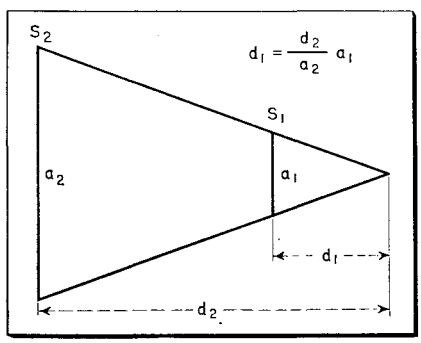


Figure 5: Geometry, Hartmann

the value of the Hartmann criterion, t, which is the weighted mean radius of the confusion disk, each zone of the mirror being weighted according to its light gathering power, or its circumference, since the area of any zone is proportional to its circumference. The value of t is given by

$$t = \frac{200{,}000}{F^2} \quad \frac{\Sigma r^2 \Delta F}{\Sigma r}$$

where 200,000 is very nearly the number of seconds of arc in a radian, F is the mean focal length, r is the distance of the zone from the optical axis, and ΔF is the axial error from true focus. All the ΔF's are taken as positive numbers; that is, we use their absolute rather than their algebraic values. If a mirror is to perform well, its Hartmann criterion must be less than its theoretical resolving power, or 4.5 seconds/aperture (inches).

"Most of the large mirrors at present in use have values of t between 0.1 and 0.2. A mirror larger than 24" in aperture, and having a value of t less than 0.5, is just satisfactory for photographic work, but unsatisfactory for visual work. In fact, seeing conditions combine with photographic graininess and the diffusion of light in the emulsion itself to make star images less than 0.035 mm. in diameter rare, while under ordinary conditions the images obtained with a large instrument are usually between 0.05 and 0.10 mm. in diameter. It is thus evident that the demands for high optical quality are about five times as stringent in the case of a telescope to be used for visual work as for one intended primarily for photography. And therein lies the reason why the average astronomer is able to obtain plates of value on

nearly every clear night. The situation is perhaps best described by saying that seeing conditions are seldom too bad for photographic work, while they are seldom good enough for visual work, at least with high powered eyepieces."

WE keep hearing of more and more men who once were ordinary amateur telescope makers and who sweated over their first 6" mirrors, "even as you and I," now finding their permanent life work in optics as the ultimate outcome. Ralph Dietz is with the Mt. Wilson shops, two amateurs now are pros with Bausch and Lomb, while around New York are several who are regularly employed in professional shops. What is called the "Optical Division" of the American Astronomical Association is that fraction of The New York City amateur astronomers who enjoy getting their rougey hands on hunks of glass and converting them into telescopes and other things optical. Its organizer was Lew Lojas, and he, for the past three years or so, has earned his living as an employed professional. He is with the Kollmorgen Optical Co., 767 Wyeth Ave., Brooklyn, N. Y., where he polishes and corrects lenses. Edward Hanna, another Optical Division amateur, now is also with Kollmorgen, edging and inspecting lenses, while Walter Howland, from the same amateur group, is a Kollmorgen computer.

Working in the Jersey City shops of the Perkin-Elmer Corporation, of 90 Broad St., New York, N. Y., is Daniel E. McGuire, a typical amateur from a typical Ohio small town who went to the great city and who is running the polishers and correcting objectives; also Stanley Brower, who does blocking and works on magnifiers, eye lenses and microscope objectives. We hear there is an opening for one more good man in these shops.

In Keuffel and Esser's shops, at 300 Adams St., Hoboken, N. J., is another optical Division man, Carl Grosswendt, doing optical inspection.

Some of these men and others who may choose similar work stand a good chance of becoming leaders in the optical industry in later years.

We have received a letter from Frank A. Eaton, of the Bausch and Lomb Optical Co., Rochester, N. Y., who mentions the comments about war emergency optical jobs for amateur telescope makers, made here last month, and says: "We are interested in knowing sources from which applicants may be obtained in the future. While it is not our intention to encourage more people to come to the plant for interview at this time, since the numbers now applying far exceed any future employment we shall have for them, if the amateur telescope makers will merely write to us, so that we have their names and addresses on record, with an explanation of what they have done with optical grinding and polishing, that will be sufficient material for us to use in seeking later interviews."

