ATLANTIC CONQUEST

Planes that Make it Possible

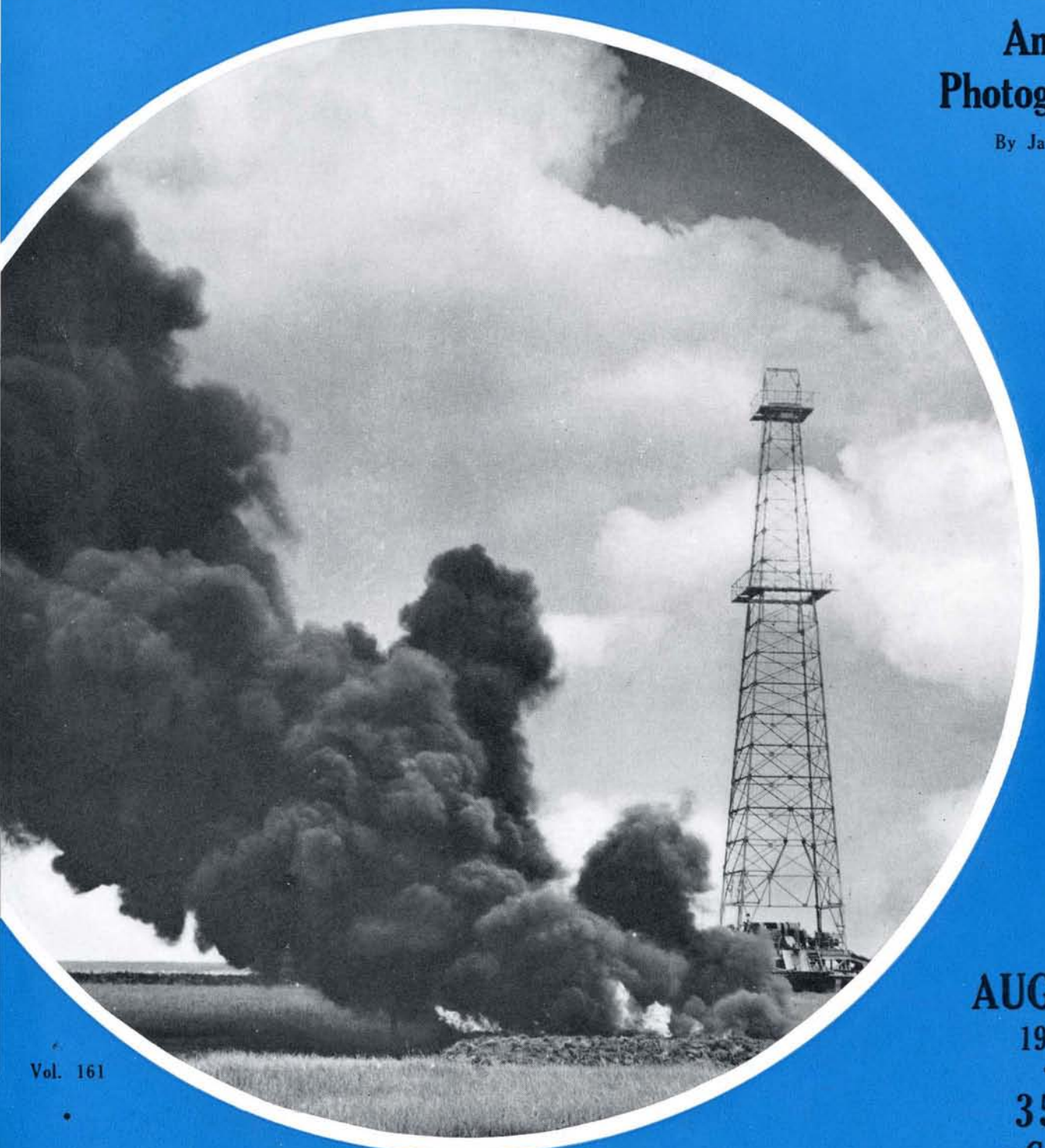
SCIENTIFIC AMERICAN

Including:
A DIGEST OF
SCIENCE & INDUSTRY

. . also . .

Amateur Photography

By Jacob Deschin



Photograph by
ROBERT YARNALL RICHIE

Vol. 161

No. 2

AUGUST
1939

35c
a Copy

For MEN

who want to become independent in the NEXT TEN YEARS

IN the Spring of 1949 two business men will be sitting in a mid-town restaurant. "I wonder what's going to happen next year," one of them will say. "My business is fine now—but the next few years are going to be hard ones, and we may as well face the facts."

The man across the table will laugh.

"That's just what they said back in 1939," he will answer. "Remember? People were looking ahead apprehensively—and see what happened! Since then there has been the greatest growth in our history—more business done, more fortunes made, than ever before. They've certainly been good years for *me*."

He will lean back in his chair with the easy confidence and poise that are the hallmark of real prosperity.

The older man will sit quiet a moment and then in a tone of infinite pathos:

"I wish I had those ten years back," he will say.

● Today the interview quoted above is purely imaginary. But be assured of this—it will come true. Right now, at this very hour, the business men of America are dividing themselves into two groups, represented by the two individuals whose words are quoted. A few years from now there will be ten thousand such luncheons and one of the men will say:

"I've got what I wanted."

And the other will answer:

"I wish I had those years back."

In which class are you putting yourself? The real difference between the two classes is this—one class of men hope vaguely to be independent *sometime;* the other class have convinced themselves that they can do it within the next few years. Do you believe this? Do you care enough about independence to give us a chance to prove it? Will you invest one single evening in reading a booklet that has put 400,000 men on the road to more rapid progress?

This booklet costs you nothing—and for a good reason. It is worth only what you make it worth. It explains how for more than thirty years it has been the privilege of the Alexander Hamilton Institute to help men shorten the path to success; to increase their earning power; to make them masters of the larger opportunities in business.

•

ALEXANDER HAMILTON INSTITUTE

Executive Training for Business Men

To the Alexander Hamilton Institute
169 Astor Place, New York City

Send me without cost a copy of "Forging Ahead in Business."

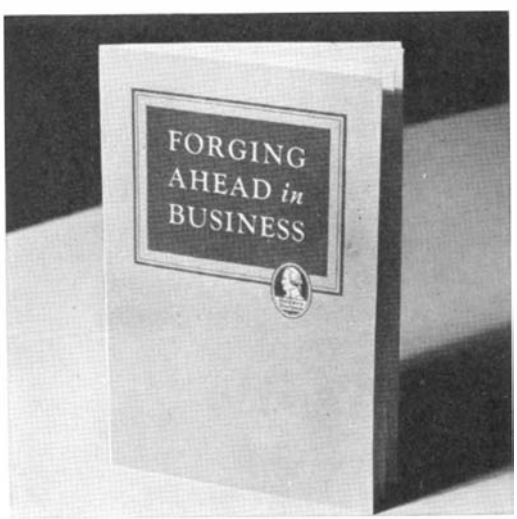
Name.....

Business Address.....

.....

Business Position.....

In Canada, address Alexander Hamilton Institute, Ltd., C. P. R. Bldg., Toronto, Can.



"FORGING AHEAD IN BUSINESS" is an interesting, helpful booklet. It is yours for the asking. Send for it. Measure yourself by it. Look clearly, for a few moments, into *your* next few years. Whether or not you will follow the path it points is a matter that you alone must decide.

• • •

CONTRIBUTORS TO THE COURSE

Just a few of the business leaders who have contributed to the Institute training course are such prominent men as:

Edward R. Stettinius, Jr.
Chairman of the Board
U. S. Steel Corp.

Thomas J. Watson
Pres., International Business Mach. Corp.

Alfred P. Sloan, Jr.
Chairman of the Board
General Motors Corp.

Frederick W. Pickard
Vice-President
E. I. du Pont de Nemours & Co., Inc.

Major B. Foster
Chairman, Dept. of Banking and Finance
N. Y. U.

Colby M. Chester, Jr.
Chairman of the Board
General Foods Corp.

The SCIENTIFIC AMERICAN DIGEST

SCIENTIFIC AMERICAN

Owned and published by Munn & Company, Inc.; Orson D. Munn, President; John P. Davis, Treasurer; I. Sheldon Tilney, Secretary; all at 24 West 40th Street, New York, N. Y.

NINETY-FIFTH YEAR • ORSON D. MUNN, Editor

CONTENTS • AUGUST • 1939

BY means of the method described on page 84 of this issue, for drilling oil wells at controlled angles from the vertical, it has been found possible not only to obtain more oil from underground sources but also to extinguish raging oil well fires and to bring "wild" oil wells under control. The secret of the process lies in the ability to direct and change the angle at which drilling proceeds.

NTIFIC AMERICAN, August, 1939. Vol. No. 161, No. 2, entered at the New York, N. Y., Post Office as second class matter June 28, 1879, the act of March 3rd, 1879; additional entry at Greenwich, Conn. Published monthly by Munn & Company, Inc., 24 West 40th Street, New City.

Subscription price $4.00 per year. Canada $4.50. Foreign Manuscripts are submitted at the author's risk and cannot be returned unless accompanied by postage.

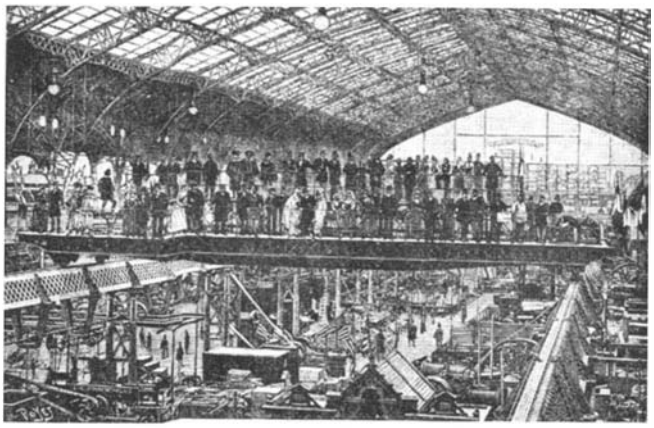
50 YEARS AGO IN . . .

SCIENTIFIC AMERICAN

(Condensed From Issues of August, 1889)

ELECTRICUTION—"A murderer in New York named Kemmler has been sentenced to death, and his execution will be the first under the newly enacted law by which electricity is substituted for the rope, hanging being abolished."

EXPOSITION—"Visitors to the Paris Exposition take great pleasure in being carried from one end of the Machinery Palace to the other on the electric rolling bridges, a general view of which is given in our engraving. In fact, they are not indifferent, whether on foot or on this original vehicle, to traversing the 1300 feet of the colossal gallery in which are accumulated so many wonders



of mechanics. Moreover, many of the visitors, if not all of them, experience an intelligent satisfaction in thinking that the motive power necessary for this aerial trip is furnished by electricity, and constitutes an interesting example of the transmission of electrical energy to a distance—that problem which is now in a large measure solved."

ICE WATER—"In the opinion of the editor of the *Sanitary Volunteer* . . . there is a great deal of sentiment and many opinions regarding the use of ice water that vanish when the light of reason and experience is turned upon them. The fact is that ice water, drunk slowly and in moderate quantities, constitutes a healthful and invigorating drink . . . The assumption that iced water is dangerous, and that iced tea, or iced coffee, or iced lemonade is a harmless substitute, is simply a delusion."

DIAMONDS—"The practical production of the diamond by artificial means has been the theme of a great deal of thought and a good many experiments, but up to this time it has eluded all the efforts of the experimenters, though carbon crystals closely approaching the gem have more than once been secured, while many persons still think it is merely a matter of time, and not a long one at that, when the secret will have been wrenched from nature."

PATENTS—"The Supreme Court has repeatedly said that a man's right under his patent for an invention is as absolute as under a patent for lands, and no one would say that one should lose the right to his house because some one else saw fit to take possession of it against his will."

FLIGHT—"When human ingenuity can match the product of nature; when it can make a machine possessing as much power and endurance to the ounce of weight as that of the homing pigeon which lately flew from Detroit to Buffalo (225 miles) in less than four hours; when it can so arrange and automatically shift a series of vanes like shifting feathers in a hawk's wings, which suspend it in the air for hours almost without apparent motion, when it can solve the problem of how this same hawk drops like a bullet from the dizzying height of a half mile, and checks itself unharmed above its prey, then it may learn to travel in the air."

REJUVENATION—"Dr. Brown-Sequard's paper, lately communicated to the Societe de Biologie, of Paris . . . details the remarkable effects produced in his own person and also in several other men of advanced years, by the subcutaneous injection of substances derived from the testicular portions of the bodies of certain animals."

BORAX—"New borax works have recently been started in Saline valley, Inyo county, California. They have eighteen crystallizing tanks, each of a capacity of 1000 gallons. Three of these tanks are emptied daily, yielding about two tons of borax."

TRANS-SIBERIA—"The proposed Siberian railway is to extend from St. Petersburg to Vladivostock on the Pacific Ocean, which is located nearly opposite San Francisco, and distant therefrom about 4000 miles. Branch lines of the proposed road would extend to Pekin. The new road would be about 4500 miles in length."

ELECTRICITY—"There are now in use in the United States more than 5650 central electric stations for light and power. There are 210,000 arc lights and 2,600,000 incandescent lamps. There were fifty-nine electrical railways in operation in March last, and eighty-six roads in process of construction. The increase of capital in electrical investments during 1888 was nearly $70,000,000."

WARSHIPS—"On August 22, proposals are to be opened at the Navy Department for five new cruisers, to be built on plans copied from what are now obsolete English ships, slow in speed, lacking in offensive and defensive means, not the latest and best designs. It is to be hoped the Secretary of the Navy will be able to defer the award of construction until Congress meets and time is given to modify the proposals so as to substitute later and better designs."

CIGARETTES—"Observation in public places gives satisfactory evidence that the use of cigarettes is rapidly on the decline. Whether this is due to the stringent laws passed in many of the states against selling them to minors, or that smokers have come to their senses and have taken warning from their own experience and the unanimous condemnation of smoking cigarettes by the medical profession, or whether the evil practice has begun to be looked upon as a discreditable vice to be only practiced in secret, we know not; but it is certain that, as compared with the past, very few cigarettes are now smoked in public."

PHOTOGRAPHY—"Modern amateur photography . . . consists, substantially, in pointing a camera and touching a spring. It requires no study, no knowledge, no experience, no genius, no skill. Even children are now photographers, and the camera is coming to be a toy."

AND NOW FOR THE FUTURE

¶The Spectroscope, Modern Aid to Research and Industrial Production, by G. R. Harrison, A.M., Ph.D.

¶Cancer Research Looks Forward, by Barclay Moon Newman.

¶Hydraulic Engineers Use Small-Scale Models in River Control Studies, by Paul W. Thompson.

¶Mystery of the Earth's Magnetism, and Steps in the Solution, by Charles W. Sheppard.

¶Modern Dog's Ancestry Traced 5000 Years by Arcl eologists, by W. H. Noble, Jr.

OUR POINT OF VIEW

Upward

WHILE a fear-ridden world is talking of nothing but war, it is truly refreshing to hear another note sounded—one that includes the word "armament" but with a meaning far removed from warfare. From England, the Scandinavian countries, the King of Belgium, the Queen of Holland, and now from the President of our own country has come a call—a call to arms. But what a different call, for this is a call for *moral rearmament.*

These far-seeing people realize, as everyone must, that unless something is done, disaster will overtake the nations of the world as it has in the past. We must not forget that nations are aggregates of individual beings, and until man changes himself we cannot expect nations to be very different. Aesop long ago, in the fable of the human body, pointed out a great lesson—that every one of us is dependent upon each other. When the individual himself will put into practice the fundamental principles of unselfishness and honesty, we will find in our business life and in our national life a great change; and as the individual and the nation change the international peace of the world will be assured. We will have both national and international peace and prosperity.—*A. M. T.*

Commerce

SOME months have passed since the liner *Paris* burned at her pier. Yet that disaster still may serve as an object lesson to shipbuilders throughout the world. Fire may strike any ship, large or small, if built by traditional designs and of the usual materials. And when it strikes, sometimes there is a ghastly toll of life, as was the case when the *Morro Castle* burned off the New Jersey coast several years ago.

As we contemplate with no little national pride the plans for upbuilding the American merchant marine (discussed by H. Gerrish Smith on other pages of this issue) a greater pride grips us at thought of all that American designers and experts have done to make all our new ships fireproof. Fires can start on practically any of them, but will burn themselves out quickly. The principle behind the use of the newer designs and the newer materials is to insulate each partition, each bulkhead, each deck, against any spread of a blaze.

The details of the fireproof features of the *Ancon* and the *Panama*, of the Panama Railroad line, were discussed briefly in the April, 1939, issue of Scientific American. The *America*, largest merchant vessel ever constructed in this country, will be made, in a similar manner, proof against fires. Likewise, the new construction will be featured in more than 20 combination cargo and passenger ships which are now on the stocks. These are following the lead of oil tankers built during recent years, all of which are immune to sweeping, disastrous fires.

Here then, we repeat, are two sources of pride—justifiable pride—for the American people. After long years of apathy toward our merchant marine, years in which we permitted other nations to outstrip us on the seas, we have at last ceased our fumbling attempts to plan shipbuilding programs and will have a merchant fleet befitting our world position. No longer may the analogy of the department store owner who delivers his orders in his competitors' delivery trucks be applied fully to us; our own bottoms will handle a much greater proportion of our export and import business than they have for many years. The second—and in some respects more important—point is that our new ships will be the safest in the world. We have long stood with the best in general safety but have now definitely taken the lead in the development of completely fireproof ships. It is to be hoped that our studies and experience may be made available to and be used by other nations so that fire at sea may some day be a thing of the past.—*F. D. M.*

Albert A. Hopkins

EDITOR, author, antiquarian, bibliophile, Dickens scholar—wide were the interests; industrious the mind; kindly, considerate, and tolerant the actions of this man whom we called friend and our readers looked up to as mentor. Our Associate Editor for 44 years, until his retirement three years ago, Albert A. Hopkins passed away on June 9 at his home in New York City, at the age of 69.

Mr. Hopkins followed in the footsteps of his father who was also associated with Scientific American for many years. Editing and writing came so easy to him that he found time for many other broad interests during his busy and productive life. Fame, which might have been his for the asking, held no glamor for him, for his was that rare mentality which loves achievement for its own sake. He wrote, compiled, and edited a large number of books, at least one of which sold into the hundreds of thousands. An authority on the history of art, he collaborated with the late Edwin Howland Blashfield in editing Varsari's "Lives of the Painters." To the New York Public Library, he presented a valuable collection of 4000 mounted photographs of Italian paintings and statuary. He was one of the guiding forces in the Dickens Fellowship of New York, a former vice-president of that organization and editor of its publication, *The Dickensian.* He was also Director of the American Museum of Safety and editor of its official monthly publication.

Proponent of progress in science and the arts, and an energetic, indefatigable worker for those ideals that make men great, Mr. Hopkins achieved a unique greatness of his own, a transcendent joy in the art of living. He took the utmost from life and gave full measure in return.

We shall miss him for we were honored to call him friend.

Is Man Sapient?

RECENTLY, A. C. Chick of the Manufacturers Mutual Fire Insurance Co., told the Seismological Society of America, Eastern Section, that the volume of earthquake insurance took a sudden leap upward after the Santa Barbara quake of 1925. The California premium alone reached a total of $3,000,000. By 1928, however, the premium had fallen to $2,000,000 and by 1932 it was only $750,000. Shortly afterward came the Long Beach quake ("Oh, *why* did we let that insurance lapse?"). Exactly the same crescendo and diminuendo followed, the total quake premium for the whole nation today being only $1,000,000.

Now, since the least dangerous period is soon after a great quake, when earth stresses have been satisfied, and the most risky period some years later when new ones are accumulating, it sounds as though perhaps man wasn't the altogether intelligent gambler implied by the term *Homo sapiens.* An odd sidelight on emotional effects of recent experiences is that the New England hurricane of 1938 stimulated *earthquake* insurance! This should not be let lapse. The east, too smug about the west's quakes, is largely a seismic area, as it may someday discover to its sorrow.—*A. G. I.*

Personalities in Science

DAYTON C. MILLER

DAYTON C. MILLER is Professor of Physics at the Case School of Applied Science, Cleveland, Ohio. Readers will recall him as the scientist whose name figured so frequently in the newspapers a dozen years ago in connection with a notable experiment on ether drift. However, Professor Miller's special interests within the field of physics are far broader than ether drift and they include the velocity of light in a magnetic field, the expansion of gases, Roentgen rays, applications of the interferometer, the photographic registration of sound waves, and the quality of musical sounds.

Is there actually an ether? A century and a half ago students of science would have asserted with honest conviction that caloric and phlogiston were actual entities having reality. Today we know these were merely words with no reality behind them. Largely, it is suspected, they acquired their high prestige from common and frequent use. They were burned into the mind. Half a century ago the word ether had similarly high prestige and solid standing. People took the existence of an ether much for granted, but it is suspected that the reason again was its common and frequent use, especially in teaching; for there never has been any really water-tight, final *experimental* evidence for the existence of an ether. The concept was simply a postulate. Light had to be transmitted by some medium, hence there must be a medium. Logic. But logic unsupported by experiment often leads astray in science. Is ether then to turn out to be only a word, like caloric and phlogiston? There is a marked human tendency to confuse names with things—to name something we think exists and then to feel sure that it exists, or even that we then understand it. Thus far, anyway, science does not know whether there is an ether or not. Preponderance of evidence seems against it at present.

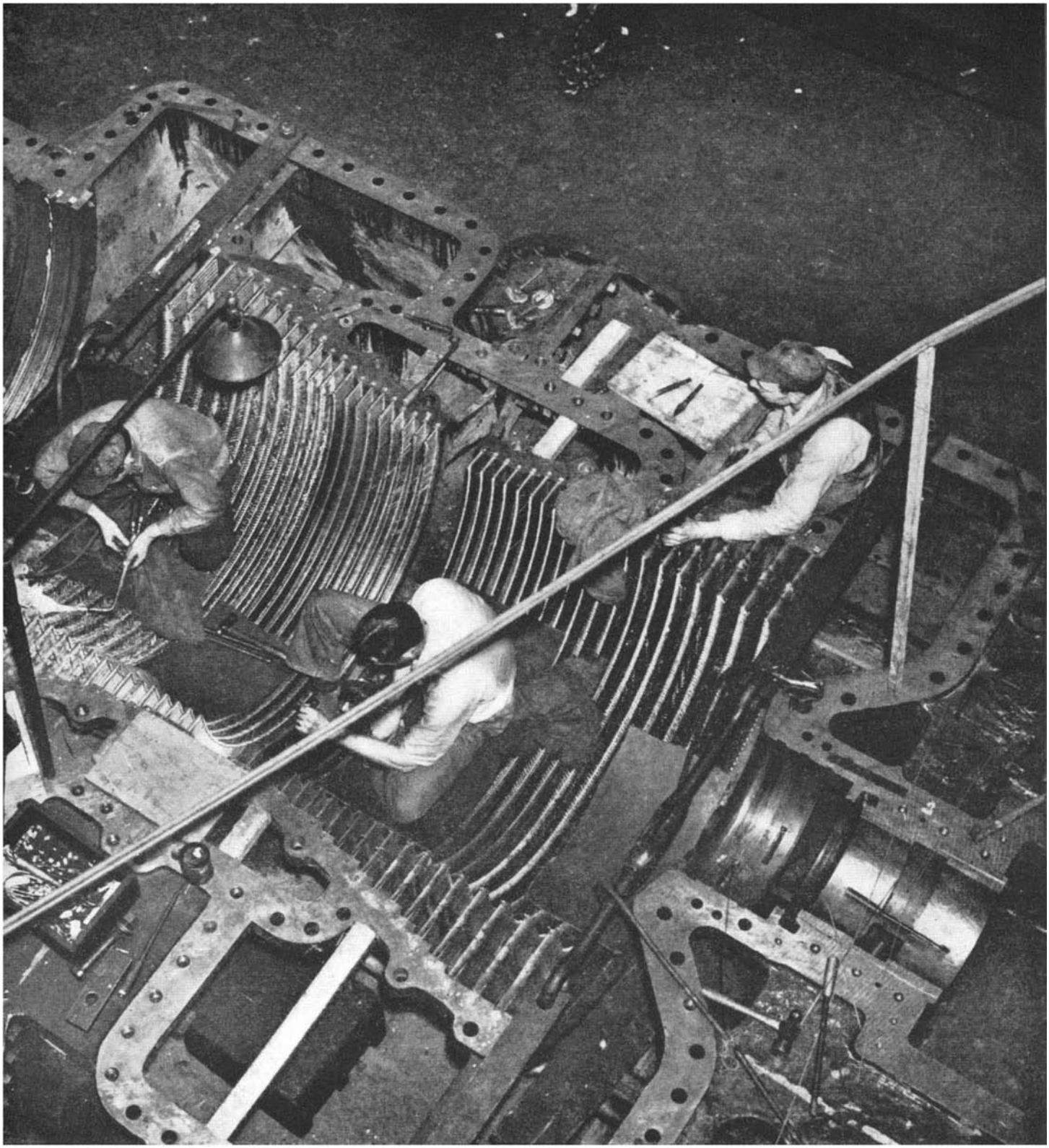
In 1887 the famous Michelson-Morley ether drift experiment had given no evidence that there was an ether. Subsequent repetitions by others gave practically the same results. Squarely on these findings Professor Einstein based his 1905 theory of relativity. Thus, when Professor Miller came to repeat the Michelson-Morley experiment in 1921, 1924-26, and in 1929, it took on greatly enhanced weight and the public heard much about it through the press. After very many exceedingly laborious individual measurements he came to the belief that he had isolated evidence of an ether drift, therefore of an ether.