LEGAL HIGH-LIGHTS

Patent, Trade Mark, and Related Legal Proceedings That May Have a Direct Effect on Your Business

By ORSON D. MUNN, Litt.B., L.L.B., Sc.D.
New York Bar
Editor, Scientific American

Notice

A PATENTEE who does not manufacture and sell the patented article may recover profits and damages from an infringer even prior to the time that actual notice of infringement is transmitted to the infringer.

Much confusion has been caused by the provision of the statute which states that it shall be the duty of all patentees making or vending a patented article to affix thereto the required patent notice consisting of the word "Patent" followed by the number of the patent. The statute provides further that "in any suit for infringement, by the party failing so to mark, no damages shall be recovered by the plaintiff, except on proof that the defendant was duly notified of the infringement, and continued, after such notice, to make, use, or vend the article so patented."

It will be readily understood that where a patentee manufactures and sells articles under his patent he must affix the proper patent notice to the article in order to recover profits or damages from the infringer. Should he fail to affix the notice to the patented article he can only recover profits and damages accruing after the date on which notice was transmitted. Confusion has existed, however, as to those instances where the patentee did not manufacture and sell the patented article. Some courts were of the opinion that profits and damages could only be recovered after the date on which actual notice was transmitted, while other courts expressed the opinion that no notice was necessary.

This confusion was dispelled by a decision of the United States Supreme Court which, after reviewing the history of the statute, concluded that it was only intended to apply to those instances where the patentee manufactured and sold articles under the patent. Where no manufacture and sale took place the patentee could recover damages and profits, the Court held, even though no notice of infringement was transmitted to the infringer.

Early American

WHEN an application for the registration of a trade mark is approved and passed by the Patent Office it is published in the *Official Gazette* prior to the registration of the mark. Anyone believing that he would be damaged by the registration of the mark may, within 30 days of the date of publication, file a notice of opposition to the registration. When the opposition is based upon a prior trade mark owned by the opposer and the opposer charges that there is a possibility of confusion between his mark and the mark sought to be registered, the Patent Office resolves all doubts as to similarity between the marks and as to the possibility of confusion in favor of the opposer and against the applicant for the registration.

This principle is illustrated by a recent decision involving the trade marks "Elgin American" and "Early American." A manufacturer attempted to register the trade mark "Early American" for cosmetics and saponaceous materials. The registration was opposed by the owner of the trade mark "Elgin American" which was applied to vanity cases, face powder containers, and containers for other cosmetic materials. The Patent Office and the Court of Customs and Patent Appeals concluded that there was a possibility of confusion between the marks and, applying the rule that all doubt should be resolved in favor of the prior user of the mark, refused to permit the registration of the mark "Early American" for cosmetics and saponaceous materials.

Impatient

THE processes of the law are slow and inventors sometimes become impatient with its delays. In a recent case the applicant for a patent believed that another person had copied his invention and was infringing upon his rights. Instead of waiting for the issuance of his patent, he filed suit while his application for patent was still pending, charging infringement of the application. While the suit was pending the patent issued.

The alleged infringer of the patent then brought a motion to dismiss the suit on the grounds that the Court did not have jurisdiction because no patent was in existence at the time that the suit was filed. The Court granted the motion and dismissed the suit, holding that the issuance of the patent during the pendency of the suit did not correct the defect existing at the time that the suit was filed.

Trade-Mark Prints

THE manufacturer of a dress fabric containing a design based on well-known trade marks enjoined a competing manufacturer from selling fabrics containing similar designs. The

original manufacturer was licensed by the owners of certain well-known trade marks to use their trade marks under controlled conditions as designs for dress fabrics. The infringer used the same trade marks without permission from the owners thereof. The Court pointed out that the copying of a fabric design which is not protected by design patent cannot be restrained. However, in this instance the copying involved the use of well-known trade marks without the permission of the trade-mark owners. Under these circumstances the Court held that the unauthorized use of the trade marks as a design for a dress fabric constituted unfair competition and an injunction and an accounting were awarded.

Double Identification

AN article of commerce may bear two trade marks and each mark may be separately subject to protection against infringement. This is illustrated by a suit involving the infringement of the trade mark "Friendly" for shoes. The manufacturer had used the trade mark "Friendly" together with the trade mark "Jarman" in the sale of its shoes. The defendant, a retail dealer, used the trade mark "Friendly" but not the trade mark "Jarman" in connection with shoes coming from another manufacturer. The dealer contended, among other things, that the trade mark "Friendly" was invalid because of its use with the other mark. It is also contended that to be guilty of trade-mark infringement it would be necessary to use both of the manufacturer's trade marks. The Court ruled that the trade mark "Friendly" was valid, that it denoted the manufacturer's goods, and that the use of this mark by the retail dealer constituted infringement.

Frozen Lollypops

THE ice cream lollypops which are so popular with children were involved in recent patent ligitation. A suit was filed against a manufacturer of such lollypops charging infringement of two patents, one relating to the ice cream lollypops *per se*, the other to the method of making them.

In making the lollypop the stick was inserted in the ice cream at atmospheric temperature while the ice cream was in fluid condition. Thereafter the ice cream was frozen with the result that it adhered to the stick.

It was claimed by the patentee that this operation involved invention. The Court, however, declared the patent invalid, referring to the age-old custom of children of inserting sticks in a snowman and permitting them to freeze therein. In this connection the Court stated:

"It is childhood knowledge that the stick for a nose in a snowman, inserted in the afternoon, is so frozen to the icy snow particles, that, in the morning, young fingers cannot pull it out."

CURRENT BULLETIN BRIEFS

(The Editor will appreciate it if you will mention Scientific American when writing for any of the publications listed below.)

ADVENTURES IN CONVERSATION is a 24-page illustrated booklet that deals with the art of conversation and the stimulating effect which it can have on every-day life. A good conversationalist can turn a dull subject into one that sparkles, can talk interestingly with conviction, can develop a personality which otherwise might be warped. The pathway to developing the art of conversation is found in this booklet. *Conversation Institute, 3601 Michigan Boulevard, Chicago, Illinois.—Gratis.*

ON THE JOB is a 32-page pamphlet that illustrates and describes more than 100 typical installations of Caterpillar diesel engines. These installations cover a wide variety of fields including uses by cities, hotels, quarries, and cotton gins. *Caterpillar Tractor Company, Peoria, Illinois.—Gratis.*

STEREOSCOPIC EYES, by Dr. C. F. Brindel, optometrist, is an 88-page book dealing with "how to see depth pictures without devices." It is Dr. Brindel's belief that with proper training of the eyes, it should become possible for anyone with "just a pair of good eyes" to dispense with a stereoscope when viewing stereo pictures. Dr. Brindel explains the physiology of the eyes and provides instruction and suggestions on how fusing of the two stereo images may be accomplished with the "naked eye." Well illustrated with diagrams and photographs. *Dr. C. F. Brindel, 27 West 10th Street, Anderson, Indiana. —$2.50.*

PHILIPPINE MINING YEAR BOOK is a volume of over 200 pages which surveys the entire field indicated by its title. It includes indexed sections covering the mining industries, mining companies, a mining staff directory, the Manila Stock Exchange, and a buyer's guide listing machine and equipment supply companies in Manila. *Mining Yearbook, Inc., P. O. Box 297, Manila, Philippines.—$1.00.*

BROWNING 5-10 METER CONVERTER is an extremely compact unit for receiving two frequency bands when used in conjunction with any mobile, home, or aviation receiver. This instrument is described in Bulletin 106, obtainable from *Browning Laboratories, Inc., 750 Main Street, Winchester, Massachusetts.—Gratis.*

ESSAYS ON HISTORICAL ANTHROPOLOGY OF NORTH AMERICA is a 600-page paper-covered book containing sections by outstanding American authorities on the early Indians of 15,000 years ago and later; archeology of the Southeast; Iroquois history; Great Plains Indians; Navahoes; Southwest and Great Basin Indians; also on Eskimo pre-history. Together, these chapters pretty well cover our present knowledge of the first Americans. *Smithsonian Institution, Washington, D. C.—$2.00.*