Scientists the world over awarded Professor Miller's research very close, serious attention, especially because they knew his record and personality and approved of both. The former was that of a careful, level-headed research worker who habitually kept emotional factors out of his mental processes—major part of the method of science itself. The latter was (and still is) genial, calm, quiet, simple, unpretentious, and unaltered by the award of medals and honors. Scientists knew he was not seeking merely to "prove" the existence of an ether or out to "get" relativity—approaches which would be motivated and therefore contrary to the method of science—but was making an experiment and observing the results. To this day these results have never been satisfactorily explained away. Professor Miller does not root vehemently for them as some might. He says calmly that the details of his work are now in the record, and that the future will prove them true or prove them wrong. In this he resembles Professor Einstein who, when told of Professor Miller's findings, calmly said that if they were finally verified the theory of relativity would automatically disappear. That is science.

A wide sector in Professor Miller's scientific territory has had to do with sound and music, and readers will recall his book, published two years ago, entitled "Sound Waves, Their Shape and Speed," a work for the popular reader.

But he is also a musician as well as a music lover. Skilful as a flute player, he used that instrument first in his researches on sound. He owns a collection of flutes of all varieties, numbering no less than 1300. Chinese jade flutes, walking-stick flutes, a glass flute once owned by President Madison, a human shinbone flute, a flute made from the wing of an eagle, an East Indian nasal flute, and many other odd flutes; also 35 modern flutes. But he is no mere collector; he can play these flutes and does.

Professor Miller's most recent book is an illustrated, popular, anecdotal history of electricity named "Sparks, Lightning, Cosmic Rays."



DELICATE BLADES IN A LINER'S POWER PLANT

HIGHLY skilled mechanics are needed for the intricate job of blading the low-pressure turbines that will be a part of the driving machinery of the great liner *America*, now being built as part of the program for a finer merchant marine which is discussed on page 88 of this issue. Some 15,000 of the delicate blades will be required—arranged in circular, parallel rows—in the shell, or casing, of this turbine. The photograph shows half the casing with semicircular rows of reaction blades in place. Another 15,000 blades, similar to these but called impulse blades, will be fitted to the rotor which is to be mounted in this casing. The projecting rows of impulse blades on the rotor will dovetail into the spaces between reaction blade rows of the closed casing.

Photo by Ben S. Beery

To man, a building is such a familiar thing that he seldom pauses to think that its strength from sidewise directions is far below its vertical strength (against gravity). In non-seismic regions this is adequate, but in earthquake areas horizontal forces about half as strong as gravity may occur. The best answer is to provide a much heavier system of diagonal braces. This requires altering human habit, custom, tradition—a slow process

EARTHQUAKES NEED NOT KILL

A Small Percentage Added to Building Costs for Adequate Bracing is Changing Earthquakes from a Dreaded Horror to an Interesting Phenomenon

By DAVID O. WOODBURY

THERE was no warning, only a deep and terrible roar, and in *four seconds* the town of Pegu in Burmese India lay in ruins, destroyed by an earthquake. Before the frightened inhabitants could run a single step their flimsy city had buried them.

The earthquake is the swiftest and most gigantic manifestation of power ever seen on the globe. It dwarfs volcanic eruptions, hurricanes, even the most deadly of man-made explosions such as the Halifax disaster of 1916. It may move thousands of cubic miles of solid rock, change hundreds of miles of geography, shift mountains, rearrange rivers and harbors, create lakes or destroy them, open miles-deep cracks in the ground and grind millions of tons of rock to powder—all in the winking of an eye.

Before men can even tell which way to run it is all over—buildings are down, hundreds or thousands dead, cities in flames. The tremor in Southern California in 1933 lasted only seven seconds but killed 120 people. In San Francisco 40 seconds sufficed to start the ruin of a metropolis. In Chile a little while ago the shake went on for two minutes; 50,000 died and as many more were injured. Through the pages of history runs a red trail of blood and fire to mark where man, the luckless interloper, has gone down before the onslaught of the laboring earth. Lisbon, Messina, Port Royal, Charleston, Tokyo, Helena, Chillán—the record is jammed with tragedies. One moment a teeming city, the next a shambles, like a Sodom and Gomorrah struck down by divine wrath.

Yet earthquakes are not "acts of God" at all. They are as normal as rain and far more frequent. Mother Earth twitches constantly like a sleeping dog and cares no more for the effect than he. Seismographs distributed throughout the world record an almost steady shiver of the ground—too minute to be felt, mostly, but proof of incessant activity below. In an average year Japan is visited by some 12,000 tremors, with other countries around the Pacific basin playing close seconds.

NOR are major quakes uncommon either. There are on the average 50 of them every year throughout the world. In Chile severe shakes occur every month or so, often accompanied by destructive seismic sea waves. Even in solid old New England there have been 350 earthquakes of major intensity since Colonial times. Earth tremors are as obedient to the law of averages as the cycles of the weather. In dangerous areas, such as Japan, Southern California, and South America, seismologists keep a continuous record of the uneasy earth and can foretell the probability of future quakes as accurately as an insurance company can predict the life expectancy of a client.

Earthquake disasters usually overtake the public without warning, but scientists are rarely surprised. Seismologists in Southern California, for example, are momentarily expecting another major shake, with an intensity as great, possibly, as the one which wrecked San Francisco in 1906. It may come tomorrow, it may not come for years. But they know that it will come sooner or later. Whether a great disaster will follow, as in Chile, depends upon where it strikes and how much protective work has been done in the meantime.

For people do not need to die when the earth shudders, nor do cities need to be ruined. The earthquake, says the scientist, is rarely destructive in itself. It is man's persistence in building inadequately—his refusal to eliminate the death-traps that he has deliberately erected for himself. Science is slowly instructing a public loath to face the simple engineering facts. Little by little it is convincing the people that if they must live where continents are still in the making they must realize their danger and prepare.

A long and difficult problem of education this is, and one that must be founded on an exact knowledge of earthquakes and of how and where they strike. Admittedly, protective seismology has only

just begun. Fifty years of research has meant no more than a start.

Though the effects of the shuddering earth are gigantic, the causes are most difficult to find. This is because they lie so far down in the bowels of the earth that they can never be studied at first hand. Only the comparatively minute vibrations which reach the surface can be used to interpret what goes on underneath. Ironically, man's entire knowledge of the deep interior comes from a study of the tremors which destroy. Without them he would know little of the depths below a few thousand feet.

Earth has a solid crust 20 to 40 miles thick. Unlike the crust of ice on a pond it does not float on liquid material below it. If it did, earthquake vibrations would not be transmitted as they are through the center of the globe. A few miles down science pictures the pressure and temperature of the overlying rock to be so tremendous that the material is actually made plastic, like tar in a barrel. On this, geologists think, the hard outer shell slips and slides like scum in obedience to forces unknown. Erosion, the gradual shrinking as the interior cools, the release of radio-active energy, the tidal pull of the Moon—any or all may be the fundamental causes: no one yet knows. But the effect on top is certain. The thin hard crust on which we live is subjected to continual twisting and bending, stretching and compression, and is tortured into ridges and hollows as it tries to accommodate itself and fails. The result, as seen by the inhabitants outside, is the mighty process of mountain building.

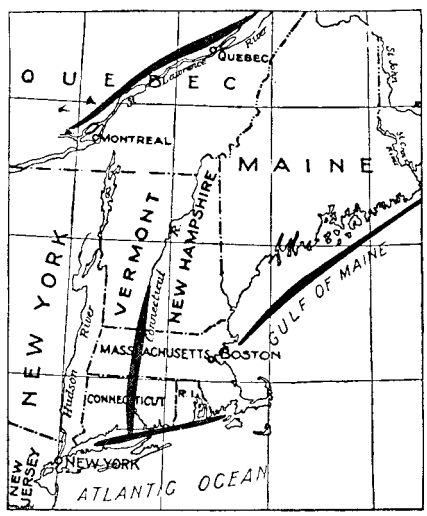
IT takes many millions of years to create mountains from a plain. Surface movements may be imperceptible within the lifetime of one man, yet in accumulated centuries they are huge. The Himalayas themselves were presumably made that way. The important fact is that the earth's crust is never allowed to rest. Over and over again great pressures are built up, over and over they reach an intensity no rock can stand. Then all at once something lets go, and the fringes of whole continents may move.

Eons of this abuse have riddled the earth's crust with fissures which run down 20, 30, even 40 miles. These are known as "faults"; they do not show on the surface like knife-cuts in home-made candy, but are filled in with pulverized rock and debris and often only geologists can recognize them. The great San Andreas Fault in California is largely hidden, and is principally identified by mountain structures which have been rent asunder and moved past one another as much as 20 miles.

Mountain building is mainly vertical but the strips of land between faults are moving horizontally also, and at considerable "speed." The friction of two neighboring blocks of crust is very large and as they try to slide past each other they stick fast and cannot move. Gigantic stresses are built up and the loose top layers of sand and boulders along the fault are actually compressed and sprung out of shape as if they were made of rubber. A fence or road across a fault often shows this condition by being bent into the form of an "S." When friction can hold the pressures in check no longer there is a roar and a shudder and whole cubic miles of rock spring into life and jerk past each other. The forces are so huge that these "elastic rebounds" invariably overshoot the mark. The earth then jerks and jerks again till the strains are for the moment eased. This is an earthquake; no wonder, then, that luckless human witnesses and their puny buildings are often destroyed!

BUT the actual slip along a fault is not in itself the destructive element. It is the aftermath of vibration which does the harm. If all the cities in earthquake zones could be built on solid rock there would be no disasters, for the rock itself shakes only a fraction of an inch. The danger lies in the deep deposits of alluvial soil which skirt the mountain walls. The loose rocks and sand are saturated with ground water and the conglomerate acts like a jelly, intensifying every earthquake vibration to hundreds of times its original amplitude. Thus the principle of resonance, which is so useful in a radio set, in earthquake country becomes the sinister devil which destroys everything in its path.

There is always a center of disturbance on a fault where the actual slip begins. It is usually miles below ground and the movement may not reach the surface at all. But the vibrations do, and they spread out in every direction, often traveling clear through the earth and out on the other side. The vibrations come in three distinct parts: first, a high-frequency wave which is too fast to be felt, but which shakes the air so rapidly that it creates the horrible roar often heard just before a quake. Next, a vibration of much lower frequency which rattles dishes and chandeliers but does little harm. And finally, the slow and deadly set of waves, traveling like rollers in the ocean along the surface of the ground.

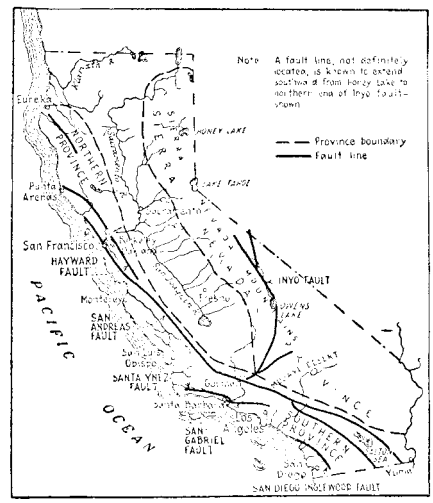


Courtesy *New York Sunday Times*

These are the ones that fling the trees about as if in a great wind; open and close huge cracks in the earth and send people staggering and often deathly seasick as they go. These are the ones that set the buildings rocking and topple them down on whomever is in their path.

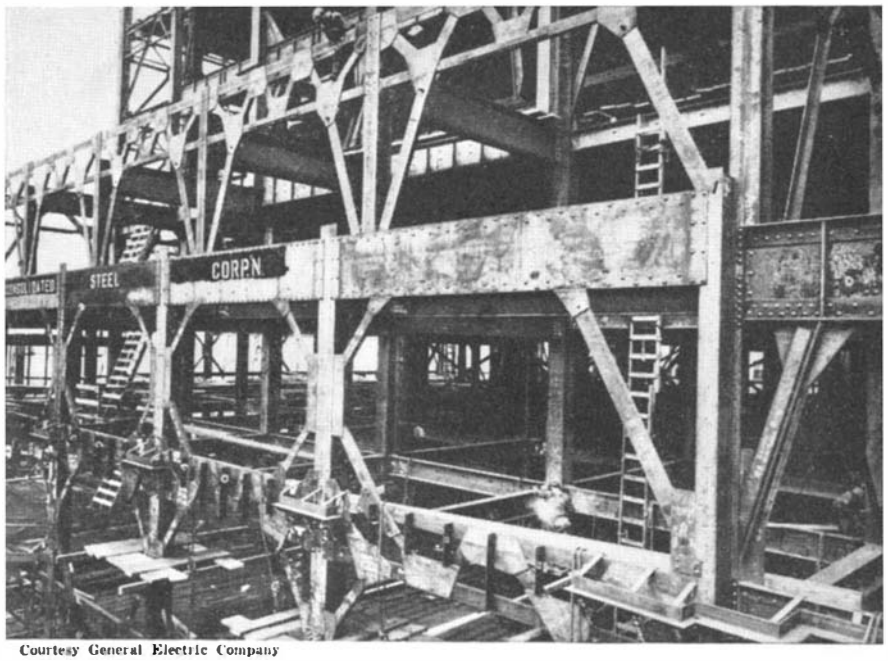
Science bases its entire knowledge of earthquakes on studies of these vibrations, transmitted through the earth and picked up by delicate seismographs hundreds or thousands of miles from the center of the disturbance. In principle the seismograph is simply a heavy weight suspended like a pendulum, holding a stylus against a piece of smoked paper. When the earth jiggles the paper jiggles with it while the weight stands still and thus a record of the vibrations is scratched on the sooty paper. In highly refined modern instruments the recording is done electrically through vacuum-tube amplifiers and a beam of light on photographic paper.

The successful analysis of an earthquake depends upon how accurately the center of disturbance can be located in the earth. This is a problem of triangulation in three dimensions and requires a detailed interpretation of vibration records taken simultaneously at widely separated points. A network of seismographic stations is gradually being built up all over the world and a central computing headquarters has been established in Oxford, England. Records are constantly flowing to this station from everywhere and the data are correlated so as to give the position of each important earthquake as it occurs. But it is a long and



Courtesy *Engineering News-Record*

Above: **Earthquake provinces of California. Note San Andreas Fault.** ***Left:*** **Lines show zones of earthquake origin in the northeast, an area by no means safe from quakes**



Courtesy General Electric Company

Showing what is meant by adequate diagonal bracing against earthquakes. The Edison Building in Los Angeles with steel frame and arc-welded seismic bracing

complicated mathematical job and sometimes years elapse before exact results on any one tremor can be published. In the United States similar work is done in Washington and St. Louis.

In localities of high earthquake danger, such as Japan and California, much more advanced measures have been taken, and well-staffed central laboratories are maintained, surrounded by a network of recording stations located with special reference to the existing faults. The work of these organizations is gradually making it possible to predict where earthquakes will occur and to show how protection can be achieved.

SEISMOLOGISTS divide the world into two narrow earthquake belts, one circling the Pacific Ocean, the other running across Europe and Asia from Spain to the Orient. Minor belts are found along the eastern seaboard of the United States and in the Mississippi basin. At any point within these belts destructive quakes may occur at any time, and there is no positive assurance that they won't occur outside them also.

Disastrous tremors are uncommon in America except in the far west, although plenty of strong shakes have been recorded. The geological formation in the east is the most ancient in the world and its worst shaking was over before man arrived. The middle west is almost as stable. Nevertheless, the greatest quake in American history took place in New Madrid, Missouri, in 1811, and only missed killing thousands because it happened in the wilderness. North Dakota is the one state where a destructive quake has never been recorded. There is no guarantee that even that will escape forever.

New York City is virtually immune, for it is built on two deep and aged rock strata untroubled by faults. Boston, on the other hand, is not far from the great Fundy Fault in the Gulf of Maine, and major shakes have occurred there. The hazard is considerable, because the whole Back Bay section of the city is built on muck pumped from the Charles River. A quake as severe as the one that struck in 1755 would probably cause severe damage and heavy loss of life. Philadelphia, Chicago, and many other large centers are similarly built on made land, which is ideal shake material, and might suffer severely even in a minor earthquake. Charleston, South Carolina, was badly damaged in 1886 by a small disturbance because it was built on poor foundations. Nevertheless, the risk is considered so slight in the eastern half of the United States that almost no one carries earthquake insurance. In the whole city of New York, for instance, only a scant handful of buildings are so covered.

By long odds the greatest danger point in America is in Southern California and it is here that a typical earthquake program is being built up. The work centers around the Carnegie Institution's seismographic laboratory at Annandale, with assistance from the Coast and Geodetic Survey and the laboratories of various universities. Intensive study was begun after the San Francisco disaster but it got little support from the public till their bad fright at Long Beach in 1933. Since then the Earthquake Commission has become an accepted institution and has made use of every opportunity to urge utmost preparedness against the serious earthquake which is surely coming.

Numerous seismographic stations are scattered about the state and their records of vibrations are ingeniously synchronized by photographing radio signals alongside the tracks drawn by the tremors themselves. From these timed records it is comparatively easy to compute the direction from which the vibrations come and their speeds, and hence to keep informed of the slips occurring on the seven faults that cross the state. The government, also, has erected a large number of monuments or bench marks on high ground and these are surveyed annually to indicate the general movements of the earth.

WHENEVER a major earthquake occurs, most of the delicate instruments nearby are put out of commission and information has to be gathered from such random sources as the direction of fall of gravestones, the pattern of cracks in the soil and the movements of buildings and their contents. Though eyewitness accounts are highly unreliable, a postcard poll is usually taken with the hope of obtaining enough data to form reliable engineering opinions. After a serious quake one man sent in a sketch of the wandering course of the gas stove around his kitchen floor. It gave the scientists an excellent picture of the earth movements at that spot in the devastation area. Recently, "strong motion" instruments have been installed around Los Angeles and hit-or-miss observations are no longer so necessary.

But these scientific studies, valuable as they are for the future, do not interest the citizens as much as the campaign for protection which the Earthquake Commission is also fostering. The last serious quake, at Long Beach, occurred just before six in the evening. If it had happened earlier thousands of school children would have been killed, for not a school for miles around was left undamaged and many were destroyed. The public instantly clamored for advice on how to rebuild their schools so that they would not fall again, and with the help of the chambers of commerce and insurance companies, a rigid building code was worked out and passed by the Legislature. Every school in California has been rebuilt or strengthened since; in Los Angeles alone it is estimated that $150,000,000 has been spent.

The rule for building protection is simple but often expensive: make them heavy and rigid and tie them to firm foundations. A shake is destructive because its third type of vibration closely coincides with the natural period of sway of the average building. Heavy, willowy buildings especially are prone to fall in step, and their own elasticity amplifies the motion until they collapse. Large reinforced structures usually do not topple themselves but send tons of ornamentation in a deadly shower to the street. Property owners are warned not to decorate their buildings with anything that can be shaken loose. Civil engineers are

EARTHQUAKE RISK IN CALIFORNIA 23

that question with any definiteness. A great shock may come soon, or within a decade, or not till after more than a decade. But it will come.

I have been asked what I would do in the circumstances and I have answered that I would try to do the sensible thing. I would see to it that my house was reasonably well tied together so that my family might sleep and live in security, and I would endeavor to arouse public interest in demanding that school buildings, stores and other structures were made safe also against wreck and fire hazard. And I would take out earthquake insurance.

San Diego District. San Diego and Los Angeles have so much in common in their earthquake history, it might at first sight seem appropriate to describe as one province the whole coastal plain, together [illegible] mountain ranges that rise from [illegible] faults [illegible]

A prophecy which caused a rumpus, and its happy aftermath. When, in December, 1923, the noted seismologist Prof. Bailey Willis, of Stanford University, published in the *Bulletin of the Seismological Society of America* the warning in the top two lines of the reproduction above, and the advice in the succeeding seven lines, incensed real estate men rushed to the head of Stanford University and (unsuccessfully) demanded recantation or discharge. Ten years later came the first major quake, Long Beach (Prof. Willis predicts another), and this made it possible for science to gain a long-denied hearing. A joint report of science and business (see below) was issued and safe buildings were begun. Before buildings can be altered, human traits must be altered—the bigger task

To the Public:

In response to official requests from many representative technical and civic organizations, the Joint Technical Committee on Earthquake Protection was organized after the earthquake of March 10, 1933, to consider ways and means of minimizing loss of life and property damage in the event of another earthquake of equal or greater intensity

We now present to you, in the form of this summarized report, our belief as to the seismic hazard in this region and our opinion as to the proper balance between the degree of protection to be afforded life and property and the cost of providing such protection

We sincerely hope that the lessons of the Long Beach earthquake will not be forgotten as were the lessons which should have been fixed indelibly in the minds of all by the earthquakes of the past.

JOINT TECHNICAL COMMITTEE
ON EARTHQUAKE PROTECTION

Robert A. Millikan

Chairman

asked to design the columns and foundations of new structures so rigidly that their natural period of vibration will be much faster than the earthquake's tremor. Buildings of this kind in Tokyo came through the holocaust almost untouched, but in Chile whole cities built of spineless adobe and brick were ground to powder, the inhabitants beneath.

Small homes of wood are unusually sturdy for their weight and rarely become death traps. They may be thrown askew on their foundations but are likely to remain in one piece.

As for personal conduct during an earthquake, say the scientists, the first requisite is to avoid panic. The victims are likely to be the people who rush screaming to the street only to be crushed by falling debris. The safest place when the shake begins is a solid arched doorway or an inside corner of a room that is well braced. Most natives of California and other danger spots know this, but by no means all of them practice what they know when the horror begins.

An important point to remember is that a severe earthquake is sure to be followed by after-shocks, some of them nearly as severe as the original. People who have dashed into the ruins to save victims are often caught by the toppling of buildings weakened but still standing. Thousands in Chillán met their death in this way.

OPEN flat spaces are usually the safest, for rarely does the ground "open and swallow men up," as it was reported to have done in San Francisco. But open spaces in the hearts of cities are to be mistrusted. In the Tokyo quake 40,000 homeless people were herded by the Chief of Police into a broad park especially maintained for this emergency, bringing with them what few belongings they could snatch from the ruins. Within a few hours they were surrounded by flames, their tinder-dry baskets of clothing caught fire and they were incinerated to a man. The Chief of Police committed hara-kiri that same night, from remorse.

In many earthquake countries people firmly believe that shakes do not come without warning. There is still a dogged faith in signs such as "earthquake weather." Seismologists find some justification for this but warn that actual predictions of time and place are surely the work of charlatans. In Japan, sometimes, low barometric pressure and high winds precede a quake. If there is any connection it is because the earth is in so critical a state that wind pressure against the mountain walls is enough of a "trigger force" to set the quake in motion. Occasionally, a few minutes or hours before a tremor, the land will begin to tilt slowly, but quite as often the land does not tilt, nor does the weather give any sign.

Far better than believing in signs is to work for preparedness. The responsibility for this lies mainly with the city governments, which must learn to face the menace of earthquakes regardless of civic pride. To let quake protection lag is misplaced economy; worse, it is an open invitation to disaster. Nor is a thoroughgoing program of protection prohibitive. As the noted engineer, R. R. Martel, said in addressing a Los Angeles meeting recently: "If you will put only 10 percent more into the cost of your buildings, the chamber of commerce can adopt the slogan: 'Come to California to enjoy the next earthquake.'"

Tinted Lenses

Sun Glasses Should Give Adequate Protection Yet Maximum Visibility . . . Objective is to Eliminate Rays Which Do Not Contribute to Seeing

EDITOR'S NOTE: *Increasingly wide use of sun glasses to eliminate glare, especially for sports and automobile driving, makes necessary a warning that only certain types and colors will give the protection that is sought. In the following article are summarized the reasons for wearing such glasses, what they must do to be effective, and the types that will be most effective for use with normal eyes.*

LIKE other organs of the body, the eyes have had a difficult time keeping pace with the rapid strides of civilization. We have turned night into day, giving the eyes little rest from the continuous bombardment of light. Although the eyes are about as adaptable as any other organ, they have a great variation in sensitivity. The deposit of pigment in the choroid, retina, and iris is as variable as are the human races, yet has a definite relationship to a person's tolerance of light. By adding pigment to the eye in the form of a tinted lens, the enhanced sensitivity of the nervous conducting mechanism of the eye is allayed. There are many pathologic and psychogenic states which respond to an absorption lens of the proper prescription. There are numbers of tinted lenses on the market, many of which are offered without any pretense of scientific coordination with the eye.

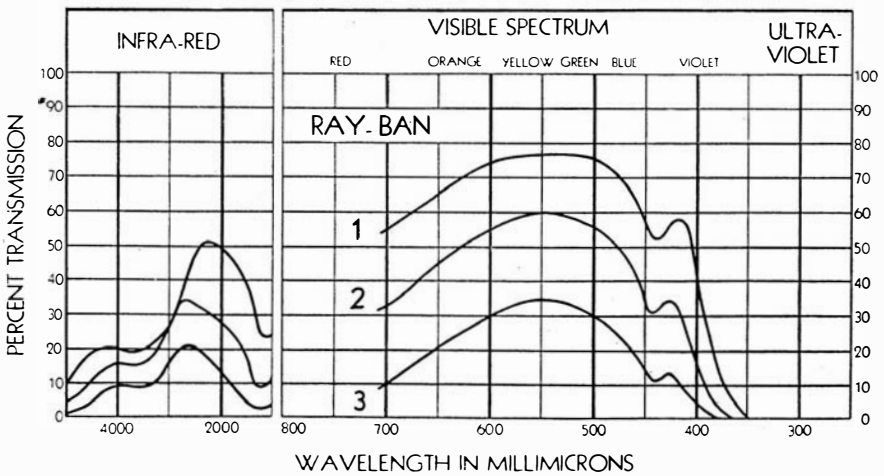
The normal eye sees primarily with the yellow and yellow-green components of the spectral light—the most luminous part of the spectrum and the one in sharpest focus in clear vision. When in exact focus for the yellow, the eye is slightly out of focus for the extremes of the spectrum, the red and violet. Discomfort may result from sharp focusing of either of these extreme rays on the sensitive layer of the retina and a tinted lens of the neutral type may remove these rays entirely or diffuse them. A neutral type is one which absorbs equal proportions of all colors of light, as opposed to selective absorption of certain radiations.