PHOTOGRAPHIC CHEMICALS, THEIR PROPERTIES AND USES, by Henry M. Lester, is a 32-page booklet reprinted from *Quarterly Supplement No. 3* to the *Photo-Lab Index*. Listing alphabetically the various chemicals used in compounding photographic solutions, this handy little guide includes for each of the chemicals, the chemical synonyms, chemical formula, common grades, uses. In the case of poisons it provides antidotes. The booklet lists about 400 chemical terms. *Morgan & Lester, 100 East 42nd Street, New York, New York.—50 cents.*

ADVENTURES IN BIOLOGY is a 101-page paper-bound booklet giving practical instructions for simple experiments in biology, mainly for teaching purposes. *New York Association of Biology Teachers, Mrs. Estella R. Steiner, Grover Cleveland High School, 2127 Himrod Street, Ridgewood, Queens, New York, New York. —50 cents.*

HIGHWAY RESEARCH BOARD, PROCEEDINGS NINETEENTH ANNUAL MEETING is a 578-page cloth-bound book that presents a wealth of information on various phases of highway design, economics, materials and construction, maintenance, traffic and safety, and so on. All papers have been prepared by authorities in their own fields. *National Research Council, Highway Research Board, Division of Engineering and Industrial Research, 2101 Constitution Avenue, Washington, D. C.—$2.25.*

FARM WIRING HANDBOOK is a 28-page illustrated booklet that constitutes a guide for planning electric wiring on farms. Such planning, properly carried out, makes for more efficient and convenient use of power. *General Electric Company, 1285 Boston Avenue, Bridgeport, Connecticut.— Gratis.*

FINCH FACSIMILE FIELD LABORATORY is an illustrated booklet describing facsimile transmission and reception, with particular attention to a mobile laboratory that is now being used for research in this particular branch of communications science. *Finch Telecommunications Inc., 1819 Broadway at Columbus Circle, New York, New York.—10 cents.*

88 YEARS is an 18-page illustrated pamphlet that outlines the history and present status of the Studebaker organization. For 88 years this manufacturing unit has been producing vehicles that have played a large part in the development of the United States. *Glenn Griswold Associates, Public Relations, 330 West 42nd Street, New York City.—Gratis.*

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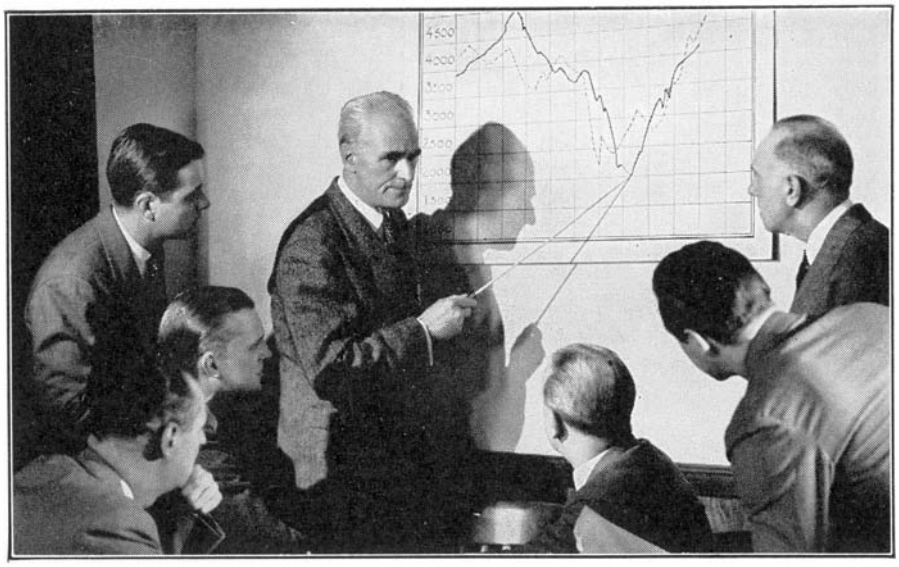

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