PERSONS with normal eyes who wear absorption lenses for summer glare are usually more comfortable with one of the greenish types of optically ground and polished lenses whose properties are definitely established and the thicknesses of which are held within close limits. Since the maximum of the visual response is in the yellow and yellow-green portion of the visible spectrum, a lens which transmits these radiations will give the utmost that may be expected in visibility with as little light loss as is possible with adequate protection.

A few types of these glasses are notable for their elimination of both the ultra-violet and infra-red radiations, neither of which contributes to seeing. The dangers of these two radiations are well known in industry and they are suspected of contributing to several ocular diseases but their exact effect in sunlight is still a subject of study. Infra-red radiation produces heat and one is warned by the burning sensation felt in the eyes. Most of the ultra-violet radiations are believed to be stopped in the cornea and crystalline lens, but any effect of them is the more insidious because the reaction is not felt for hours.

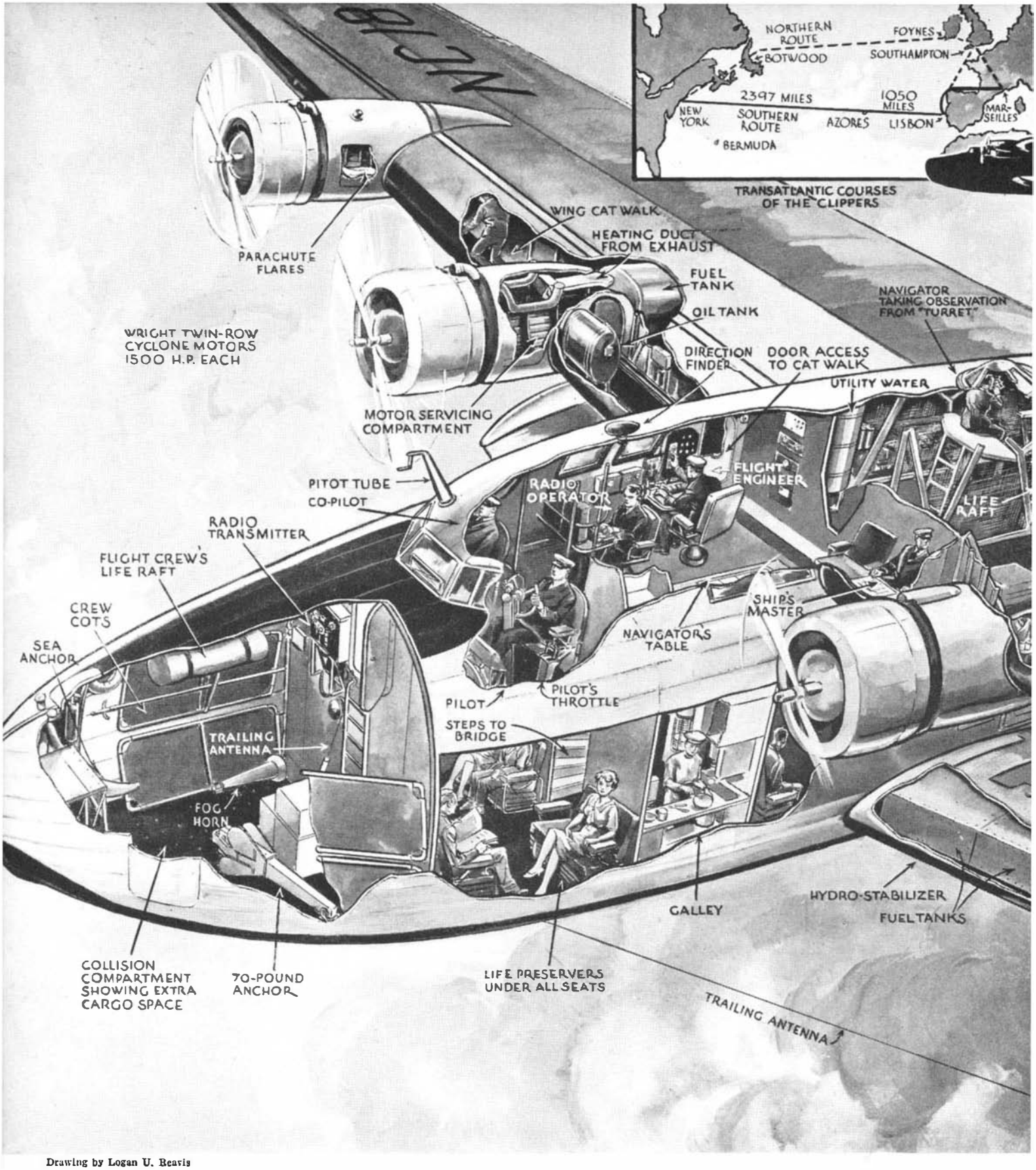
Yellow-green and blue-green glasses appear to increase visibility by brightness-contrast, due to the elimination of scattered light of short wavelengths, just as a photographer obtains fine pictures of clouds and distant scenes by using a yellow-green filter. The aerial photographer gets sharp photographs of enormous stretches of country by using a filter which excludes all but the infra-red rays. All these devices function largely by removing the veiling effect of short-wave light scattered by the intervening atmosphere.

The various tints of glasses on the market result from the kind of oxides added to the glass-forming constituent, usually a soda-lime batch. Cobalt oxide produces a blue glass; chrome and uranium oxides, green glass; gold oxide, ruby; silver oxide, yellow; manganese oxide, pink or violet; and cerium oxide, brown. All of them absorb different portions of the spectrum. Amethyst glasses have a strong absorption in the blue region and modify colors to a great extent. Amber and brown glasses absorb the blue and violet, flatten the yellows and intensify the reds, but their transmission of infra-red is high. Blue glasses of the cobalt types absorb selectively in the green, yellow, and orange-red. They also have high transmission of the infra-red. Crookes glasses, brought out in 1913 by Sir William Crookes, were a great advance over previous absorption lenses, definitely absorbing both the ultra-violet and infra-red rays. Although widely prescribed today they are not so popular as formerly, due to a marked selective absorption in a narrow band of the visible spectrum, caused by the use of the rare earth, didymium. In the darker shades they absorb heavily in the region of maximum visibility.



Courtesy Bausch and Lomb

Light transmission of one type of sun-glass lens, in three different shades. Note high percentage in visible, low in infra-red, and opacity to ultra-violet



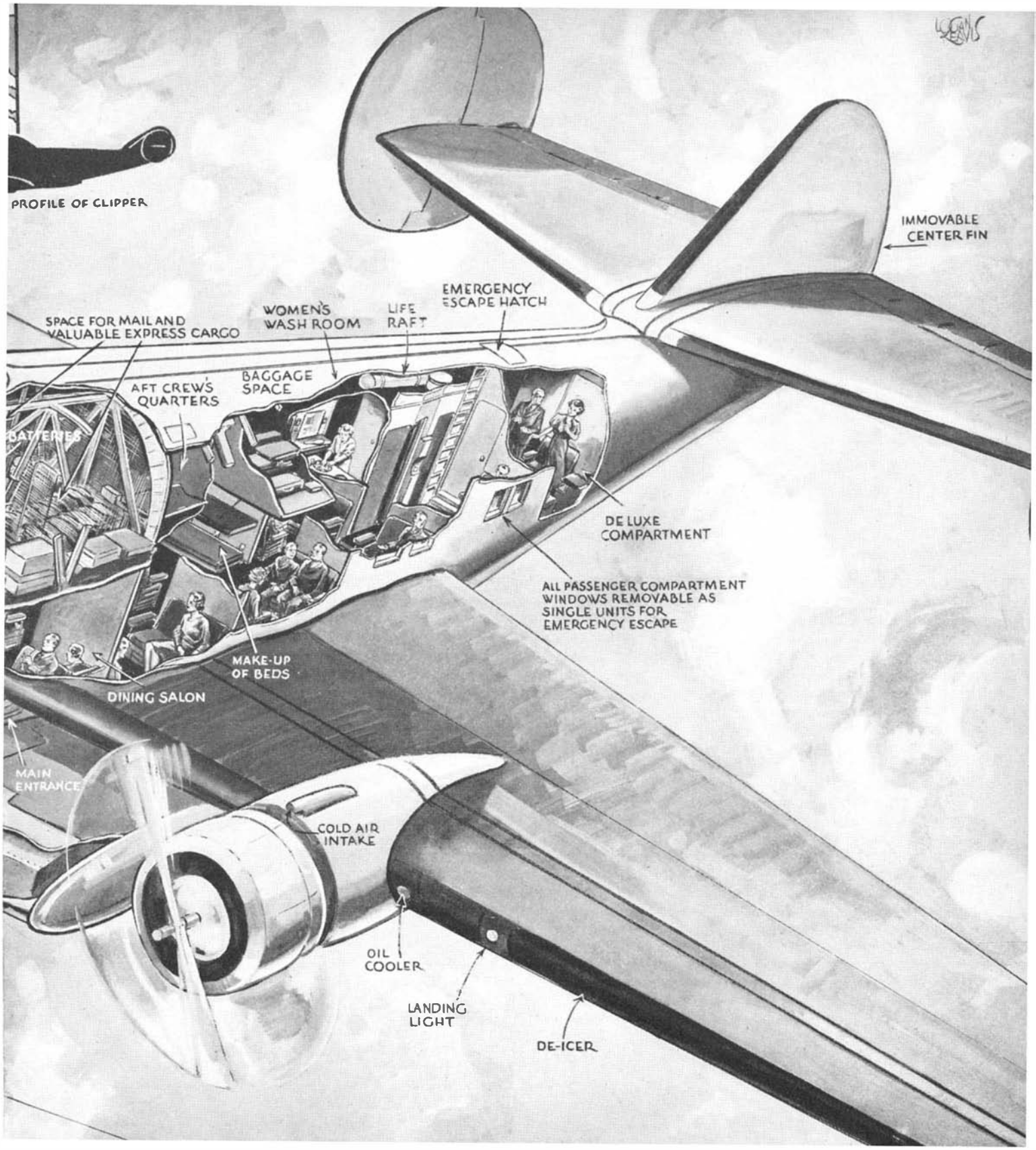
Drawing by Logan U. Bearis

In the Transatlantic Service

WITH wings spreading 152 feet and hulls 106 feet long, Boeing Clipper ships have inaugurated transatlantic air-mail service; it is expected that, by the time this issue reaches the reader, transatlantic passenger service will have been established on regular schedule. Already six of these huge ships have been built. Two of them are in use over the Pacific, while the other four are to be used in the Atlantic flights. Our drawing shows the details of these ships, which have been designed to offer the utmost in comfort and safety to the passenger. When used for daytime flights, 74 passengers can be carried; berths made up from triple-seat davenports will accommodate 40 passengers for night flying.

Sound-proofing is extensively used throughout the Clippers, in crew quarters as well as in passenger compartments. Air conditioning assures comfortable temperatures at all times. A completely equipped galley serves hot meals while aloft.

Designers of the Clippers have foreseen every possible emergency and have made provisions for insuring the safety



of passengers and crew at all times. Individual life preservers are placed under all seats; life rafts, each capable of supporting 10 persons, are readily available when needed. A kite, stored above the after crew's quarters, can be used as a signaling medium in case of a forced landing. Complete fire-fighting equipment is provided.

The inset map at the top of the drawing shows the two routes that have been surveyed from the United States to Europe. It is possible, however, that, due to weather conditions and the desirability of taking advantage of favoring winds, deviations from direct courses will be a matter of routine when transatlantic flights are on regular schedule. In fact, on one of the first mail flights, the *Yankee Clipper*, first of the ships to fly the Atlantic, made a 300-mile detour to the south of her normal course when adverse winds were encountered. This detour made possible a stop at Bermuda.

More technical details of the Boeing-314, as ships of this type are known before they are christened, will be found in issues of Scientific American for July 1938 and May 1939. As is usual in the design and construction of new plane types, changes have been introduced as work progressed and it was found that such changes would be advantageous for one reason or another. For example, early plans for the Clippers did not call for the immovable center fin of the tail assembly. In fact, test flights were made without it and it was not installed until experience indicated that it would be desirable.

McDonald Observatory

The Large New Observatory in Western Texas Was Made Possible by an Amateur . . . An Admirable Site, An Efficient Housing and a High-grade Telescope

By 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

THERE is no more successful example of human co-operation than is found in astronomy. Here, at least, the rule of reason prevails. Our political, national, and racial differences, however important, have really very little significance beyond the limits of the Earth's atmosphere. Here we cannot act or experiment, but must be observers only—but we may still be active observers, seeking eagerly for the best opportunities and the most powerful means of investigation.

Many kinds of co-operation among astronomers are an old story, such as the division of a great field of observation, such as cataloguing the stars, into parts undertaken by different observatories; and the continual exchange of information, published and often unpublished, is the very life-blood of our growing knowledge. The smaller institutions, in particular—as the writer of these lines has abundant reason to acknowledge with gratitude—are continually indebted to the great observatories, which, gathering information far faster than the photographs can be worked up, are most generous in supplying material for theoretical workers elsewhere.

A new and very effective type of co-operation has just been formally inaugurated in the principal astronomical event of the past month—the dedication of the McDonald Observatory.

Forty years ago, Mr. William J. McDonald, a banker of Paris, Texas, became deeply interested in astronomy, as an amateur student. Upon his death in 1926—leaving no near relatives—he left the bulk of a considerable fortune to the regents of the University of Texas "for the purpose of aiding in erecting and equipping an astronomical observatory, to be kept and used in connection with and as a part of the University, for the study and promotion of the study of astronomical science."

When certain legal problems were settled, the University found itself in possession of about $800,000, and a major problem arose. This sum was enough to provide for the construction of a really great telescope, and equip it with the accessories required for modern research: but if this was done, there would be very little left to provide salaries for astronomers to observe with it. If enough endowment were set aside to provide for an adequate staff, only a telescope of moderate capacity could be built with the remainder.

Rather than suffer this limitation, it was at first planned to let the fund accumulate until it became adequate. But, at the same time, the University of Chicago found itself facing a similar, yet curiously different problem. The Yerkes Observatory was rich in staff, and less so in equipment. Under the new director, Dr. Struve, a very able and enthusiastic group of young astronomers was being assembled. The great refractor of the Observatory—the largest in existence—had been built when the possibilities of great reflectors were not yet appreciated. Indeed, it was the construction, shortly afterward, of the 24-inch Yerkes reflector (the first to be equipped with a mounting conforming to modern standards of accuracy and convenience) which brought the reflecting telescope back into its own. A great reflector was badly needed to extend the equipment of the Observatory; but there was no money for it.

SOME genius realized the complementary character of these two problems—each was the solution of the other. With the enthusiastic approval of President Hutchins of Chicago, and the late President Benedict of Texas (himself an astronomer) plans were developed for a close co-operation between the two universities—culminating in a formal agreement covering a period of 30 years. According to this, the University of Texas was to build the observatory and the University of Chicago to staff and operate it—equitable arrangements being made regarding running expenses, and publication of the results. This close partnership between two independent institutions—one a state university, the other privately endowed—is a novelty, and promises great things.

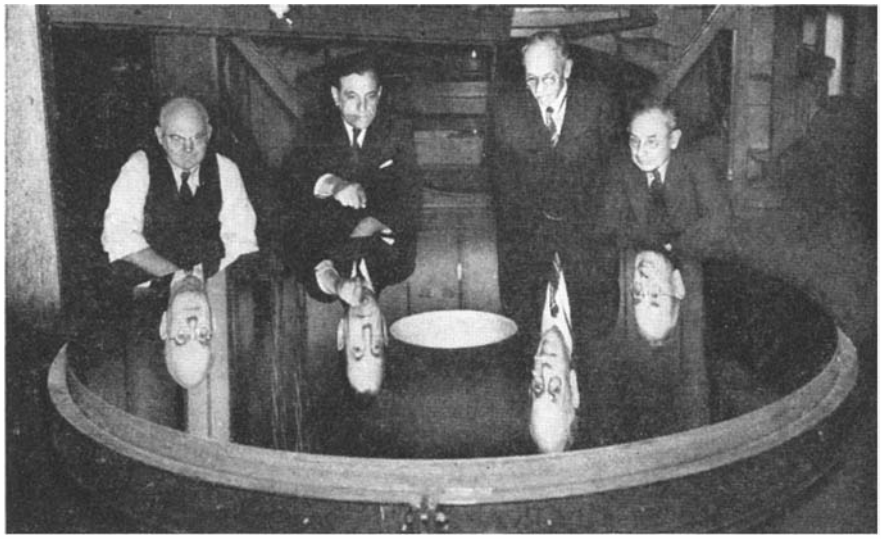
The next problem was to find a site for the new observatory. Fortunately, Texas is a large state, and its western portion extends into the semi-arid region where high altitudes and clear skies may be found. After the usual extensive reconnaissance, a site was chosen on Mount Locke, in the Jeff Davis Mountains, in the county of the same name. The peak is 6800 feet above the sea, with slopes not too steep to allow a well graded road to be built to the very summit, and covered closely enough with trees to protect the ground from overheating by the Sun. There are some higher peaks in the region, but these are either too remote or difficult of access, and the Observatory commands a clear horizon in every direction. A well drilled on the slope, 600 feet below the summit, provides an adequate supply of good water. About 20 miles of good—though not paved—road lead to the town of Fort Davis where adequate supplies can be obtained. The nearest railroad is 20 miles farther.

The necessary conditions of habitability are therefore met—and well met. It is a cattle country, of good-sized ranches. (This phrase has a special meaning there—one may hear a cattleman say: "Oh, he hasn't a big ranch—only 80 sections.")

The observing conditions are also excellent. The seeing is good, the air clear, and the site is as remote from city lights and man-made glare as could easily be found. From the summit the view ranges in all directions over wooded mountains separated by tawny grass-lands, with hardly half-a-dozen human habitations in sight. Long before the great telescope was erected, Struve and Elvey had proved the advantages of its location by observations of the spectra of faint diffuse nebulae, and of the brightness of the zodiacal light, and the faint diffuse illumination of the night sky—which could only be successfully accomplished in the clearest and purest of skies.

The Observatory itself crowns the very summit. A glance at it—or at a picture—shows one difference from most others. The walls of the cylindrical sub-structure below the dome are pierced with many windows. This reveals a very nice piece of architectural efficiency. To get the line of vision clear of the disturbed air near the ground, the great telescope is usually mounted at a respectable height, so that the floor of the dome is as far up as the third story of an ordinary house. In all other large observatories, the space under

this floor is simply vacant. Part of it may be used for constant-temperature rooms, and other scientific purposes; but most of it resembles the huge space below the dome of the 100-inch telescope at Mt. Wilson, which was once described as "providing ample parking space for the automobiles of the mechanics and the walking-sticks of the astronomers." On Mount Locke things are different. The large available space is divided by floors, and provides for a library with stacks and a main room big enough to hold 80 to 100 people—it was crowded at the conferences!—also offices for the principal members of the staff, and several small bedrooms for astronomers who come down from Yerkes for special work. The permanent members of the staff have houses on spurs of the mountain a little below the summit—and the writer cannot refrain from expressing his admiration of the good judgment which has made these houses really attractive.



The 82-inch mirror, 12 inches thick, after aluminizing. From left to right: H. L. Cook, director of the Warner and Swasey Company's instrument department; C. A. Robert Lundin, director of the optical department, who figured the mirror; Dr. John S. Plaskett, director emeritus of the Dominion Astrophysical Observatory, who tested it; George A. Decker, works engineer. The focal ratio is *f*/4

MOUNT LOCKE is remote enough to make it necessary for the permanent observers to live on the mountain. There is no near-by town, as at Pasadena or Victoria. Living in a small isolated mountain community has some inevitable disadvantages. They are far less serious than they once were—no one who has heard it will forget the story of the young son of one of the astronomers at the Lick Observatory, who lay unconscious, after a bad fall, for three hours, while the doctor summoned by telephone toiled up the steep winding road as fast as a team of good horses could take him. Even today there are some inconveniences—but they count for less when the things which can be provided to make life pleasant are available.

But all else on the mountain centers, of course, upon the great telescope—the second in the world. The 82-inch mirror is of Pyrex glass—of very low coefficient of expansion—and has been figured with almost ideal precision. Thorough tests by the veteran observer, J. S. Plaskett, show that the deviation of its surface from the true form averages only seven ten-millionths of an inch—one thirtieth of a wavelength of visual light. The "diffusion disk" resulting from the failure of all parts of the mirror to bring the light to precisely the same focus is considerably smaller than the diffraction disk arising from the properties of the light-waves themselves—so that a still more perfect adjustment of the figure would gain nothing practically.

The mechanical mounting of so large an instrument is a difficult engineering problem—the moving parts weigh 45 tons. The "cross-axis" design has been adopted—in which the principal polar axis extends between two separate piers and the telescope tube is at one side of this, counterbalanced by suitable weights on the other.

This type of mounting has the great advantage that all parts of the sky may be observed—including the pole and the southern horizon. Great reflectors, with mountings of this sort, existed already at Victoria, B. C.; Delaware, Ohio; and Toronto; but the new instrument has one great advantage that these lack—a coudé device for spectroscopic work. When this is in place, a plane mirror, inclined at 45 degrees, reflects the light from the telescope tube at right angles, through the hollow declination axis, to a second mirror, which sends it down the interior of the hollow polar axis. It comes out at the lower end of this at the same place, no matter to what point in the sky the telescope is directed. The rays are received in a room maintained at constant temperature, in which very powerful spectroscopes, and so on, may be installed.

The 100-inch mounting at Mt. Wilson was designed with an arrangement of this sort, which has proved increasingly valuable and useful; but the engineering problem of adapting this to the cross-axis type of mounting had not previously been solved. It was necessary to alter the construction of the main bearings, about which the telescope is turned to reach northern or southern stars, so that, whatever its position, the light might have an unobstructed passage. The unusual position of the great counter-weight at the upper end of the polar axis rather than opposite the telescope-bearing was part of the same scheme.

The instrument has also the usual Cassegrain arrangement in which the light is reflected back by a convex mirror through a hole at the center of the great mirror, to form a large-scale image, and an ingenious device for taking photographs at the primary focus in the middle of the top of this main tube—thus avoiding the loss of light by reflection at a diagonal mirror. The moving platform by which the observer may reach the upper end of the instrument in any position is also very efficiently designed.

The latest methods have again been used in the "drive," which turns the great mechanism about the polar axis to follow the stars. This is entirely electric, and regulated in rate by the precise and effective vacuum-tube control devised by Dr. McMath. It can be adjusted so as to allow for the changing effects of refraction as the stars change their altitude, and the test of actual operation shows that it is "practically perfect."

It would be of little value to have even so powerful an instrument if there were not a good program of work to be done with it. Here Dr. Struve—now director of the McDonald as well as the Yerkes Observatory—has outlined plans which should meet the hearty approval of all astronomers. Problems which demand the utmost light-gathering power—such as to extend the boundaries of our knowledge of the "universe of galaxies"—are wisely left to the 100-inch telescope, and the 200-inch when it is finished.

But there is an immense field of work in the study of individual stars, and especially of those unusual and interesting objects which are found here and there among the faint stars. With an excellent outfit of accessories—spectrographs and the like—the McDonald telescope has already, before its formal dedication, revealed new and important things. Its admirable site, its excellence of mechanical and optical quality, and, above all, the skill and enthusiasm of the staff, make a long career of usefulness certain.

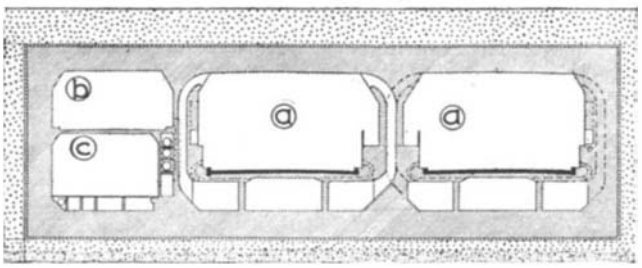
—*Princeton, June 1, 1939.*

Under The Nieuwe Maas

Unique Tunnel at Rotterdam . . . For Vehicles, Pedestrians, Cyclists . . . Rectangular . . . Sections Built on Land, Then Floated Out and Sunk in Place

By R. G. SKERRETT

At an outlay of approximately $8,225,000, Rotterdam is building a subaqueous tunnel that differs radically from other structures now in use as underwater traffic routes. This single structure, which passes beneath the Nieuwe Maas River, is designed with four passageways—one for pedestrians, one for cyclists, and two for motor vehicles. As an engineering undertaking, the tunnel is unique in a number of particulars. Work on it is now in full swing, and some of its main sections are in advanced stages.

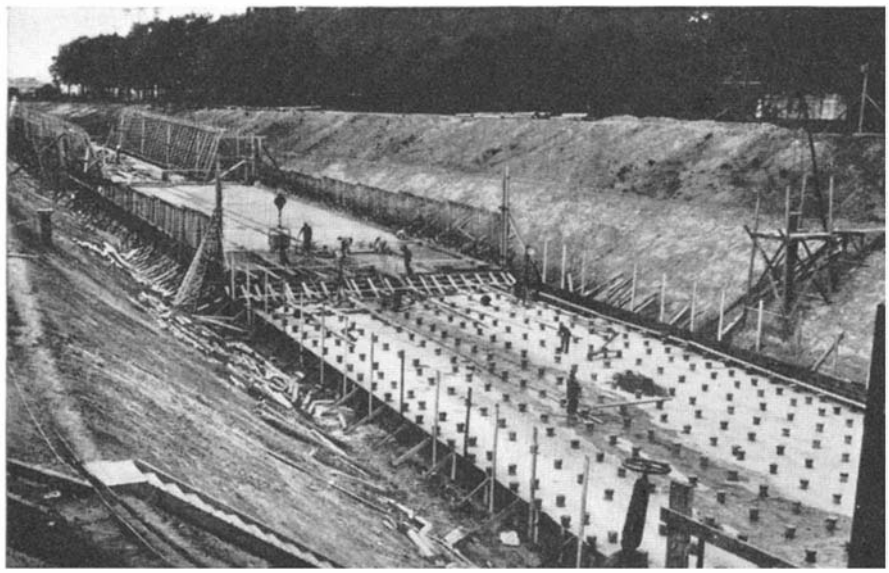


Cross-section of under-river part of tunnel in which all three classes of traffic will be accommodated. Passages for motor vehicles at (a, a) ; cyclists (b) ; and pedestrians (c)

To appreciate why Rotterdam is thus equipping herself, one should have some understanding of the extent of this center of Holland's maritime commerce. The port is situated less than 20 miles inland from the North Sea at a point where tributary river routes and various canals have made the harbor accessible to vast interior regions of Holland, Germany, and Belgium. Rotterdam's social, industrial, and commercial expansion during recent decades has profoundly altered her intra-urban traffic problems.

At this time, 30 percent of Rotterdam's people, many of her foremost industries, and the greater part of her shipping interests are located on the south side of the stream which bisects the port from east to west. The old Willems-Bridge, built in 1878, still remains the single crossing available to pedestrians, vehicles, and street railways. That structure is now not centrally located in relation to the most active sections on the two sides of the river, and it is overtaxed at peak periods of traffic. To some extent relief has been afforded by cross-river ferries, but these have operating drawbacks. The city authorities have for years recognized that one or more additional permanent crossings should be constructed; but the question was what kind would best meet the requirements. Bridges, of course, have been considered as well as tunnels by the engineers.

In and out of Rotterdam there is moved by water annually nearly 34,000,000 short tons of freight in overseas commerce, and the Nieuwe Maas, now familiarly known as the New Waterway, is threaded continually by ocean-going craft. There are, besides, well-nigh ceaseless movements of vessels of other sorts. The land on both sides of the river is low; but a low bridge, with a draw, would not answer because its frequent opening would halt and congest the flow of motor vehicles. A high bridge, with ample under-clearance for the masts of any ships using the port, would require very long approaches in order to assure acceptable gradients for vehicles. Such a bridge would have to have a length of 2.5 miles, and its approaches would be too far inshore to be readily accessible to motor trucks, for example, plying between the docks on one side of the stream and distributing points on the other side. The engineering experts, accordingly, decided in favor of a subaqueous tunnel capable of providing annually for the transit of 8,000,000 vehicles, and daily use by thousands of pedestrians and cyclists.



Unstable soil in the deep trenches of the approach ramps made necessary use of large numbers of piles. Deep-well pumps are operated continuously to keep the trenches drained. Each finished ramp will be a great reinforced concrete trough

THE route chosen for the tunnel crossing is some distance downstream from the Willems-Bridge, and is intended to link what is known as the Park section of the older part of the city with the Charlois area on the south side of the river, where it will have its portal close to the very busy docks. The tunnel will also serve as a link for much used motor highways leading to and from other important cities of Holland. The low land on each flank of the waterway permitted the designers to keep the total length of the undertaking within approximately 4800 feet; yet the nature of the ground both on shore and in the bed of the river has presented major difficulties.

The project may be subdivided into two open-cut ramp approaches; two land tunnel sections; two ventilation build-

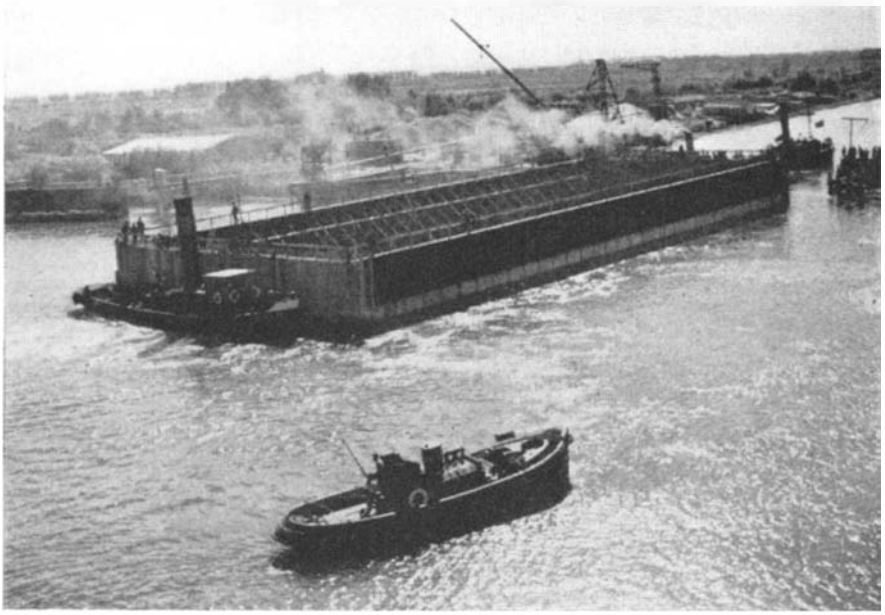
ings, one at the water's edge on each flank of the river; and a central subaqueous tunnel section, which under-runs the stream and which connects with the underwater foundation structure of each of the ventilation buildings. The river tunnel has a length of slightly more than 1917 feet, and the adjoining two sections of land tunnel are, respectively, 902 feet and 692 feet, in length. From end to end of the tunneling, including the substructures of the ventilation buildings, the undertaking will measure 3511 feet.

The land tunnel sections are being built in deep open cuts; the foundations for the two ventilation buildings have been carried down to their prescribed depths at the shore fronts by means of pneumatic caissons; and the under-river tunnel will be assembled by what is described as the "sinking method." That is to say, each of the nine separate sections of the subaqueous tunnel is built up to a degree on shore, then floated out into the river for completion in a buoyant state and, when ready for final placing in the river, it will be towed to a point directly over its given site and sunk into a trench excavated in the river bed. The substitution of this procedure for the familiar shield-and-pneumatic method of tunnel driving is because the soil of the river bottom is too loose and sandy to permit the use of compressed air unless the tunnel were carried much deeper to reach firmer subsoil. Other subaqueous tunnels have been constructed in a measure along kindred lines, but even so, the Rotterdam tunnel represents some novel and very interesting departures in practice.

THE two sections of land tunnel are designed only for the passage of motor vehicles, while the river section will provide for the passage of pedestrians, cyclists, and motor vehicles. The pedestrians and cyclists will enter and leave the river tunnel through connections leading to and from surface buildings adjoining the ventilation buildings.

Each of the nine units forming the under-river tunnel is a great reinforced-concrete block that is perforated from end to end by four traffic passages and numerous lesser longitudinal chambers for the transmission of fresh air and the withdrawal of vitiated air. Each of these box-shaped elements has a length of slightly more than 200 feet, a width of about 81.25 feet, and an exterior height of 27.53 feet. The roadway in each of the two vehicular passages has a width between curbs of 19.7 feet—affording room for two traffic lanes; and the ceiling is 13.77 feet above the roadway. The passageway for cyclists has a width of nearly 16.25 feet, while the passageway for pedestrians has a width of about 14.34 feet.

To protect each of these reinforced-concrete blocks from water penetration, it is to have a coating of welded steel 0.236 of an inch in thickness, covering both sides and the top and bottom surfaces. As an extra protection against corrosion, that steel is to be covered with a thin layer of concrete. The working schedule has called for the simultaneous construction of three such tunnel sections in the Municipal Building Yard at Heysche-haven. When a certain stage of partial completion has been reached, the drydock is flooded, the sections are floated out into the river and towed to Waalhaven, where the rest of the work is done preparatory to sinking.



A partly finished tunnel section being towed from the drydock, where it was built, to the finishing slip where it will receive the remainder of its concrete body. This view serves to give a good comparison of the section's size

To make it possible to float the sections from the drydock and to shift them to the finishing slip, each section, after the concrete is poured to half height in the drydock, is sealed at each end with a temporary reinforced-concrete bulkhead, and closed along each side with a temporary timbered bulkhead—all the bulkheads extending high above the surface of the water and giving the section the appearance of a great rectangular barge. At the finishing slip, each floating section is completed up to full height by pouring the remainder of the concrete within complex forms, and other necessary arrangements are made to put a section in readiness for sinking. The end bulkheads of concrete will be cut through after the various sections are located in contact in the river-bed trench. Wherever two sections are joined, they will be bound together by an enveloping joint of concrete—the concrete being poured under water and within forms provided for that purpose. When all the sections are linked together beneath the surface of the river, then the intervening concrete bulkheads at the joints will be cut away, one by one, while the tunnel sections are unwatered progressively.

Each section of the river tunnel will be handled by floating cranes and other floating equipment; and to give it deadweight to cause it to sink, it will be filled with water so that it can be lowered deliberately and precisely to its assigned location. When it settles in the trench it will rest on a temporary foundation consisting of hydraulically controlled jacks which will hold it at its proper level. With that done, all depressions between the uneven bottom of the trench and the underside of the section will be filled compactly with sand jetted in under high pressure in accordance with a method recently devised. When all sections are firmly supported, the jacks will be withdrawn and the entire trench will be back-filled to the original level of the river bottom.

To facilitate pedestrians and cyclists using the tunnel, there will be installed in a building at each side of the river four escalators, each of which will have a vertical travel of 55.77 feet. The bicycle is very extensively used in continental Europe not only for pleasure travel but in making the daily trip, back and forth, between the home and the place of business. Hence the special provision that is being made in this under-river tunnel for cyclists. Likewise, the moderate length of the tunnel will encourage many persons to use it in walking to and from the opposite and neighboring sections of the city.

The actual building of this unusual structure is being done by a group of experienced engineers and contractors, for the time being known as Maastunnel Limited. The chief engineer for the municipality is Mr. J. P. van Bruggen, to whom we are indebted for much of our information.

FLINT FLAKING

The Amateur Workman, as He Practices, Can Progress in Days through the Same Stages of Skill for which his Ancestors Required More Than 100,000 Years of Gradual Invention

By C. STUART JOHNSTON
Department of Anthropology, West Texas State College

Figure 1: Indians mining flint at Alibates quarry. From a painting by Gustaf Sundstrom

THE art of working stone into useful implements is perhaps the most ancient of human arts. It dates back to the dim dawn of civilization more than 100,000 years ago, yet it is still practiced by primitive peoples in many parts of the world. One of the outstanding differences between man and his other relatives of the animal kingdom is his ability to make and use implements of one kind or another.

Stone implements are in many instances the only records that we have of early human history. Thus man's earliest efforts toward accomplishment are recorded in the impressionable medium that he has left behind—stone artifacts or "fossils of the mind." On the basis of their study the earliest phases of human history have been sub-divided. We thus speak of the Paleolithic, or the Old Stone Age, and the Neolithic, or the New Stone Age. But even prior to the Old Stone Age there must have been a time, many thousands of years ago, when man was just learning through crude efforts that stone could be roughly fashioned into a tool. Artifacts of this early beginning are referred to as Eolithic—the dawn of the Stone Age. After the stone ages came the Bronze Age, and this in turn was followed by the Iron Age.

The ancestors of the American Indians are thought to have migrated into the Western Hemisphere from Asia, in Neolithic time, following the Glacial Period, and, though their culture reached a high point of development in several localities, and though metals such as bronze and a few others were used, the Indian was essentially a stone-age man when America was discovered by the Europeans.

In several world localities the technique of working stone reached the distinction of a fine art, due perhaps in part to an abundance of fine raw materials as well as to the character and inventiveness of the workman. One of these localities was centered in Denmark and parts of Scandinavia, one was in Egypt, a third was in the Pacific Coast region of the United States, and a fourth in the Great Plains region east of the Rocky Mountains. Here Folsom

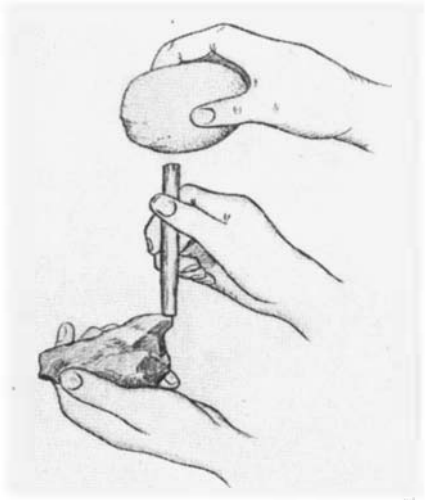


Figure 2: An accurate method of positioning and placing a blow

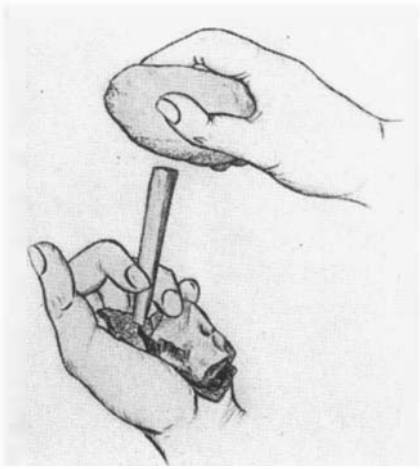


Figure 3: The same principle applied with an awl on a small scale

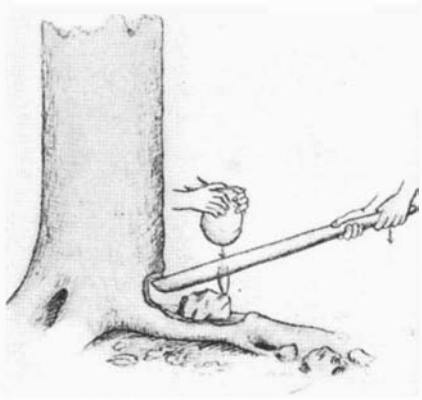


Figure 4: The same principle applied on a more powerful scale

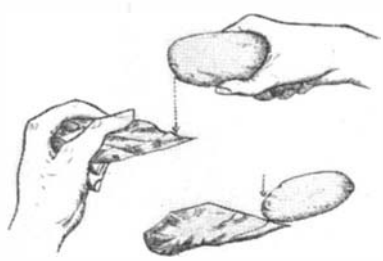


Figure 5: Detaching flakes by a direct blow from the hammer stone

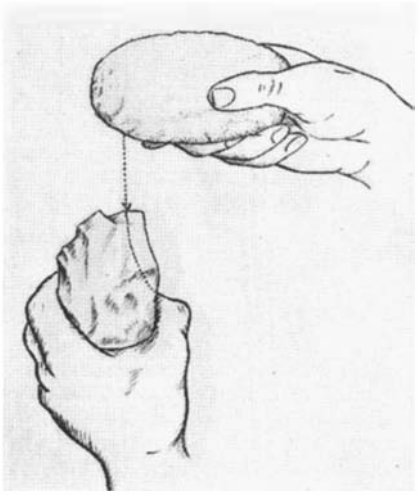


Figure 6: Practice soon teaches shape and size of detachable flake

Man made fine implements of stone, and with them hunted animals that are now long since extinct.

One of the largest and oldest quarries from which the American Indian obtained his flint is located on Alibates Creek, about 40 miles north of Amarillo, Texas. Here the flint is of a characteristic red and grey color with an even texture, and is easy to recognize even in a small arrow point found, as some have been, hundreds of miles from its source. Even Folsom Man, himself, who is known only from a certain definite type of implement that he made, obtained much of his material from this quarry. Figure 1, from a painting by G. T. Sundstrom, represents the Neolithic workman mining flint at the Alibates location. The writer is indebted also to Mr. Sundstrom for the other illustrations in this article.

After man passed the long, crude stages of the Eolithic Period we find him manufacturing the first definite implement of the Old Stone Age, and, though still rough in many ways, it was unquestionably designed for a useful

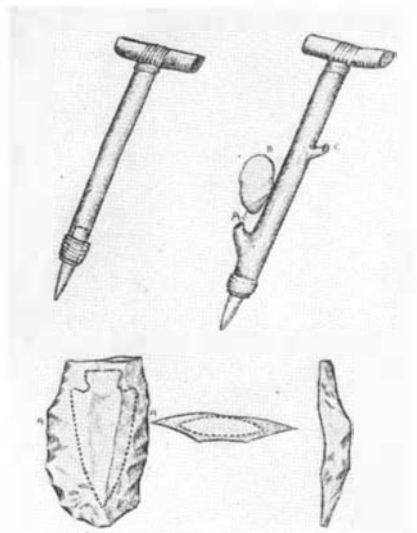


Figure 7: **How pressure, blows, or both may be used when necessary**

purpose. This early tool, known in the Old World but not in America, is called by the French a *coup-de-poing*, or hand ax. This did not usually exceed six inches in length, and when held firmly in the hand it probably was an effective instrument for many purposes.

The hand ax was made from a nodule of flint by striking off rough flakes until the core reached the desired shape. This technique is important and characteristic of Early Paleolithic time. The same technique was continued into the next epoch, but with the difference that there was a specialization toward more varied types of tools. Later, the flake itself was worked into a tool by a process known as retouching, but this was applied only to one side. The next step was an improvement and greater skill in the art of retouching. The workman became more proficient in the use of the awl in scaling off thin flakes of flint to achieve the desired shape and edge of the tool. Eventually we find that the entire implement was retouched. Finally, it was discovered that, by the proper application of a sharp blow from a hammer stone through the aid of an awl (Figures 2, 3, 4), flakes could be detached from the core more effectively, and that it also was possible to control the process to such an extent that long slender flakes

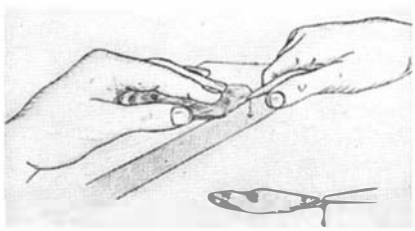


Figure 8: **How the bone awl may be used for retouching a thin flake**

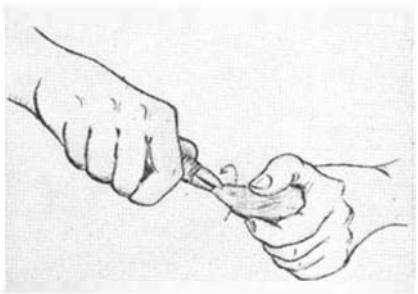


Figure 9: **Notched bone awl used for twisting off very small bits**

Figure 10: **Pressure flaking with an awl against a leather protector**

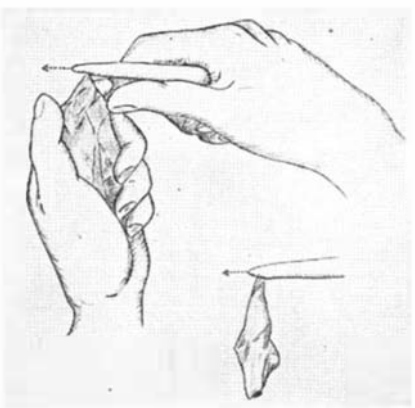


Figure 11: **Still another method—detaching flakes with side of awl**

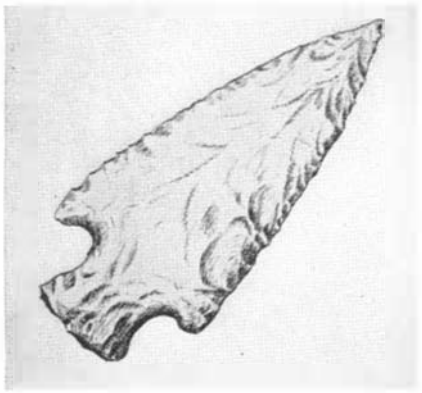
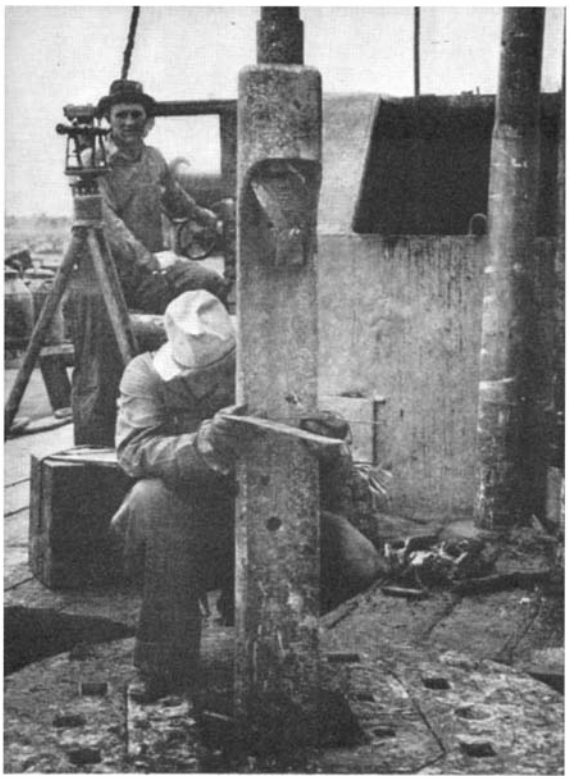


Figure 12: **Completed, and you'll be sure your ancestor was a mechanic!**

could be produced with knife-like edges, satisfactory for use without the time-consuming process of retouching. These steps as outlined, though apparently simple, represent nearly 100,000 years in man's advance from the Lower Paleolithic through the Upper Neolithic, and are so definite that chronology in culture can be based upon them.

Contrary to popular opinion the method involved in making stone knives and arrow points is not a lost art. Indeed, the methods are rather simple, although considerable skill is necessary, and the worker will find that painstaking practice is essential before he is able to produce a pleasing product. The only required tools for arrow making are an awl, either of bone or iron, a hammer (for this purpose the Indian used a stone), and a leather pad to be used as a protection for the hand from the sharp chips of flint.

THE first step in making an arrow point or a knife, or spear point is to produce a suitable flake from the material at hand such as obsidian, flint, or glass, as shown in Figures 5 and 6. This is then further worked with the hammer and awl to the rough outline in Figure 7. Now that the flake has been worked to the approximate shape of the desired implement the next step is the process of retouching. In this the flake is held firmly in the hand (Figures 8, 9, 10, 11) in such a way that, by application of pressure from the point of the awl, thin scales of flint can be chipped from the edges over the surface of the flake toward the mid-line of the flake. Thus the flake is sharpened and thinned down to the desired shape, as shown in Figure 12. After the point is thus brought gradually into shape the notches for attachment are worked into the flint in the same way. First efforts will probably be crude and of the Old Stone Age type, but continued practice should bring the new craftsman with his ancient art up to the Neolithic period in which his work will be admired by others and a source of pride to himself. His respect for ancient man is likely to expand.



Lining up an Eastman removable whipstock—note slant groove—before lowering into well

More Oil from

By UPTON CLOSE

BY drilling deliberately crooked oil wells instead of straight ones, a young Oklahoman has added immeasurably to the dwindling oil resources of the world. H. John Eastman, though told by engineers that it couldn't be done, showed them how drilling on curve and slant can outwit geology, put a subterranean cork in wild and flaming wells, and, by angling out under the ocean, open up to man's use huge new reserves of petroleum, hitherto counted as beyond his power to exploit.

But Eastman's methods have also opened a gusher of legal controversy. If oil can be pumped from under no-man's land, the sea, who owns it? "We do," say, in a confusing chorus, the operators who finance the drilling, the sovereign states in whose coastal waters it is done, and the Navy Department, speaking for Uncle Sam. Furious controversy and legislation lie ahead. Meanwhile, several states have boldly "annexed" miles out into the shoal waters off their shores.

This new method—which Eastman calls "Controlled Directional Drilling"—offers to the oil industry dazzling vistas and undreamed of skills. By making holes straight, slanting, or curving at will, drillers can follow geologic formations, avoid rock structures, go through faults and under salt domes. From one derrick and top hole a driller can probe under 20 acres. This new slant-hole drilling makes available deposits formerly withheld from man and greatly cheapens and makes more thorough the exploitation of known fields. Because of its underground surveying system, well operators for the first time know where their bottoms are; and, in new fields, can plan spacing and drainage *in* the oil sand, instead of blundering at it from the surface.

Where oil is found under cities, buildings, parks, and cemeteries, Eastman's process can tunnel down at an angle from far enough away to make unnecessary such projects as putting the derricks on the lawn of Oklahoma's state capitol. Most sensational of results: John Eastman has given the oil industry its first conclusive means of controlling wild wells and extinguishing dangerous and shockingly wasteful burning craters.

Thanks to Eastman, we can get some of that 70-odd percent of the oil formerly left in the earth when wells were "through." The driller can start from any point along his casing, plug up the bore below that point and at small expense drill slantwise right through the casing pipe to a point at which the oil sand still contains enough pressure to make the oil flow. Or he can even turn a hole to run within and parallel to the oil bearing stratum and drain the sand by gravity. Vast low-production deposits hitherto commercially unworkable, and exhausted fields, such as those in Pennsylvania and West Virginia, may now contribute the "fluid of life" for man's productive and destructive activities.

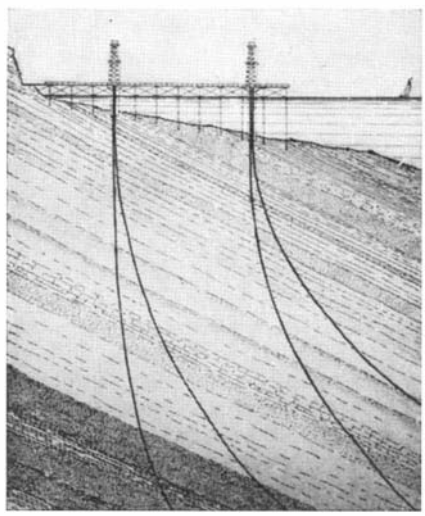
Map showing wanderings of an oil well, from surface (0) to full depth

Great economies can be achieved through the Eastman method by drilling multiple holes from the same derrick. Where oil lies under shoal water the advantages of this method are enormous. At Elwood, California, piers running out 2000 feet from shore bear traveling derricks which have bored wells eight feet six inches apart on the surface and several hundred feet apart at the bottom. This field, too expensive to exploit by previous methods, has yielded 54 million barrels.

Oil men wondered how Eastman would get straight steel casing into bent holes. Eastman had been so busy he had overlooked this problem. To the surprise of all, the pipe easily bent to follow the curving hole. Natural pressure and heat helped at several thousand feet down.

Untold petroleum resources, hitherto guarded from man by the ocean, now lie open to his use. Much of the world's untapped ocean oil can be reached by angling out from shore. Where ocean floors shelve gradually enough to make piers or artificial islands possible, multiple curving wells drilled on Eastman principles can tap more of it. All along the shallow coast of Texas and southern California, where oil men once saw only fathom soundings, they now see dollar signs. "Directional drilling" makes profitable the building of small islands many miles out in the Gulf of Mexico. It suggests that many years can be added to the life of the world's oil resources by exploitation in the shoal waters of the Black Sea, the Caspian, the Persian Gulf, and Maracaibo, Venezuela's great inland sea. American oil geologists, according to whose past estimates we ran out of oil in 1924, in 1928, and again in 1932, will once more have to revise their predictions.

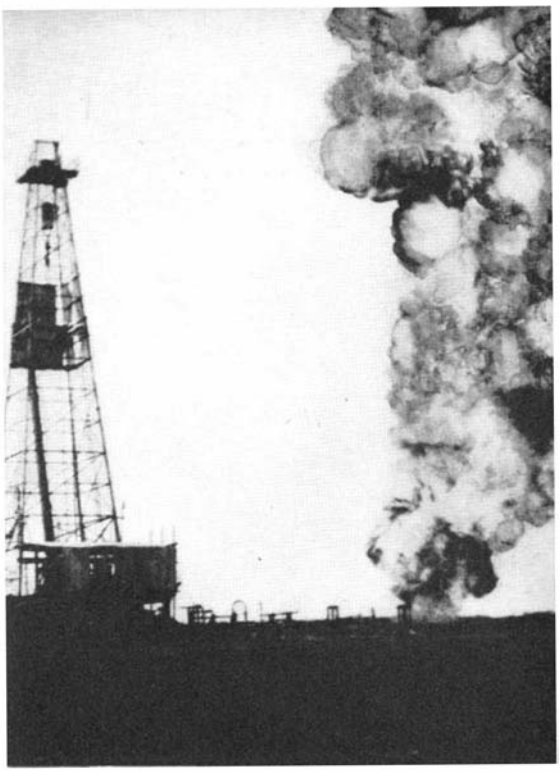
FOR 5000 years, ever since the Chinese began drilling for salt with stone bits hung on bamboo ropes, men have been trying to drill holes straight. Even in America's modern oil industry this has been so nearly impossible that oil men still call a well "straight" if it is less than three degrees from the perpendicular. And a three-degree deviation is enough to make a 6000-foot well find bottom anywhere within an area of seven



Short piers support rigs for drilling out under water along oil strata

Crooked Wells

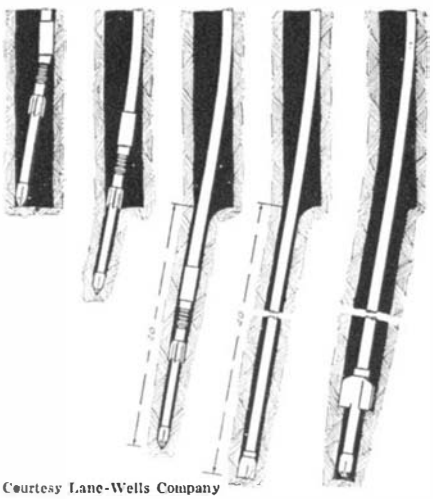
Controlled Directional Drilling . . . Significant Advance . . . Adds to Available Oil . . . Offshore Pools Tapped From Land Rigs . . . Other Uses



The relief well employed in killing a wild well must be located a considerable distance away

acres, often drifting onto a neighboring lease or missing the oil sands entirely. Wells have been so crooked as to require 800 feet more drilling—at $10 a foot—than was necessary to reach the bottom level; others, though scientifically spaced 200 yards apart at the surface, practically met at the bottom. Charts of capricious corkscrew wells often look more like the wanderings of a mole under the lawn.

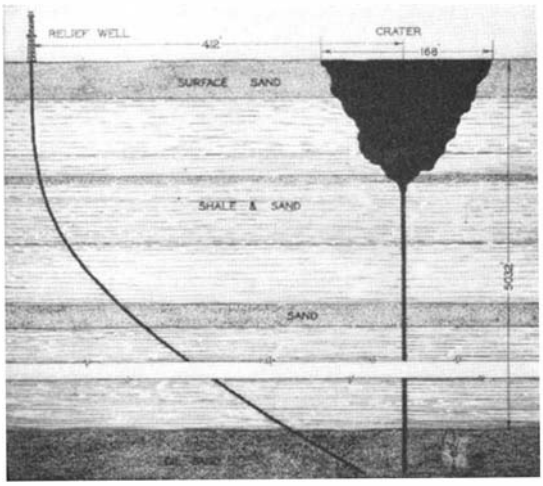
Some 10 years ago, at Signal Hill, that black Golgotha of derricks at Long Beach, California, hundreds of wells driven within each other's shadows were tangling as they went down, and owners were at law over subterranean trespass. Nearby, at Huntington Beach, men were trying frantically with costly piers and artificial islands to tap the oil which lay deep under the sea. Young John Eastman, a salesman turned oil field "roughneck" by the depression, fresh from Oklahoma and unhampered by knowledge of engineering, worked after hours on devices to make perpendicular holes. To do this, he had first to make an instrument that would trace where holes were going; and, second, a tool to correct them to the perpendicular. With these devices, Eastman made it possible for the first time for an operator to tell exactly where his hole was at every foot of depth and to steer the new well constantly while it was being bored.



Courtesy Lane-Wells Company

Steps in turning a drill hole with a knuckle joint. After the turn-out is made, the hole is reamed until large enough for regular drill bits

Then came his simple, brilliant idea, contributed to an old profession, as so often happens, by a complete novice. Why be content with correcting error? Why not pierce through the ceiling of perfection into a new field? Why not apply the technique of drilling straight holes to the drilling of intentionally crooked ones—holes which would feel their way along the slant of strata, and detour around projections of hard rock?



How Alexander I, 5000 feet deep, was killed by drilling a relief well. Explanation in text

Perhaps he could even angle out under the sea and reach those rich oil sands beyond the farthest Huntington piers!

Eastman and his young wife organized a company, put every cent into development of his tools, went broke twice in the first two years. He gathered inventive young engineers and helped them to get patents in their own names. Controversies arose—at one time he had 14 lawsuits over patents on his hands. It was tough sledding. But in 1932 he and his associates were able to set up a derrick on Huntington Beach and offer proof to a skeptical oil industry. Curving from the beach 4000 feet down and out under the sea, the well brought in more than a thousand barrels a day. One of the big California operators, the Wilshire Company, grasped the idea and took a chance. Result: A 5000-barrel well. The rush was on. Ninety wells had curved away from Huntington Beach before the city and state authorities moved to bring order out of chaos and claim shares in this bounty from under the Pacific.

Two years later, a still more spectacular use of Eastman's methods took him out of California and "sold" his system to the oil industry in general. This was the conquest of Texas' most feared "wild well," early in January, 1934. In the Conroe field near Houston, Texas, a well, known as Alexander I, had blown up from a subterranean gas explosion. Its derrick was demolished and the explosion formed a huge crater nearly 200 feet across and nearly as deep, boiling with oil and throwing off fumes as dangerous as dynamite. The entire Conroe oil field, one of the world's largest, was imperiled. In addition, the Humble Oil Company, owners of the adjacent leases, saw their wells failing while this one spewed forth 9000 barrels a day, which past experience showed could end only with exhaustion or conflagration.

A Humble official had heard of Eastman's directional drilling at Huntington Beach. Eastman was called in, told that if he could hit within 50 feet of Alexander's bottom the flow could be checked. Was that asking too much? "I'll go to within 25 feet," promised Eastman, "and if I don't, you needn't pay." Humble's own people would drill. Eastman would boss. That settled, Humble made a strange deal with Alexander's owners. It paid them $300,000 for the privilege of trying to kill Alexander. If the attempt succeeded, the 15-acre lease on which Alexander stood should be Humble's. If it failed, Humble would get nothing. If

Alexander took fire after Humble started operations, the Humble company would be financially liable. Since the only end to such a wild well known up to this time had been very unhappy, the boys felt they were taking Humble's $300,000 against slight odds. No driller had ever hit a bull's-eye of 25 feet radius a mile below the surface, and in Texas slant-drilling was still a "crazy idea."

First came the most elaborate use of fire protection technique in drilling history. A barbed wire barrier unequalled in no-man's land was built to keep spark-making men and animals out of the area. A battery of six boilers set at a distance sprayed steam continuously over the crater. Tanks of chemicals were ready to be turned into the steam to blanket the gas and oil lake with foam in a few seconds. Then a steel fire-shield was erected 400-odd feet from the crater's edge, the derrick put up behind it, and drilling begun. No one had bothered to chart Alexander with the new Eastman instrument as it was bored, and it was impossible now to put a cylinder down the erupting crater. Eastman surveyed neighboring wells and risked reputation, career, and money on the likelihood of the drift being similar.

CHECKING every hundred feet with his directional camera instrument (described below), Eastman began to shoot at his small invisible target a mile underground. He drilled straight down for 1500 feet, then on a carefully calculated corkscrew slant. When, eight weeks later, a mile deep, he figured he was within six feet of the bull's-eye, water under 1800 pounds pressure was pumped into the slant hole he was drilling. The falling of pressure showed that the water had been forced through into the bottom of Alexander I. Within 24 hours the oil well stopped flowing. It had been corked from the bottom with the weight of the column of water.

Eastman was "made," yet so impersonal are oil men that today the name stands for a method, not a man. Several oil men have told me that no such *man* as Eastman existed! Controlled directional drilling, said they, was the general property of the profession. So it is! H. John Eastman presented it in detail at the World Petroleum Congress in Paris in June, 1937.

Eastman has since done greater salvaging marvels than killing Alexander. In January, 1935, he killed a burning crater for Sinclair in southwest Texas, boring 400 feet from the flame and ending within five feet of the hole

The top illustration shows drillers starting a survey instrument into a well. This complicated device, which the author explains, is shown in section at the left, while below is the "watch-face" table on which the instrument indicates the location of the drill hole at a given depth

at a depth of 2300 feet. The old well was sealed with concrete, the oil was pumped up through the new. In August, 1936, he extinguished a burning well at Silsbee, Texas, the most spectacular conquest of a flaming "hell" in history. He struck its bore at 7000 feet depth from a surface point 800 feet from the fire. His process killed a fired well in Venezuela. He "relieved" a blown well in Roumania, making his only recorded semi-failure — his relief vent was below the source of pressure. In most of these cases, he had to contend with failure of original drillers to survey their wells. But drillers are converted now. Recording of a well's position at every hundred feet of drill-pipe paid out is routine. The Supreme Court of California has established the legal authority of Eastman's surveying method. He and his associates are supervising jobs and instruments in the greatest oil fields of North America, the East Indies, Venezuela, the Argentine, Roumania, the Persian Gulf, Australia, and Japan. One of his prospective jobs is turning the Black Sea into an oil field—as soon as rival empires settle the control of that region.

The basis of his method is accurate knowledge of where the bit is at each hundred feet of depth, and ability to change its course. Eastman began with the primitive method, then current in the oil fields, of hanging a partly filled glass bottle of acid down the well and leaving it for 15 minutes. The acid etched a mark along the fluid's top, showing the approximate slant of the bore. But it was also necessary to check the slant against true north in order to locate the well's position upon a survey chart. South African diamond miners had dangled gelatin floated compasses down their exploration wells. Eastman and several young collaborators worked to combine these two ideas. At first they used an ordinary compass and fine pendulums to maintain a horizontal surface against which the angle of the casing could be photographed. Later they substituted a gyroscopic compass, which maintains true horizontal and true north undeflected by magnetized ores, lost tools, or casing pipe. This was found to be too large for best efficiency.

THE instrument that informs Eastman today is complicated, and amazingly intelligent. It can be seen at the Petroleum Industries exhibit at the New York World's Fair—a long, thin metal cylinder which contains electric batteries, a compass, a plumb bob, and a miniature camera loaded with graph film or 16mm movie strip. Sealed against mud, and let down into the narrow darkness of a well, this device will photograph, either in single shots or at repeated intervals, the position of the compass and the angle of the wall of the well. These were the eyes that enabled Eastman to see his slanting way down to within five feet of the bottom of the flaming well at Silsbee, Texas.

All this must be encased in a mud-tight cylinder small enough to follow a drill bit. This watch-like instrument has actually been put in a 3.5 centimeter diameter. Its length varies from five to seven feet. Eastman is trying to make it yet more spindling. Although not a professional mathematician, he has worked out little "watch face" trigonometrical graphs in the form of negatives upon which the miniature camera photographs, at one exposure, the shadow of the compass needle and an angle shadow. The driller needs no technical knowledge; a tank develops the negative and he reads the indicated graph figures and checks the result on his blue print. About 30 minutes suffices for the entire operation of dropping, raising, and reading the in-

strument. (Still another survey method developed by Eastman checks by the turns of the drill pipe.)

So much for the underground survey instrument. Compared with it, the tool to guide the boring bit is simple indeed. When Eastman developed it for keeping bores perpendicular, he called it the "correctional whipstock." Now it is called the "removable directional whipstock." It is a three- to ten-foot-long hard steel shield looking somewhat like a grooved banana, fatter at the bottom than at the top, and ending with a sharp point. The point—at the end of perhaps several thousand feet of drill pipe—is jabbed into the bottom of the hole. The whipstock is hung around a drill pipe by a collar just above the bit and is lowered and fixed in position at the angle desired. Then the drill pipe slides down through the collar, the bit follows the slanting groove and is deflected off through one side of the hole. As soon as the slant bore is long enough to guide the bit forward without help, the bit is drawn up, catches the whipstock by the collar and lifts it to the surface where it is detached until the surveying instrument shows that it is needed again for the next deflection.

A second tool for bias drilling has since been developed by Eastman and his associates: the "knuckle-joint," which is just a drill bit operated by universal gears and looking like a giant dentist's drill. Before lowering, it can be set to start boring at a given angle. Eastman's preference is still the whipstock.

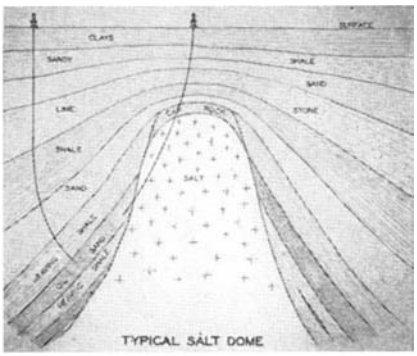
FAMILIARITY and skill are, of course, the secrets of the successful use of these instruments. You have to know how they behave in different strata and at different angles. You must know that up to a certain speed of revolution the bit drifts right, and beyond that it drifts left, and that it tips and pierces at a right angle through hard, slanting strata—unless the slant is too great when, on the contrary, it slips along it and leads off in the other direction. And there are a thousand other tricks.

Before Eastman came along, no state or nation had much reason to be concerned with submarine oil rights. But his discoveries have produced controversy and melodrama which are national now, will perhaps be international tomorrow.

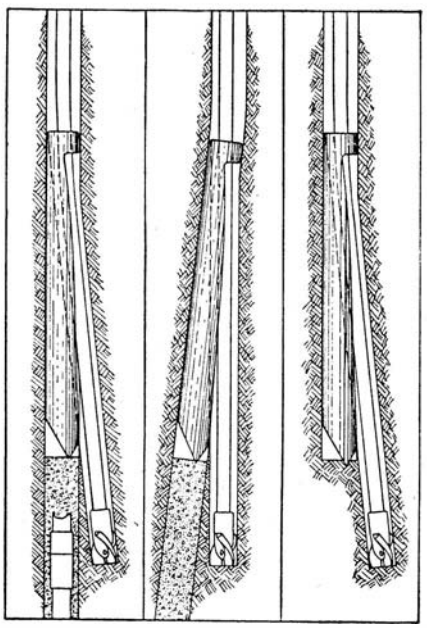
Soon after the California gold rush, a community of Spiritualists settled on the Californian coast south of Santa Barbara, and named their haven "Summerland"—their word for the world after death, for Paradise. Their placid beach was occasionally soiled by oil seepage, recognized by members from Pennsylvania where petroleum exploitation had begun. Scruples about tampering with Mother Earth were eventually overcome through the assurance of friendly ectoplasms. "Spirits" guided the enterprise of the community's Colonel Wayne Darling in putting the first oil well in the world through ocean water in 1896.

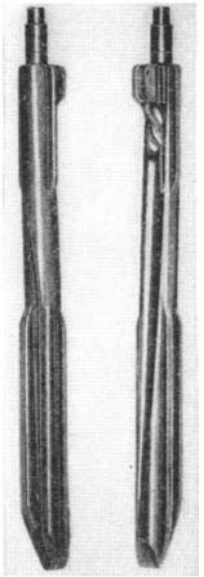
It, and succeeding wells, out as far as 1000 feet from tide mark, became California's Eighth Wonder of the World. They were more successful as tourists' attractions than as money-makers, and the profits were small. After the turn of the century, hard-boiled "black gold" prospectors took the minds of Summerlanders off the other world and destroyed the character of the community. Wildcatters seized upon the under-water drilling idea and applied it in the rich fields farther down the coast at Huntington and Elwood.

Then came Eastman, at Long Beach, pioneering with his curves out under the ocean floor. The local politicians, who had thought no more of oil under the sea than of gold on the moon, became excited over wells put out into the harbor from Ford's and Standard Oil's waterfront fills. The city had granted the waterfront sites for factory and dock space —not for oil wells. This case is still in the courts. Next, the California State Senate, led by Culbert L. Olson, accused corporations of taking untold wealth from state domain without benefit to the people. Two-hundred-odd wells are drawing oil for 80 corporations from under six miles of the state's 1000 mile coastline. The wells have cost twenty million dollars, and have paid the state eight million in royalties.



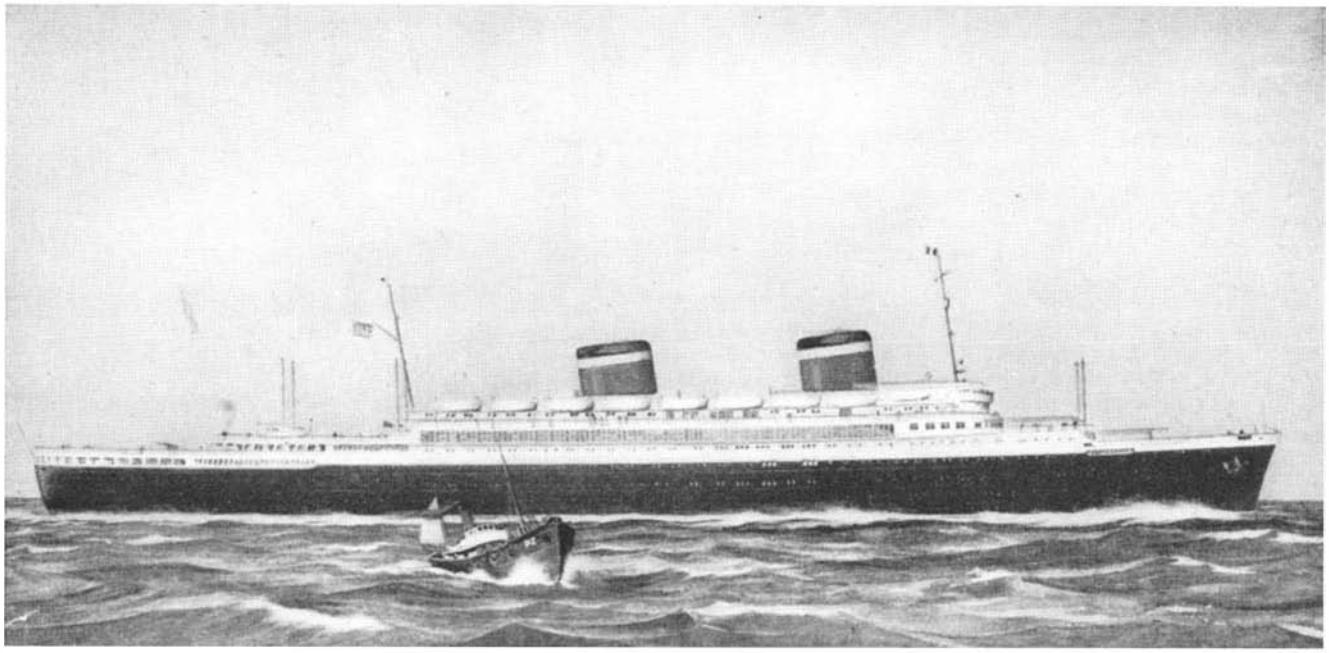
California drew these royalties from underwater wells, claiming the ocean oil fields as state domain. Oh no, suddenly said the United States Navy, in the person of its Inspector of Petroleum Reserves, Commander William J. Greenman. How can corporation, municipality, or state claim ownership of the sea and what lies under it beyond low tide? All this is "open territory," belonging neither to state nor corporation, but to any power able to annex it. And only the United States can "annex"—individual states cannot. So the Navy, in deadly earnest because naval oil reserves on the West Coast are inadequate, for strategic reasons supports the Hobbs Bill, which would declare these submarine oil lands to be the property of the United States and, therefore, subject to the Navy's administration.





Above are shown three uses for the removable whipstock—the first to deflect the drill bit past a lost tool, the second to straighten a hole, and the third to bend a hole. *At right:* Two views of the slant-grooved whipstock. *At left:* Two widely separated wells directed into the same oil stratum

But corporation lawyers and chambers of commerce object bitterly. So does Texas because, alone of the states, it entered the Union not as a territory but as a sovereign nation. The Legislature of Louisiana, a tough state with the richest off-shore oil shelf of all, has already "annexed" as far out as 27 miles. Little Delaware, thinking of sea-water chemicals, has annexed out to 14 miles. Answering California's clarion call, state's righters have gone trooping to Washington with a cohort of harbor-masters in the van. The battle cry they shout is this: "If the Federal Government can preempt oil lands under the sea, by the same token it can possess or abolish the works and jurisdiction of every state or jointly controlled port authority in the union." It is a fantastic and also serious tangle—and also further proof of the profound significance of John Eastman's discoveries to a world that, for war or peace, cannot live without oil.



To be ready for transatlantic service in the spring of 1940, the *America* is the most important unit thus far in the United States Government's program for the construction of 500 American merchant ships in the next ten years, or 50 per year

We Build More Ships

The American Merchant Marine Begins Extensive, Orderly Expansion . . . Important for Our Economic Self-Sufficiency and National Security

By H. GERRISH SMITH
President, National Council of American Shipbuilders

PASSAGE by Congress of the Merchant Marine Act of 1936 and of the amendments thereto, in 1938, evidences the determination of Congress to continue the policy adopted in the Shipping Act of 1916 and in the Merchant Marine Acts of 1920 and 1928 to carry a substantial percentage of our goods in foreign trade in our own ships, and to build up and maintain a merchant marine for both our foreign and domestic trade adequate for our national security and for our economic self-sufficiency.

The preamble to the Merchant Marine Act of 1936 varies somewhat from that in the Acts of earlier years by specifying that we should carry a substantial portion of our water-borne foreign commerce in our own ships whereas the previous Acts mandated that we should carry the greater part. The Act of 1936 provides for a direct subsidy to the steamship operator both in the building and operation of ships as against an indirect system in the Act of 1928.

The new Act requires that the Maritime Commission created under it should make a thorough survey to determine what additions and replacements of vessels are required to carry forward the national policy of the Act, and to study, perfect, and adopt a long-range program for replacements and additions to the American merchant marine; and, in the event that such additions are not provided by private operators, the Commission is directed to complete its long-range program by the construction of vessels for its own account for charter, and ultimate sale if possible, to private interests.

The purpose of the Act is evidently to foster the development of American shipping under private ownership and operation if practicable, but it is quite clear that its purpose in any event is to develop an American merchant marine whether this can be done through private ownership and operation or not. A reading of the Act should convince anyone of the many difficulties involved in the development of American shipping under private operation, but the Act has not yet been sufficiently long in operation to determine what the final outcome may be.

A BRIEF study of our present-day American shipping will show that, with the exception of the few vessels built under the provisions of the Merchant Marine Act of 1928, the vessels in our general passenger- and cargo-carrying trade are mostly wartime-built and have, therefore, reached the age of obsolescence. It will show further that, in the foreign carrying trade, the United States is faced with the inevitable decision of putting new ships into our foreign trade services or of very soon withdrawing from these services altogether.

It is true that the foreign trade of the United States is far less than it was in the boom years of 1928 and 1929, but its value for 1938 was still approximately $5,000,000,000, and it will undoubtedly continue to be of such volume as to be an important factor in our economic prosperity. Its preservation and development still require a substantial participation in its carriage in our own ships.

At the present time, less than 30 percent of our commodities in foreign water-borne trade is carried in vessels under the American flag, while the percentage of the carriage abroad of the American traveling public in our own vessels is about the same.

The Maritime Commission has heeded the mandate in the Act of 1936 to provide for a replacement program so that

new vessels are now off the drawing boards and are under construction in the private shipyards of the United States. Sixty-six seagoing vessels are building, 46 of them for Maritime Commission account and 20 for private owners. In this group are 40 vessels for the carriage of cargo; 13 of the combination type for the carriage of both passengers and cargo; one of the passenger type to supplement the *Manhattan* and *Washington* now in transatlantic service; and 12 high-speed vessels for the carriage of oil. All of these vessels are designed to meet the requirements of auxiliaries for national defense. The passenger vessel, to be named the *America*, is the largest commercial vessel ever constructed in the United States and should be ready for service in 1940.

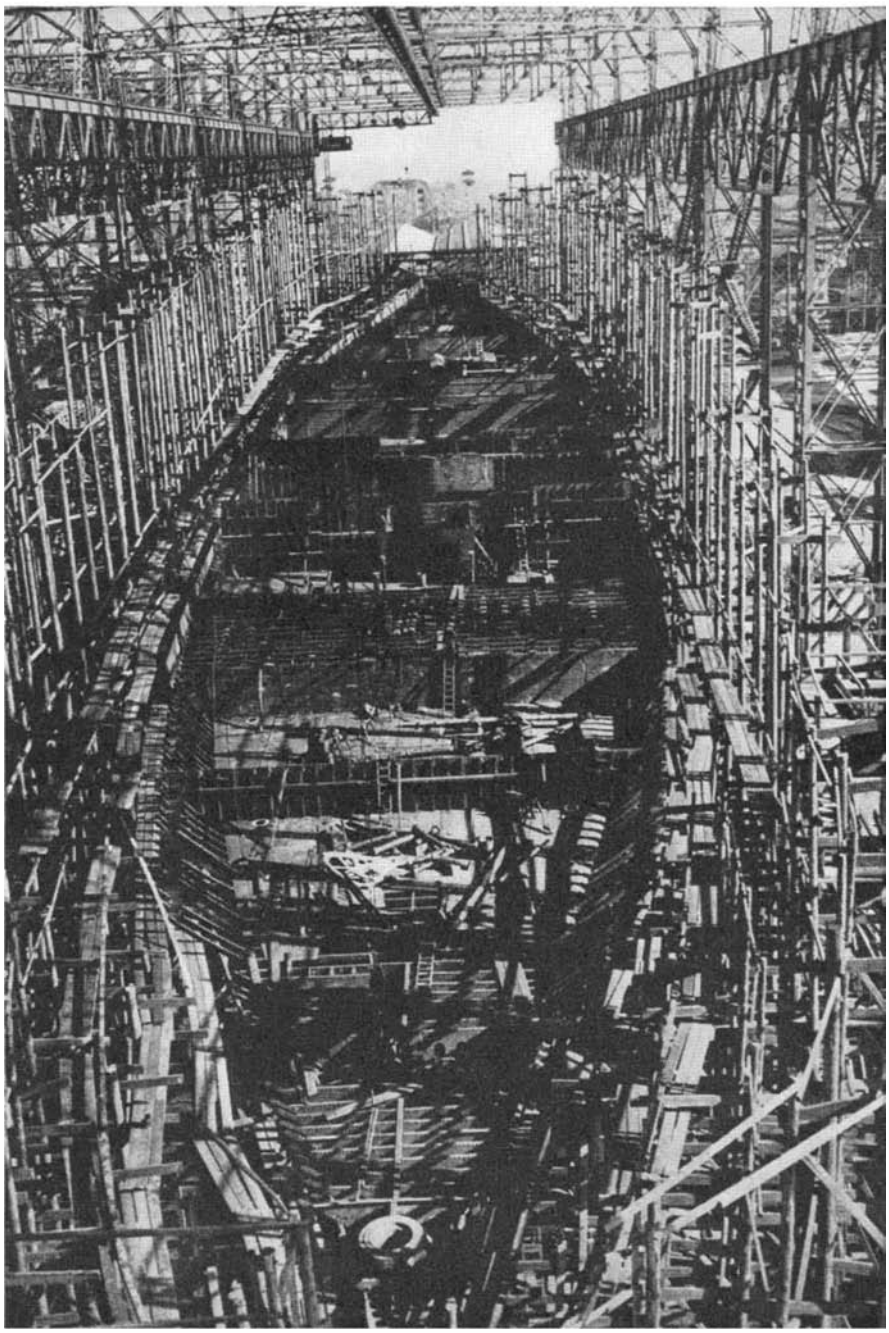
It is gratifying to know that the greater part of those vessels building for Maritime Commission account have already been allocated to existing privately operated, foreign-trade services to take the place of obsolescent vessels.

A PROBLEM of great importance which has not yet been definitely solved and may require further amendments to the Act of 1936 is the disposition of old vessels now in service when new vessels take their place in operation. It is important that such vessels, when removed, should not be allowed to enter into competition with either subsidized government lines or other established services. Legislation to cover this matter is now under consideration by Congress.

The present program of the Maritime Commission, as frequently stated, is the construction of approximately 50 vessels a year over a period of years to take care of necessary replacements. Such a program must have in mind vessels for both the foreign and the domestic trade. The Act of 1936 without some modification, however, does not offer much encouragement for the building of ocean-going vessels for the domestic trade.

As a result of the combined national defense program and the program of the Maritime Commission, the shipyards of the United States are busy, in fact with a greater volume of construction at the present time than in any previous period of shipbuilding in the United States except during the World War. The 66 vessels now building under the Merchant Marine Act of 1936 involve an expenditure of approximately $185,000,000, sufficient to give an average annual employment to approximately 50,000 American workmen over a period of two years, in which employment the shipyards and the various interests throughout the country that furnish materials and equipment share about equally.

Notwithstanding shipyard activity, there is no immediate need of any expansion of shipbuilding facilities other than such expansion as may take place in existing operating shipyards.



Looking down on the hull of the *America*. Divided by 14 watertight bulkheads this ship has been called "the safest ship in the world" by Admiral Emory S. Land

Much has been said recently, not only in this country but abroad, of the high cost of ships. It is true that the price of ships, like the price of other commodities, has risen materially in recent years, but the reasons are many and are easily seen.

Ship design of today is far different from what it was 20 years ago—or even ten years ago. The development of the art has brought about changes which have added to cost. Added requirements of owners for the greater expedition and safe handling of cargo and for the comfort of passengers have added to cost. Government safety requirements have been greatly increased with large additions to cost. The cost of labor is much higher than a few years ago, and the costs of materials, which reflect the higher labor rates, are also much higher. All of these added costs are almost wholly beyond the control of the shipbuilder.

American shipping in foreign trade is in competition with the shipping of other nations whose costs to build and costs to operate are less than those of American ships; and in domestic trade it is in competition with railroads, trucks, busses, pipe-lines, airplanes, and other means of transportation; and its development is faced with many difficult problems. Yet notwithstanding the problems involved, American shipping is in a new era and its importance to the country is such that I have faith in its continued growth and permanence.

PREHISTORIC AIRFOILS

Aboriginal Boomerangs Were Based on Principles Only Recently Rediscovered . . . Analogous to the Helicopter . . . For Sport, Game, Protection

By ARTHUR E. OXLEY, M.A., D.Sc.
Major, Royal Air Force

THE development of the boomerang by Australian aborigines marked one of the most brilliant achievements which illuminated the dim aeons of paleolithic civilization. Those primeval tribes, of unknown linguistic affinities, foresaw and put into practical service what the advanced intellects of the 20th Century are so laboriously rediscovering; the conception and application of mechanical flight. Pertinent, too, is the fact that they developed their discovery primarily for purposes of warfare; the principles of flight again are being so applied today, threatening modern civilization with annihilation.

Like many scientific discoveries which have proved to be really momentous, that of the boomerang was probably fortuitous; perhaps the outcome of idle contemplation of the graceful gyrations of an acacia leaf or the whirling of the winged fruit of the gum tree. Whatever it was, we must concede the presence of a remarkable mental trait within those savage minds which leapt far beyond contemplation by producing from the wood of those trees a unique and deadly flying weapon.

Even in the incipient stages of tribal life, weapons of defense and offense were a necessity. There would be times when the hated enemy stood beyond the reach of thrust or parry; when the possession of a missile filled the frenzied warrior with delight. He took chances and hurled. It was then that he made his great discoveries. Some implements flew prodigious distances—far beyond the range of a round object of the same weight. Some flew straight; some curled in their flight in curious ways. Why, he did not know; but we must at least assume that he would practice strenuously in times of peace, prizing and reproducing in every detail those implements which behaved in the way he wished.

It is likely that his very crudeness of workmanship was his talisman. Soon he would notice that all implements which were of any use were more rounded on one side than on the other. But this was not the whole secret. The weapon had to be hurled in a special way so that during its flight the more rounded side always came uppermost. This was the key to the prolonged flight. The pressure above the rounded surface was less than that under the flatter surface below. Gravity was, in part at least, compensated. The savage had unwittingly discovered the principle of the *cambered airfoil*—a principle of aerodynamics to be rediscovered untold centuries later.

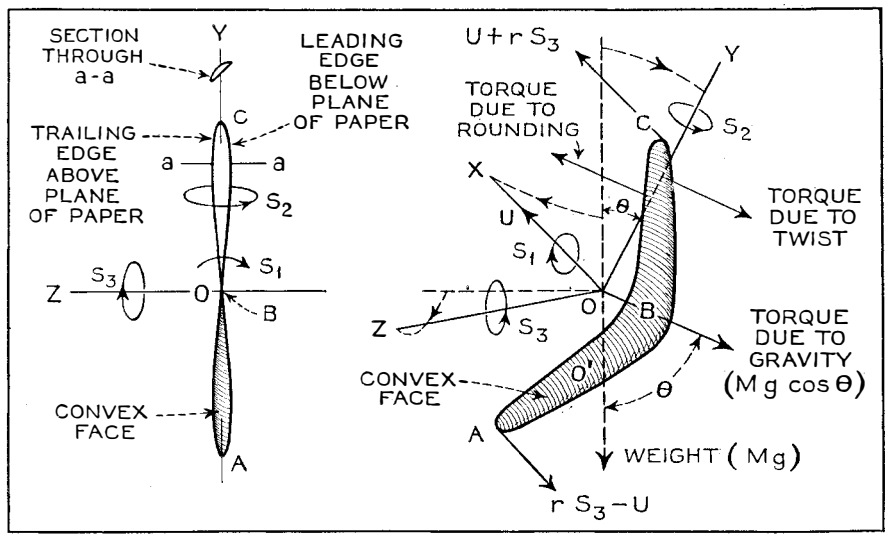


Figure 1 (left): Side elevation of boomerang immediately after throwing. *Figure 2 (right):* Oblique view about two seconds after projection. See text

Important as this discovery was, many puzzling problems remained to be solved. For example, those weapons which were straight, like spears, would not fly nearly as well as those which were bent near the middle—scimitar-like. In fact, Captain Cook, when he first saw boomerangs at Botany Bay, thought they were crude wooden swords. Unless the implement is bent in this way the subsequent flight is erratic and unstable. A very wide variation in the angle between the arms is permissible; from 90 to 140 degrees. In this recession of the arms we see the stabilizing principle which has been adopted in a variety of successful tailless airplanes; the backward sweep of the wings taking the place of the tailplane.

THE most remarkable feature of effective boomerang throwing lies in the skill of the thrower. The implement is thrown in a horizontal direction with as high a linear velocity as possible. At the instant of release, it is given as high a spin as possible, the implement revolving about its center of gravity O, Figures 1 and 2.

Boomerangs may be conveniently divided into two general classes known as *the Return Type* and *the Non-Return Type*. The first is commonly used in hunting, for bringing down birds, and so on; the second is used purely as a war-weapon. In the return type the arms BA and BC are twisted about two degrees in a right-handed direction. The non-return type has an opposite and usually smaller twist. Upon this difference of twist and the method of projection depend the characteristic flights of the two types.

Whether in the most primitive of implements such twists were intentionally made is not known. More probably they were accidental insertions due to crude workmanship or they may have resulted through warping in the sun's heat. All efforts to find the true origin of the twist have proved abortive and it seems most probable that its influence was derived entirely from observational experience. The fact remains, however, that its presence introduces us to that all-important feature of mechanical flight known as the twisted-airfoil or air-screw. In the linear propulsive and rotary motions of a skilfully hurled boomerang we have all the essentials, except adjustable controls, common to the helicopter-airplane.

When throwing the return-type implement, it is grasped by the right hand at A and held over and to the rear of the right shoulder, the plane ABC, Figures 1 and 2, being vertical and the rounded side facing the thrower. At the instant of projection the implement proceeds with velocity U in the horizontal direction OX and rotates with spin S_3 about the axis OZ which is also horizontal and at right angles to OX. We are at once confronted with the problem of a wind-mill airfoil projected in an oblique wind. The tip C has a maximum velocity $U + rS_3$ away from the thrower; the tip A a velocity $rS_3 - U$ toward the thrower, where $r = BA$ or BC. As a result, differential pressures are set up by both twist and rounding which cause the principal plane of the implement ABC to rotate about OX. The direction of this induced spin depends partly on the twist, which, as Figures 1 and 2 show, acts in a clockwise direction as seen by the thrower, and partly on the rounding which acts in an anti-clockwise direction. In all effective, that is, useful, specimens of the return-type, the resultant of these spins, S_1, is clockwise and small, so that the plane of rotation ABC is seen by the thrower to heel slowly over to the right. Immediately the plane ABC leaves the vertical, the force of gravity begins to contribute to the clockwise rotation through the torque of the component Mg cos θ acting about the center of oscillation at some point O', Figure 2.

IN addition, the spinning boomerang behaves like a free gyroscope and, as such, each of the forces just named—which arise from the twist, the rounding, and gravity—causes the plane ABC to precess about the axis OY with a new induced spin. That part due to the twist is negative, that to the rounding positive, and that due to gravity negative. For all effective return-type implements, these component spins are such that their resultant, S_2 in Figures 1 and 2, is positive and small. Thus, as the boomerang flies away, it is seen to heel over slowly to the right and at the same time curl gently around to the left. This combination of induced spins S_1 and S_2, since the rounded side is kept uppermost, results in the implement's "skying" or soaring as it

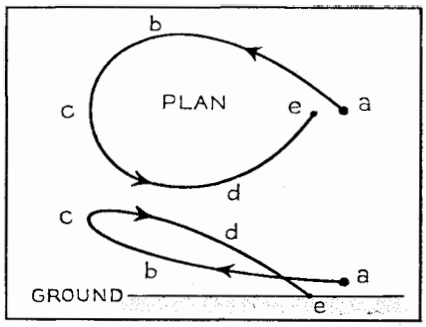


Figure 3: **The simple loop flight of a boomerang thrown from point *a***

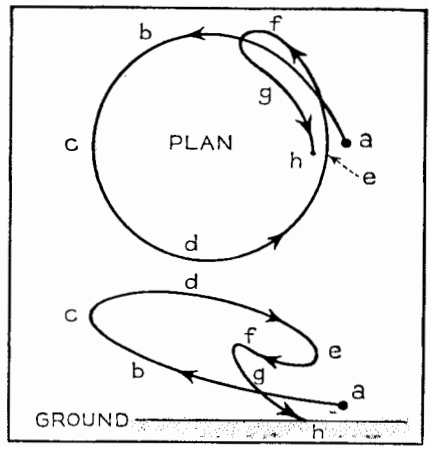


Figure 4: **Double loop path of a boomerang when thrown hard**

swerves to the left. The evaluation of these angular velocities explains the character of the simple loop-flight illustrated in Figure 3. The curling to the left, due to the precession spin S_2, is shown in the plan by the arc $abcde$ where a is the thrower and e the end of the flight. The soaring is shown in the region bc of the elevation of the flight path. The axis of initial spin, S_3, is horizontal at a. It climbs upwards on the thrower's left and at c it is pointing upward and backward.

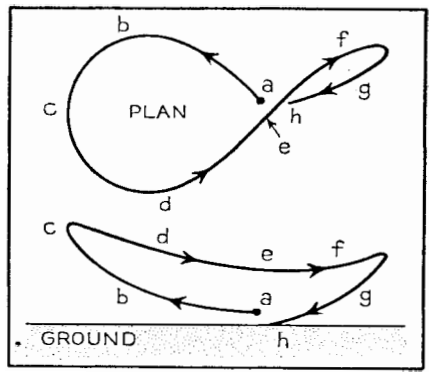


Figure 5: **Another double loop, this time in the form of a figure eight**

If the implement is to describe a second loop, it must be thrown much harder so that on returning over the thrower's head it has still appreciable linear velocity and spin. What will happen now depends on the position of the axis of the original spin, S_3. If this is inclined forward of the thrower, the implement will start to describe a second loop like the first, $efgh$ in Figure 4. If it points backward above the thrower, the implement will proceed to describe a reverse loop behind the thrower, and may, if its energy is sufficient, complete the figure of eight shown in Figure 5. If the energy expires during the flight, the implement will fall gracefully to earth under the influence of gravity.

Still more complicated flight-paths are possible as a result of an expert's skill. There is on record an authentic description of a flight involving five complete loops before the implement glided steeply and gracefully to earth.

In the non-return type, the war-weapon, the twist is in the opposite direction to that in the return type. It is hurled differently. At the instant of projection, the plane of rotation is inclined to the horizontal at an angle θ of from 30 to 60 degrees and the direction of projection is a few degrees "uphill" to the forward horizontal OX. There is but a small torque about OX when the implement has reached a horizontal position with its rounded face uppermost. If the implement passes this position, the gravity-torque falls off (since it is proportional to cos θ) and the torques due to rounding and negative twist bring it back to the horizontal which is its stable position of flight. This very small value of S_1 necessarily means that the precessional spin S_2 is very small and this is especially true if S_3 is large, since the precessional spin

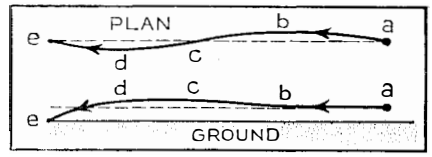
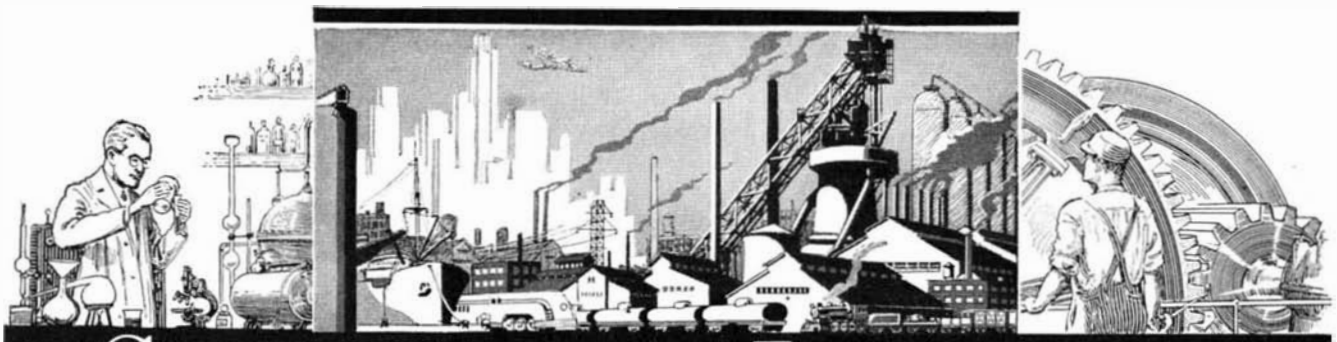


Figure 6: **Plan and elevation of flight of non-return boomerang type**

is inversely proportional to the initial spin S_3 about OX. The flight-path of this type of boomerang is shown in Figure 6. At first the implement swerves slightly to the right along ab, and returns to a point on the straight at c. Then it swerves slightly toward the left from c to d and returns again at e. This sinuous path results from precessional forces which oscillate about the horizontal position of stable flight. Since the rounded face of the implement is uppermost, the downward trend of the flight-path is counteracted and the trajectory appears practically horizontal, as viewed in side elevation, until the forward velocity is almost spent, when the implement falls, spinning, to earth. Along such a path, the flight of the boomerang simulates closely that of the helicopter-airplane, the horizontal plane of rotation of the arms resulting in a vertical lift which adds to the levitation arising from the camber of the upper rounded surface of the arms.

Near the end of the flight, the steep angle of glide, without the slightest suggestion of stalling, is fascinating to watch. The boomerang illustrates well those principles of mechanical flight which the modern aeronautical engineer is striving to perfect; safe descent at very steep angles combined with almost negligible landing speed. And yet the possibilities of such heavier-than-air machines—models though we may call them—were known and used in instruments of sport, livelihood, and protection not only among the primeval races of Australia, but among the savage prehistoric tribes of Central India, Ethiopia, and among the Hopis of Arizona.



SCIENCE AND INDUSTRY

A MONTHLY DIGEST

Conducted by F. D. McHUGH

Contributing Editor

ALEXANDER KLEMIN

In charge, Daniel Guggenheim School of Aeronautics, New York University

Unique Hinged Swing Spans on Bridge

THE completion of a reinforced concrete arch bridge across Big Creek, 40 miles south of Carmel, California, constituted the last link in a series of structures, inseparable elements of Coast Highway Route 56, between Monterey and San Simeon. Its construction introduced unusual problems in bridge design.

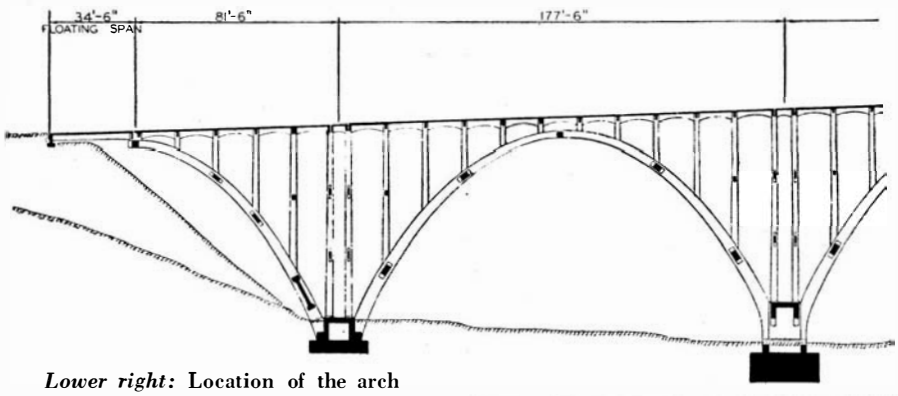
At the site of the crossing, Big Creek meanders along the bottom of a deep "U" shaped canyon. Foundation exploration indicated that the steep, sloped canyon walls consisted of a badly fractured shale formation and that underlying the stream were beds of clay, sand, and gravel of reasonable bearing value for the bridge foundations. The highway alignment at this location is immediately adjacent to the sea coast and approximately 90 feet above the bed of the stream.

In selecting a structure most suitable for this site, foundation conditions were of course an important consideration, as was also the locale with its heavy fogs, rains, and salt spray laden winds. In fact, the latter consideration ruled against a type of construction suitable for an inland site. Full consideration of these factors led to the adoption of the reinforced concrete arch as the most suitable type for this location.

The arch structure comprises two main arch spans 177 feet 6 inches long across the canyon, and two tied half arches of 81-foot 6-inch span with 34-foot 6-inch swing spans which vault the canyon walls to the abutments at highway grade. The structure from abutment to abutment has a total over-all length of 587 feet and provides a clear roadway width of 24 feet.

A unique feature of this structure involves the function of the swing spans which are hinged to the half arches. Foundation conditions at the bridge ends indicated that the design should anticipate settlement of the end abutments. This condition, should it occur, may be readily overcome by virtue of the hinges which permit jacking the swing spans back to grade without detriment to the half arches. In effect, any settlement at the abutments is localized and the correction effected with a minimum of expenditure.

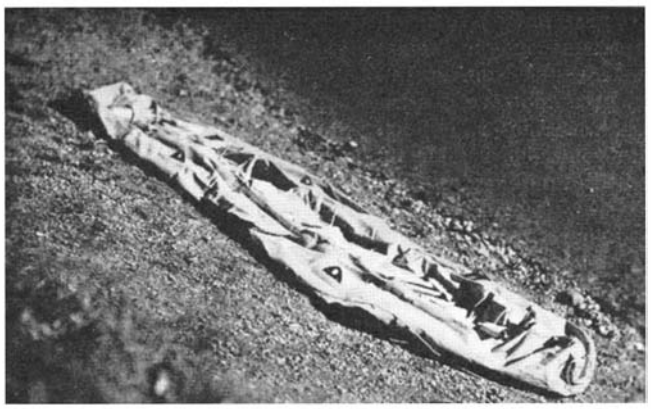
The half-arch spans supporting the ends of the swing spans are hinged at the lower end and held in position by means of a steel eyebar tie extending from crown to crown of the half arches. Hingeing of the half arches at their bases was indicated to eliminate stresses which would be induced by elongation and contraction of the eyebar tie from temperature change.—*H. E. Kuphal, in California Highways and Public Works.*



Lower right: **Location of the arch bridge discussed in the text.** ***Above:*** **One of the arch spans, one of the half arches, and the floating span**

Ten-man Pneumatic Life Raft

RECENTLY under test at Wright Field, Dayton, Ohio, has been a pneumatic life raft, developed for use with large airplanes of the bombardment type when engaged in over-water flight. When inflated and placed in the water, the raft is capable of seating 10 men, while a life line attached to the raft and extending around it will support 10 additional persons.



The pneumatic life raft ready for inflation and, *right*, the raft in use

The supporting structure of this raft consists of a latex rubber bladder with a heavy rubberized duck outer cover. The bottom is of heavy rubberized duck fabric and contains three pneumatic inflatable seats. The latex tubes are equipped with valves and manifolds for CO_2 inflation. About five pounds of the CO_2 is required for the inflation operation. The cylinders containing the CO_2 are attached to the raft and fed directly into the tubes. The weight of the raft when inflated is approximately 115 pounds. When folded the raft can be rolled into a bundle approximating three cubic feet of space.

Four two-section metal oars make propelling of the raft possible in the water for a considerable distance. Four army canteens of water, a quantity of emergency rations, emergency signal kit with six red flares, and a pyrotechnic pistol form additional equipment. All of these are encased in water-proof holders.

In order to repair possible punctures while afloat, an emergency pump is provided. With a repair kit, this makes it possible to keep the raft afloat indefinitely. When inflated, the buoyancy is such that the raft is virtually nonsinkable. It will float even if turned upside down on the water, and has been found to be considerably more stable and more easily handled than the smaller sizes.

In the bombardment airplane, the rafts will be stowed in a position within easy reach of personnel.

Experimental testing at Wright Field having been completed, an order was placed for a service test quantity.

Catalytic Refining

CATALYCTIC refining is becoming a routine method for the manufacture of petroleum products. Limited originally to large plants, because of the heavy investment required, catalytic refining processes now have been developed for the smaller plant. Increased production of gasoline of 2 to 8 percent is reported by the operators of the "midget" catalytic plants, together with an increase of 2 to 4 percent in octane rating of the gasoline. Similar results, with even greater increases in gasoline yield and octane rating have been reported by operators of the larger catalytic plants.

As currently operated, catalytic refining plants produce about 45 percent of 80 octane gasoline the first time the crude oil is passed through the stills, making no fuel oil unless desired, and producing only gasoline, gas, gas oil, and a small amount of heavier residue. On subsequent runs through the stills, additional amounts of gasoline and other usable products are obtained. Conversion of 100 percent of the crude oil into gasoline is physically possible under the new technique.

Catalytic refining adds the action of a catalyst to the action of heat and pressure, the physical contact of the oil with the catalyst causing a chemical reaction which converts greater portions of the oil into gasoline. Refinery gases, resulting from cracking and distillation, also are subjected to catalytic processing, adding still further yields of gasoline.

Catalysts ordinarily used have metallic compounds or alloys as their base. A typical catalyst is a mixture of silica and alumina, pressed into bricks. Other catalysts are made of acid-treated clay, containing oxides of manganese and nickel. The effectiveness of the catalyst decreases very little in use and can be renewed after continued operation.

A Blight-Resistant Chestnut

SEVERAL years ago the Bureau of Plant Introduction of the U.S. Department of Agriculture brought in shipments of the Chinese chestnut *Castania mollissima* in an effort to find a variety that would be resistant to the chestnut blight which worked such havoc in the chestnut area of the United States that practically every American chestnut has been destroyed. Crosses of one or more of these chestnuts were sent to the Bartlett Tree Research Laboratories, and among them was one which has grown for 20 years and has fruited for several years. The nut, too, is similar to that of the American chestnut in size, quality, and sweetness. Mr. Bartlett early recognized its merits and has distributed more than a thousand one-year-old seedlings to commercial nut growers in different sections of the United States. Because of the service rendered by Mr. Bartlett in co-operating with federal agencies in the distribution of this promising cross, the chestnut has been named by government workers the Bartlett chestnut.

Blight resistant

In some instances, our native chestnuts have sprouted for a few years, and some have even fruited but then succumbed to the blight so that it does not appear likely that a disease-resistant native chestnut will grow again in the areas originally affected by the blight.—*C. F. Greeves-Carpenter.*

Instrument for Chemical Analysis

BASED on established principles and developed by the engineers of the Fisher Scientific Company, a new instrument has been announced for conducting qualitative and quantitative analyses in both organic and inorganic industry.

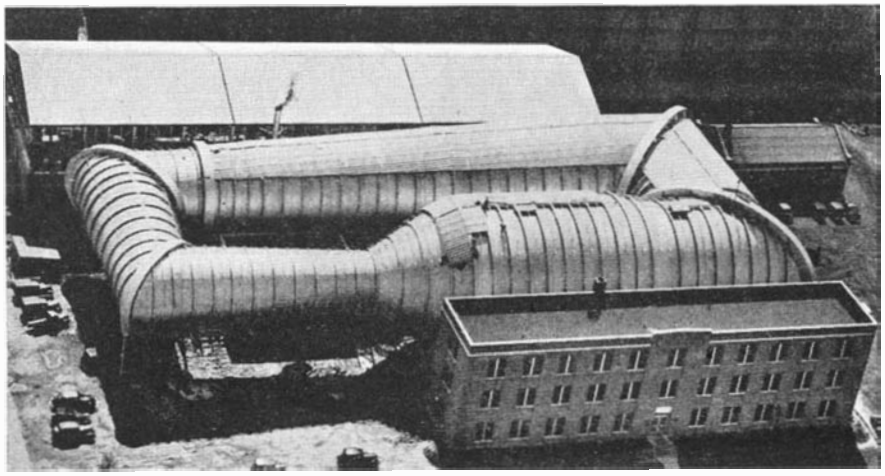
The Elecdropode, as the compact instrument is called, employs the dropping mercury electrode system for analysis. With this system, a series of potentials are applied to drops of mercury as they fall through the solution being analyzed. The results are plotted and the presence of each particular ion is indicated by an increase in the current at a specific voltage. The extent of the increase depends upon the ion concentration.

Another View of German Aviation

WE have heard glowing reports of German aviation from many sources, and German bombers have been Hitler's trump card in his diplomatic or, rather, undiplomatic maneuvers. Is it just possible that the Reich's strength in the air is over-rated? *Picture Post*, a well informed English magazine, published some interesting views in this regard.

One hundred pilots a month were killed last year in the German Air Force, which is an indication of hurried training, and of weakness rather than strength.

Visitors have apparently free access to German airplane factories and are duly impressed with such facts as the production of three-engined bombers at the rate of nine a day, or single-seater fighters at the rate



Exterior of the pressure tunnel for testing airfoils and airplane models

of twelve a day. But such glimpses may be deliberately misleading. *Picture Post* says: "That factory may have been building its airplane parts for months, and other parts may have been worked on by other factories, and all might have been ready for the final assembly of aircraft the day before the visitor was shown over." The final rapid assembly might thus well be the culmination of months of relatively slow effort.

Again, in building American Pratt & Whitney engines under license, the quality of the steel was so bad that the crankshaft of the engine had to be strengthened, weight of the engine increased, and over-all efficiency lowered. It is also reported that the German-built Pratt & Whitney Wasps have to be overhauled every 35 hours, whereas in the United States overhaul is placed in hundreds of hours. German airplane tires made of synthetic rubber have a life of only 40 hours, which is but a fraction of the time that American tires will serve.

These are rumors. Still, there is some reason to believe that reliability may have been sacrificed to quantity in the Nazi Air Forces, and in time of war, only that airplane counts which is capable of continued service.—*A. K.*

Multiple Hangars

FROM time to time we have pointed out in these columns that hangar space is valuable and that hangar rent is an important item in the budget of the private plane owner. Considering the present type of conventional hangar, elaborately constructed in steel and concrete, with high roof trusses, it is obvious that hangars cost money, and that the present high rents are probably a necessity. To overcome this drawback, the Edwards Multiple Hangar has been designed to reduce the cost of airplane housing, and also to provide the owner of an "airplane garage" with housing of such flexibility that he can adjust his space to current requirements and not be tempted to speculate by erecting an expensive building which may remain half empty.

One of our illustrations shows a seven-unit hangar block. The low over-all height, made possible by use of a special cantilever roof truss, is only 16 feet as compared with the 36-foot height of the conventional big hangars. This reduces the minimum area required for the landing field, since the approaches become lower. The staggering and overlapping of the hangars reduce the ground required for a number of machines to the absolute minimum. Each unit houses a single plane. The hangars can be built singly, or in blocks of two or more as desired. The privacy of each block should make an appeal to the amateur flier.—*A. K.*

A Huge Pressure Tunnel

OF great interest to visitors at Langley Field is the 19-foot pressure tunnel shown in one of our photographs. To secure conditions comparable with those of flight, the new 19-foot tunnel is designed to use air at a pressure of two atmospheres; the speed of the 19-foot diameter jet will be 250 miles an hour. In operating the tunnel, the operators will work inside the pressure chamber, like the "sand hogs" who drive tunnels under our rivers. Special air locks and a decompression chamber will be provided.

The tunnel is of steel tubular construction, with a maximum diameter of 60 feet, a length of 270 feet, and a width of 128 feet. The 34½ foot propeller will be driven by an 8000-horsepower electric motor. In the working chamber the large forces on airfoil or airplane model will be recorded by automatic balances, which will give the engineers a faithful picture of what they may expect from the actual flying machine.—*A. K.*

"Smoked" Glasses

THE American public has declared a defensive war on invisible rays, using for armor certain types of glass which protect the eyes by admitting visible light and stopping the invisible ultra-violet and infra-red rays. A 700 percent increase in the use of this glass since 1928, amounting to many tons, is reported by the American Optical Company.

According to latest scientific investigation, the invisible ultra-violet and infra-red rays are not necessary for seeing and in excess quantities may produce pathologic eye conditions. The protective glasses, the composition of which is responsible for their absorptive qualities, are used for outdoor wear to protect the eyes from excess light (glare of the sun) and the invisible rays.

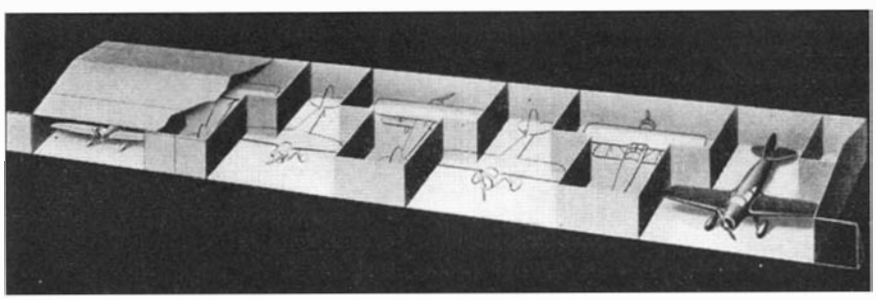
Many years of research were required to develop efficient absorption glasses, Dr. E. D. Tillyer, the optical company's research director, stated. The problem was complicated from the beginning by the difficulty of cutting out the invisible rays and maintaining at the same time a desirable transmission of the visible light rays.

Finally, after long experimentation, certain elements in pure form having ultra-violet and infra-red absorptive properties were discovered. Added to batches of glass, these elements produced glasses which transmitted light without undesirable color distortion and at the same time uniformly absorbed the invisible rays.

The elements having these remarkable properties, Dr. Tillyer stated, were cerium (a rare metal resembling iron but much softer) and very carefully balanced quantities of iron compounds. To prevent color values from being distorted, he emphasized, the ratio of the iron compounds must be watched very carefully.

Conquering the Atlantic

IT is now a matter of record that Pan American Airways have crowned their many achievements by the first scheduled flights across the Atlantic, under commercial conditions of operation. All honor to Pan American and to the Boeing Clipper. (See also page 76, this issue.) The achievement is all the more remarkable when we consider how brief is the chronology of transatlantic service. Scarcely twelve years ago (October 1927) the first international airmail and passenger service extending beyond the borders of the United States was established by Aeromarine on a little 90-mile airline between Key West, Florida, and Havana, Cuba. Early in 1929 Pan American Airways formulated its first plans for transatlantic operation, undertook a complete survey, and adopted specifications for aircraft, weather and radio services, base facilities, and so on. In 1931, the first "laboratory tests" were made on a northern great circle route. In 1932 and 1933 there were expeditions to Greenland, and the building of the Sikorsky *S-40*, the first four-engined flying boat. The year 1933 saw another survey headed by Colonel Charles A. Lindbergh. In 1935 was held the first international conference on Atlantic air travel. Then came more surveys, a larger Sikorsky, and finally, in 1938, the *Yankee Clipper* was constructed. Then came shake-down flights, more surveys, and, finally,



Multiple hangars for airplanes conserve space

in May 1939, the first regularly scheduled flight. To the public the establishment of this service has seemed slow. In reality, progress has been very rapid, when one considers the immensity of the task.

Pan American will not be left alone in the transatlantic field. We may expect Air-France, Imperial Airways, Lufthansa all to be active. And, moreover, there will be another American company in the field. Thus American Export Airlines has filed with the Civil Aeronautics Authority application for a certificate of convenience and necessity covering Atlantic routes from New York or Baltimore, via Botwood, Newfoundland, to Foynes, Ireland; Horta, Azores; Biscarrosse and Marseilles, France. As soon as the latest Consolidated flying boat, shown in one of our photographs, has been approved by the Authority, three survey flights will be made, one of these being non-stop from New York to Biscarrosse. A strong argument in the application is the fact that the new airline will be affiliated with American Export Lines, which maintains a fleet of 18 surface vessels. From five to eight of such ships are normally at sea at all times between New York and Gibraltar. With complete two-way radio and meteorological observation services, the help to navigators will be immense. Investment bankers have bought enough stock to finance the venture on a sound basis.

The Consolidated Model 31 Flying Boat has made successful test flights with 52 passengers and a crew of five. The Model 31 is a twin-engined flying boat, powered with Duplex-Cyclones of 2000 horsepower each. The gross weight is approximately 50,000 pounds. Hydraulically operated Fowler flaps extend from the hull to the ailerons. The rear portion of the hull is so designed that the tail surfaces rise high above the water, and the vertical surfaces project well below the stabilizer, which is a safeguard against spin. There will be two full decks. Wing span is 110 feet. Carrying 28 passengers, the boat will be capable of non-stop commercial service across the Atlantic.

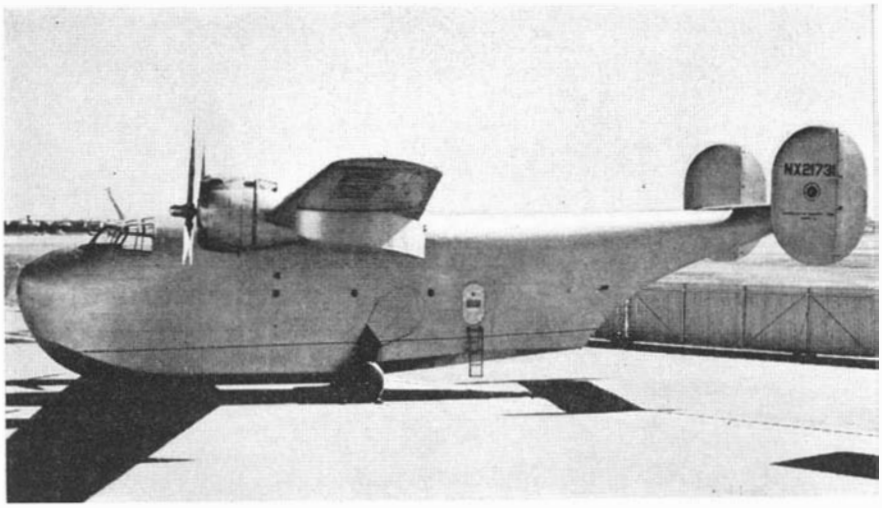
Pan American with Boeing Clippers, against American Export with Consolidated Model 31, will provide the competitive zest which is needed to secure maximum effort and efficiency on the part of both companies. —*A. K.*

No-Slip Paint

FROM United Laboratories comes announcement of a new non-skid paint for use on stair treads, concrete floors, steel floor plates, and other places where resistance to abrasive action is desired. It is known as Armor-Plate 419, made up of stainless steel flakes in varnish vehicle.—*Streamlining.*

Most Powerful Air-Cooled Engine

BUILT by Wright Aeronautical Corporation, and known as the Duplex-Cyclone, the most powerful air-cooled engine in the world is of the radial type with 18 cylinders arranged in two rows of nine each, and is rated at 2000 horsepower. It derives from the Double-Row Cyclone of 14 cylinders which is rated at only 1500 horsepower. Provided always that a suitable propeller can be designed to absorb its immense power efficiently, this latest engine will do a great deal to increase the speed both of our transports and of our large Army bombers. Two of the Duplex-Cyclones have already served in a large flying boat of Consolidated Aircraft which has been recently test-flown on the Pacific Coast with marked success, and is described above.—*A. K.*



Consolidated Model 31 Flying Boat for transatlantic passenger service

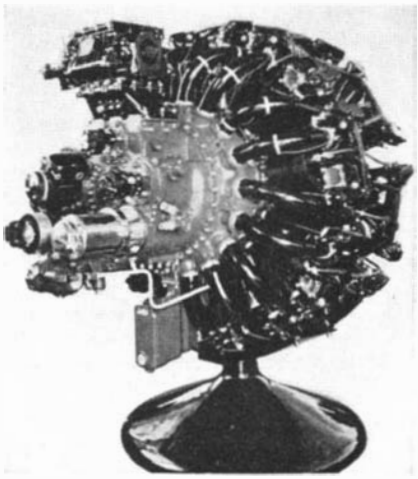
Izaak Waltons Use Metal

MONEL braided and twisted fishing lines are becoming exceedingly popular, and in England the foremost reel manufacturer uses Monel for spindles, disks, "agate" rings, and ferrules on rods. Here, at home, Monel is used for a weedless fish lure, red on one side, a bright tumbled finish on the other. And when Wisconsin fishermen began to raise a row about galvanized minnow buckets rusting rapidly, they changed to Monel.

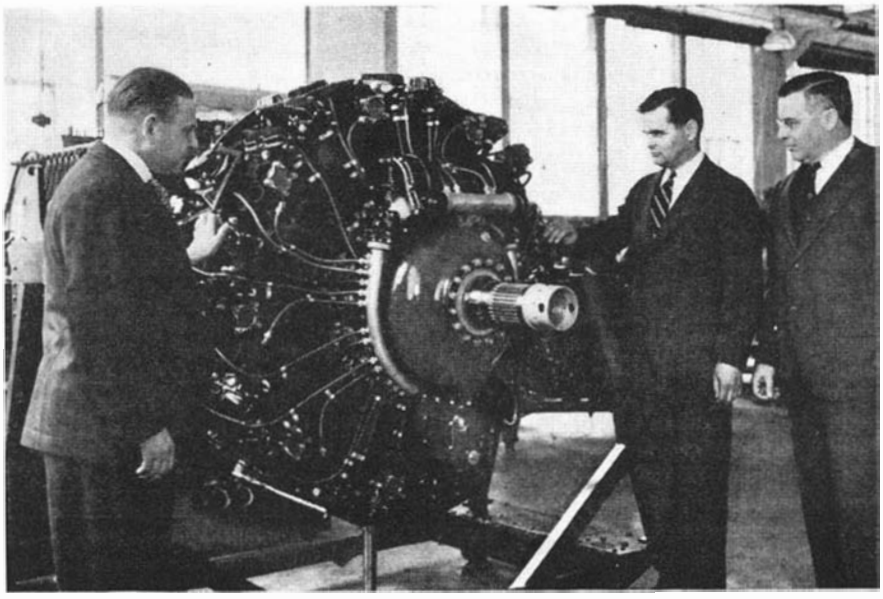
Need for Rubber Lubricant

AS the result of an extensive field survey, the Acheson Colloids Corporation conservatively estimates that 200,000 grease-rack attendants consider squeaking rubber parts a pet peeve in automobile lubrication. In desperation these individuals apply brake fluid to the offending points. One concludes from the frequency and number of comebacks reported, however, that the effect is soon lost.

Making inquiries on other phases of the problem, the investigators find that practically every rubber part requires some degree of lubrication. Spring shackles, sway eliminator bars, steering columns, shock absorber arms, spring pads, fan belts, mount-



Below: **Engineers inspecting one of the Duplex-Cyclones, world's most powerful air-cooled engines.** ***Above:*** **Rear of Duplex-Cyclone, showing the various accessories**



World's largest truck, compared with an ordinary truck in foreground

ings, silencer strips, and bushings—to name the more important—are included in their list.

In addition, this survey points to a growing popularity of colloidal graphited preparations for the purpose. Because of its chemical inertness, this material does not soften or otherwise deteriorate rubber, but rather tends to preserve it when combined with glycerine according to U. S. Patent 2,083,-176. Being widely known as a positive dry lubricant, colloidal graphite also provides squeak-free lubrication for the remotest and closest of fitting parts. Evidence now available suggests that automobile manufacturers and owners will presently use graphited rubber lubes in standard lubricating practice.

World's Largest Truck Electrically Driven

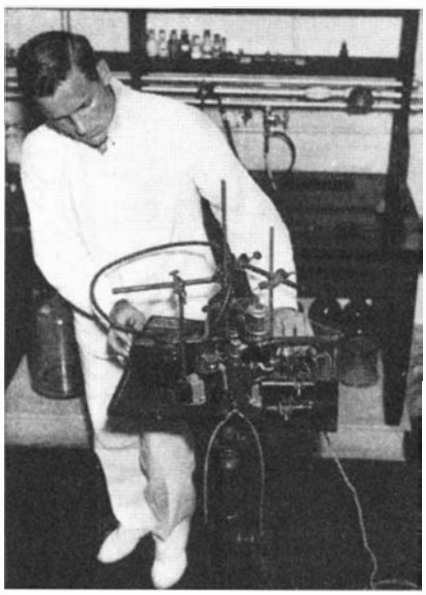
ELECTRICITY drives the giant truck, shown in our photograph, which hauls a 70-ton pay load of coal from strip pit to the tipple, over a four-mile private roadway of the Sinclair Coal Mining Company's Tiger mine in Hume, Missouri. Two General Electric generators, each direct-connected to a butane-burning Hercules engine under the hood of the truck, furnish energy for traction motors connected to the two rear-end drives.

The trailer is 35 feet long, 12 feet wide, and 10 feet high. Total weight of load and equipment is 103 tons.

Artificial Heart

A REMARKABLE artificial heart which can replace any animal heart for pumping blood at its ordinary temperature of 98 degrees, Fahrenheit, through the arteries and veins has recently been perfected by Dr. Gerhard Katz, of Tulane University. This heart can, in fact, be used either for the perfusion of living organs with fluids other than blood, or for the maintenance of the circulation of an experimental animal. It can be operated at a maximum speed of 100 strokes a minute, although a lower rate is usually preferable. An air valve in the heart is opened and closed by a photo-electric cell activated by two beams from two light sources, which pass through the glass tube and are interrupted by the blood column. These light beams are focused by lenses in such manner that one passes through the bottom of the tube, while the other one is focused on it at any desired height.

During the systole operation, the air valve is opened and the top light is dark. Air pressure then pumps the blood out of the tube into an experimental artery, for example, until the blood column reaches the beam of the bottom light. This beam is thus allowed to penetrate the glass tube and activates the photo-cell, which then closes the air valve and switches on the top light. The output of blood per stroke is regulated by the height at which the top light-beam passes through the glass tube. Increase or decrease in the venous blood return to the heart correspondingly changes the ordinary rate of flow.



Above: **The artificial heart perfected by Dr. Katz.** ***Below:*** **A close-up view of the mechanism used for research on experimental animals**

This artificial heart has been used in studying the action of arteries, veins, and kidneys, when detached from the animal to which they originally belonged. An outstanding advantage is that it can be slowed down or speeded up as desired; its operation is wholly mechanical. It contains neither tiny motors nor moving parts; the blood comes in contact only with glass and touches no rubber. And there are no pistons, because the blood which comes in contact with them sometimes becomes toxic. It is the first apparatus of its kind operated by use of a photo-electric cell.

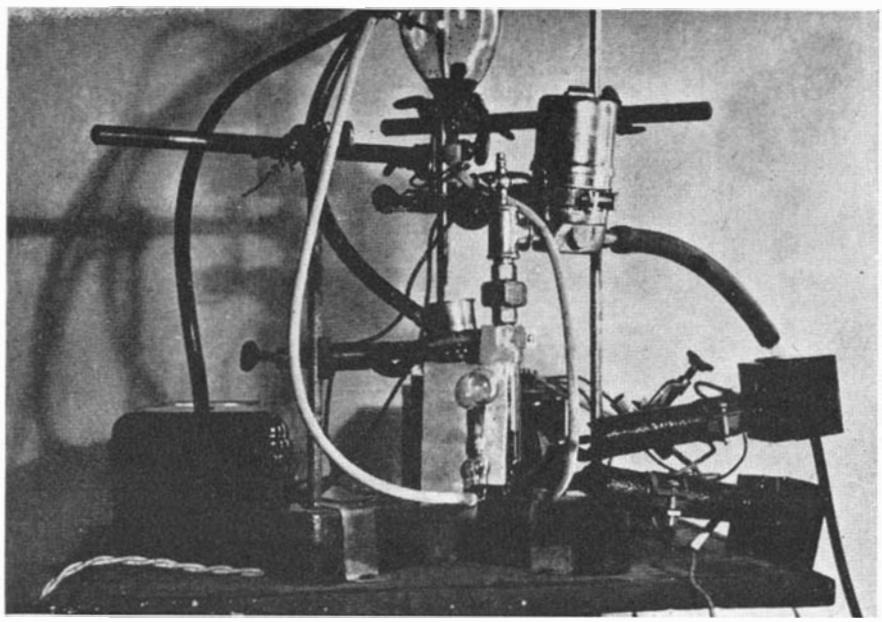
This heart is not designed to serve as a substitute for a human heart in the prolongation of life; neither is it available for the alleviation or cure of heart ailments. Various drugs for the treatment of heart trouble are now used practically by physicians and specialists. Artificial hearts for experimentation and research are not new; they have been used by experimenters during the last 35 years in the study of blood vessels, veins, arteries, and their reactions. *—Taylor-Rochester.*

New Smallpox Vaccine

ON the heels of news of recent smallpox outbreaks in New York and Tennessee comes an announcement to scientists of a new smallpox vaccine which eliminates the severe scars and other inconvenient features of ordinary vaccination.

The new vaccine was developed by Drs. Thomas M. Rivers and R. D. Baird and S. M. Ward of the Hospital of the Rockefeller Institute for Medical Research in New York. It is made by growing vaccine virus on a special medium consisting of minced chick embryo tissue and Tyrode's solution. Vaccinations against smallpox ordinarily are made with calf lymph vaccine virus.

Vaccination with the new vaccine virus should be followed, within six months to one



year, by re-vaccination with calf lymph virus, the Rockefeller scientists advise in their report to the *Journal of Experimental Medicine*. "In this way," they state, "vaccinated individuals will not become sick and will not be subjected to the dangers associated with primary vaccination with calf lymph virus, but will obtain a solid and lasting immunity to smallpox."

No scar forms after the primary vaccination with the new vaccine virus, it is reported, if the inoculation is properly made. Nor is there any fever or discomfort. Following re-vaccination later with calf lymph virus, very few of the children had fever or other symptoms, and what scars occurred were only "small superficial" ones.—*Science Service.*

ANTI-CORROSION

AN aqueous solution of alcohol is one of the commonest anti-freeze solutions for automobiles. The addition of less than 1 percent by weight of nitrate salts, according to a recent patent, will prevent corrosion of aluminum parts of cooling systems.

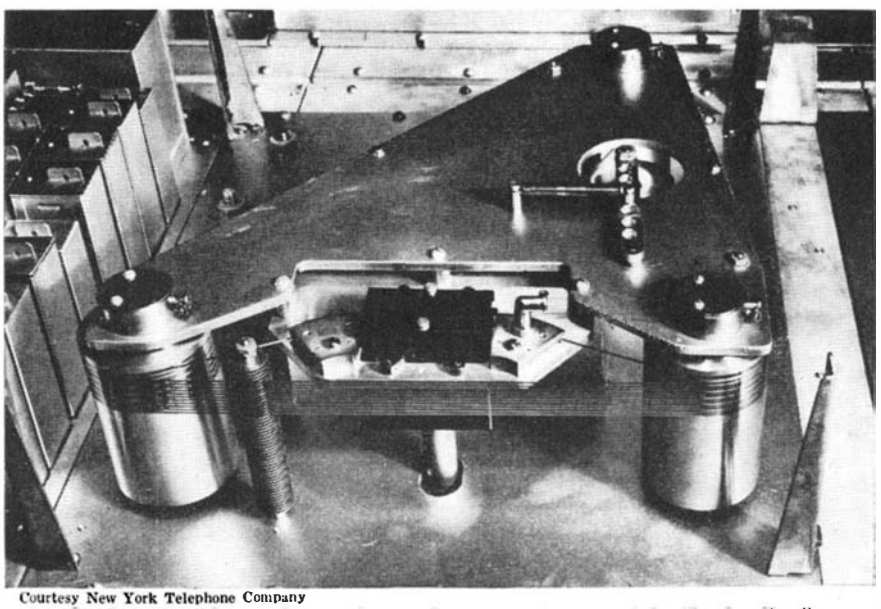
IT "TALKS BACK" TO YOU

THE machine shown in one of our illustrations can both "listen" and "talk back." And it's a perfect mimic too. In fact that's its job. It "mirrors" what is said to it —sends it back as accurately as a mirror reflects your image.

Looking like little more than an endless belt of narrow steel tapes wound upon small drums, this device is a voice-recording and reproducing machine that has many uses. One of the first of its kind was introduced several years ago as the "voice mirror," and thousands of visitors to "open houses" conducted by the telephone company in New York State and elsewhere used it to "hear themselves." One spoke a message into a telephone transmitter, and then heard the exact words and tones spoken back to him through the receiver.

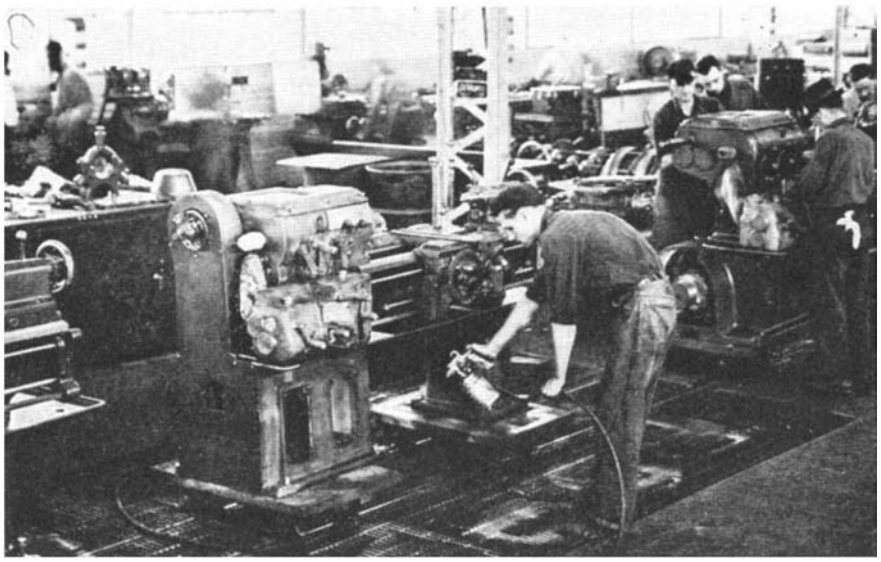
Applied to everyday use, such devices provide the "voice" for the telephone company's weather forecast bureau in New York City, and in New Jersey are used to give farmers and produce dealers crop reports by telephone.

In recording the voice, a moving belt of steel tape passes across the poles of an electro-magnet at a rate of about a foot a second while speech currents produce a varying magnetism on the tape. The machine will repeat the message indefinitely. The recording can be "erased" by the flick of a key, and the machine is then ready to take a new message.



Courtesy New York Telephone Company

Steel tapes and recording and reproducing mechanism of the "back-talker"



Spray painting over a floor grating; no booth is necessary

SPRAY PAINTING WITHOUT BOOTHS

UNIQUE facilities for spray painting which eliminate painting booths, remove the fire hazard, and make it practically impossible for operators to inhale the spray, have just been installed in the lathe manufacturing plant of the Monarch Machine Tool Company.

Lathes are now being painted on the assembly floor within a few feet of other operations with no walls or partitions of any kind to screen off the sprayers. Painting is done over a seven- by twelve-foot grating in the floor through which air is exhausted at the rate of 200 feet per minute. The fume-laden air is discharged into a large welded tank located directly below the grating where a continuous cascade of chemically-treated water effectively segregates the solids in the paint fumes. This precipitates a sponge-rubber-like substance which can easily and conveniently be cleaned from the pit. The air is then carried off through an underground tunnel to an outside exhaust stack.

Since the solids precipitated in the water are non-inflammable, the fire hazard created by the highly combustible pyroxylin which collects around the conventional spray booth, on the floor and in the exhaust system, is eliminated.

With the air suction down instead of up, and since the painter never has to hold the spray gun above his head, which would put him between the spray gun and the exhaust, the operator is never in a position where he can inhale the fumes. The draft is strong enough to pull effectively into the exhaust any spray not immediately deposited on the metal being painted.

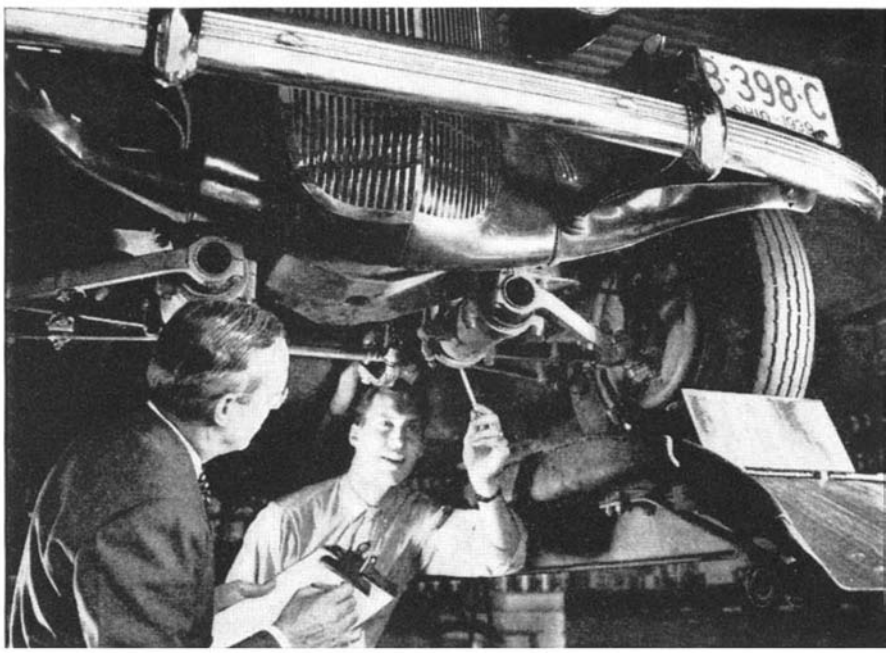
FOR POLISHED PARTS

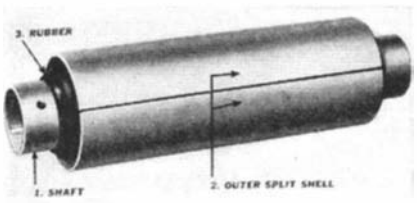
APPLIED by brush or spray gun, No-Rust Liquid V-15, recently introduced by Frost Paint & Oil Corporation, dries quickly to form a tough, non-porous film which resists abrasion, the elements, and salt water, and is recommended as protection for polished steel parts in storage or shipment. It is readily removed by wiping with kerosene or gasoline.—*Streamlining.*

VITAMIN ALPHABET GOING OUT OF STYLE

THE vitamin alphabet, that is, designation of the various vitamins by letter, is going out of style. For example, if you want to be really up-to-date, you must learn to say ascorbic acid instead of vitamin C when you are referring to the substance in orange juice (or other citrus fruits, tomatoes, and other vegetables) which prevents and cures scurvy.

This may be discouraging, especially if you pride yourself on having really learned the vitamin alphabet, or most of it. But the scientists who have most to say about vita-





Above: Rubber springs in the front-end of a motor car. *Below:* One of the springs, showing how rubber is placed between a shaft and a shell and stressed in torsion

mins—the nutritionists and biochemists—are trying their best to get the vitamins out of the alphabet. They make the point that the letters did very well for names in the early days of vitamin discoveries when only a few were known and not much was known about them. Now, however, since there are about as many vitamins as letters of the alphabet, with half-a-dozen going under the name of B, it is confusing and even leads to inaccuracy to call these essential food factors by letter.

Some of the vitamins have been identified chemically and even made synthetically. They have regular names, just as other chemicals have. Vitamin C is ascorbic acid. Thiamin is the beriberi preventing and curing substance that once went under the name of vitamin B or B_1. Nicotinic acid, the stuff that is curing pellagra, is the chemical that was variously called vitamin B_2, vitamin G and the P-P or pellagra preventing factor. Riboflavin is another diet-essential that was once labelled vitamin B or vitamin G. Recent discoveries have shown that it is necessary for the health of both man and other animals.

The anti-sterility vitamin, formerly called E, is now known as alpha tocopherol. Vitamins A and D may keep their letter names for some time, because there is not so much confusion about them as about the B vitamins. Until the chemical composition of other vitamins is discovered, however, scientists favor calling them by descriptive names, not by letters.—*Science Service.*

New Auto Spring Relies on Rubber

DEVELOPMENT of a new type of automobile spring which uses three pounds of rubber and seven pounds of steel in place of the usual all-steel construction was announced recently by the B. F. Goodrich Company. The new spring requires no lubrication and reduces rattles and squeaks, reports *Science Service.*

Rubber springs have been invented and patented many times, but none has ever come into general use. The new spring gets around the difficulties of most of its predecessors through the fact that the rubber is under compression and twisting or torsion pressure instead of being under stretch or tension. When under tension, cracks develop in the surface of rubber and it soon deteriorates.

The rubber surrounds a central steel shaft and is in turn surrounded by a pair of hemispherical steel shells. By making the rubber layer a little larger in diameter than the inside diameter of the steel shells before they are fastened together, the rubber is put under pressure. High pressures are applied during the curing process to bond the rubber and metal firmly. The spring is stressed in torsion by anchoring either shell or shaft to chassis and rotating the other member.

The entire arrangement takes advantage of one of rubber's most marked and most desirable characteristics, its ability to absorb and damp vibration. This has not previously been done in the springs in widest use in automobiles.

New Plywood Finishes

TO extend the usefulness of plywood further in modern building construction, I. F. Laucks, Inc., has presented two important new paints that offer not only decoration but fire resistance as well to plywood construction.

These two new paints are known by their trade-names, Rezitex for certified exterior plywood, and Plasterez for interior plywood walls. They have as their binder a special combination of synthetic resins, which assures perfect adhesion to the plywood, and a surface that is durable and non-brittle. Both paints are heavy bodied and will cover up small cracks and joints in the plywood surface.

These products were originally developed for application on plywood, but since have proved themselves suitable for application on all types of surfaces—plaster, wood, metal, and wallboard. Rezitex and Plasterez both simulate plaster, stucco, or concrete finish.

Hoover Dam

IN newspapers recently there has been considerable comment regarding the question of the name of the dam recently completed in the Black Canyon of the Colorado River. Officially named "Hoover Dam" some years ago, its designation was changed to "Boulder Dam" about the year 1933. It now appears that this change was never officially made, for in an exchange of official correspondence recently, the United States Attorney General indicated that the name "Hoover Dam" had been legally fixed and that it was not feasible to change it. Since new maps will carry the original designation, Scientific American will henceforth refer to this project as Hoover Dam.

Bacteria and Mine Fires

A MINE fire is sometimes extinguished by blocking off and sealing the area. To determine whether or not the fire is out, tests for carbon monoxide are made of the sealed atmosphere.

Recent studies by the U. S. Bureau of Mines have shown that, under favorable conditions, unidentified bacteria or micro-organisms which inhabit waters and sludges of anthracite mines react with carbon monoxide and produce carbon dioxide. These studies show that failure to find CO in a sealed area does not prove the absence of fire as bacteria may consume the gas as fast as it is produced by the fire.

Progress Note—Traffic Changes, 1904 to 1937

BRITISH automobile traffic appears to be moving backwards.

A survey of traffic speeds by Great Britain's minister of health reveals that in 1904, the average speed of a horse-drawn bus traveling from Swiss Cottage to Oxford Circus, in the heart of London, a distance of about four miles, was not quite nine miles an hour. In 1937, several tests indicated an average speed for the same journey by motorbus of about eight and a half miles an hour.

In 1904, the average speed on a trip from Highbury to Piccadilly, about five miles, was a little more than eight miles an hour. Today, the speed is somewhat under eight miles an hour.—*Science Service.*

London Plane Trees

LONDON plane trees, among the few species that can stand the smoky air and other unfavorable conditions of city life, are now menaced by a killing epidemic disease, the U. S. Department of Agriculture recently reported. Seven thousand of the trees are dead in the Philadelphia region, and 700 in Baltimore. The disease has also appeared in Washington.

The infestation is a slow killer. In the

first year, cankers appear in the bark of the trunk and large limbs and dark streaks in the young wood. In the second year the leaves thin out. The tree may die then, or linger one or more years longer.

The London plane is a cross between the American and European plane trees or sycamores. It is widely used as a shade tree along streets and in downtown parks because of its hardiness under city conditions. Its disappearance would denude many American city streets and leave city foresters and park commissioners at a loss to find an equally good substitute.

R. Kent Beattie, Department of Agriculture plant pathologist, is seeking information regarding the distribution of sick London plane trees. It is requested that chips of young wood from planes or sycamores suspected of having the disease be sent to the Division of Forest Pathology, U. S. Department of Agriculture.—*Science Service.*

Waterproof Fabric

ZELAN is a recently announced water-repellent finish for fabrics. Developed by duPont, it is claimed that the new finish is the first which will still shed water after the merchandise has been washed or dry cleaned many times.

Other water-repellent finishes coat fibers like wax on a thread, and some of the waterproofing chemicals cover the entire cloth and close the pores of the material, making the garment hot and uncomfortable to wear.

Instead of coating the fibers, it is said that Zelan goes into each individual fiber. It becomes part of the material itself without closing or clogging the pores; thus the cloth can "breathe" and the garments are much more comfortable to wear.

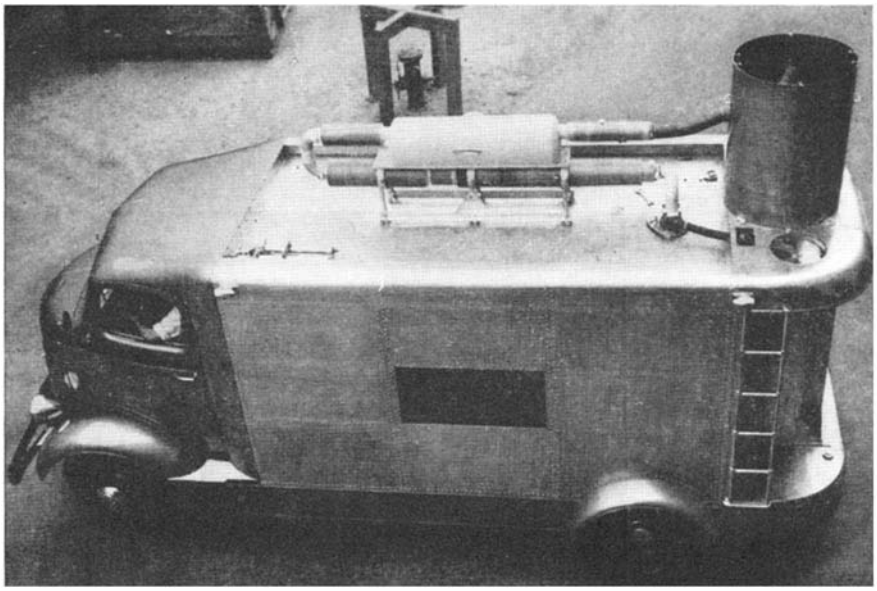
An Unforeseen Result of Air Conditioning

WHEN an air-conditioning unit was installed in one of Boston's large jewelry stores the primary consideration was the comfort of customers and clerks. It was soon evident that there was a more practical benefit from the installation. The humidity control and the removal of sulfur from the air by the air-washer eliminated a source of silver tarnish, and it was found that silver articles on display had to be polished much less frequently.

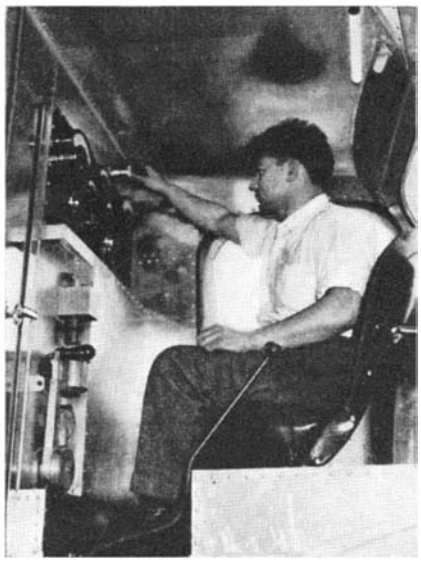
The Culture of Organs

AT the instant of a human being's legal death, and for hours and sometimes even days thereafter, major sections of the body are still alive. Consciousness and many brain cells may be dead, yet at the same time the heart tissues as well as many another tissue may often be found living, merely in a low state of activity. Deft technique frequently can induce an apparently lifeless heart to throb. These facts have long been established, but little has been made of them until recently.

Now new methods yield important discoveries. The hearts of dead patients can be revived and kept beating for hours, within the body or cut out. In such revival, blood or a bloodlike synthetic fluid is supplied to the heart and its vessels through a double set of tubes. From one reservoir, fluid at high pressure is forced through tubes piercing the



Above: **The soundproof truck, with muffler and oil radiator on the roof.** *Below:* **The truck driver's seat can be reversed so that the operator faces the convenient controls of the Diesel-powered generator**



aorta and passing directly into the heart's private circulatory system, the coronary vessels. From a second reservoir which develops a lower pressure, fluid is made to flow less forcefully through another tube, that goes past the valves of the aorta and into the ventricle. By this method, hearts can be perfused and kept in rhythmic contraction for as long as four hours. These are human hearts—which had stopped all action at death. Hearts of experimental animals can be kept alive much longer.

The Carrel-Lindbergh techniques indicate the advent of methods which should give indefinite life to organs in glassware. They should neither age nor die, says Carrel of organs in such culture of the future. Today organs in culture may show no great change after weeks. And there is steady advance in the preparation of choice nutrient fluid or in the pump which forces the fluid under precise pressures into the blood vessels of the organ outside the body. Carrel has devised new bases for the whole research; Lindbergh a more practical pump.—*From "Lo!" by Barclay Moon Newman.*

Wall Paper Removal

A PRODUCT developed for use by paper hangers and decorators, Aerosol KA, decreases the tendency of water to form droplets by lowering the surface tension. Thus, when one ounce of the powder is added to one gallon of water, the solution will wet old wall paper almost instantly and permit its removal more readily.

Soundproof Portable Diesel Generating Plant

EYEBROWS went up early this spring when Paul Grosso drove his latest creation, an ultra-modern soundproof, portable, Diesel electric generating plant onto the Selznick International Studio lot in Hollywood. Grosso's striking looking "brain child" was built from a re-vamped cab-over-engine truck chassis entirely of Dural and at a cost of $24,000. Entirely portable, the new soundproof generating plant makes it possible to get within 200 feet of a movie set on location without disturbing the sensitive sound microphones. An ordinary generating set must be at least 1000 feet away. With a need for less than one fourth the cable, transmission line losses of the high amperage direct current are greatly reduced. Grosso says he can work as close to a set as 100 feet with a building or some sort of a deflector between the generator and the microphones.

Grosso has found a way of balancing the speed of his Diesel with the amperage loads, something electrical engineers have been trying to do for years. Any variation in the engine's speed, large or small, does not affect the voltage output which has been predetermined and set by the master control knob. This is of tremendous importance to the movie industry, especially now that Technicolor is gaining in popularity. It is well known that color movies demand a great deal more light than black and white movies. Any variation in the line voltages tends to change the intensity of the artificial light which, in turn, causes the hue of the photographed color to change. As the light decreases, many colors fail to register and all tend more toward the blues.

Total thickness of the walls enclosing the plant is three inches, made in three separate "layers," with a one-inch, sound deadening, air space between each. On solid metal where sound-proofing was desired, a mixture of cork and rubber was built up with a spray gun to the proper thickness. The floor is made up of ¾-inch five-ply wood, one inch of the cork and rubber compound, and another layer of the wood. All free edges are sealed and the top is covered with linoleum.

Windows are made of a sheet of transparent, synthetic glass on the outside, and two sheets of plate glass with one-inch air spaces between on the inside. The outside of the truck body is solid Dural riveted and bolted.

Sulfanilamide Treatment of Ear Ailment

THE new drug, sulfanilamide, has extended its sphere of usefulness to cover otitis media, that extremely painful disease of the middle ear that often is the forerunner of a mastoid operation.

Eighty-eight patients with otitis media due to beta hemolytic streptococcus were given sulfanilamide in a recent series of cases and only seven required a mastoid operation, reports Dr. Gilbert E. Fisher of Baltimore in the *Journal of the American Medical Association.*

In a control group of 95 patients who were given the regular treatment of puncturing the membrane for drainage and irrigation, 66 required a mastoid operation.

Moreover, the patients treated with sulfanilamide recovered in one third the time taken by the other group.—*Science Service.*

Dry Ice Aids Welding Operation

IN the construction of a 40-foot welded steel boat hull, an unusual expedient was used to prevent the high temperature from buckling the steel plates. Four cakes of dry ice were used, two inside and two outside the hull. The cakes were placed as close as possible to the weld while the plates were being joined, and it is reported that the resulting flat surfaces are fully satisfactory.

Coloring Concrete Floors

LACK of permanence and lack of resistance to moisture and alkali are two bogeys that make difficult the coloring of concrete floors after they are laid. When a paint-type coloring is used there is superimposed a relatively soft oil film on top of hard concrete, and this does not withstand hard traffic. Also, the alkali in the concrete, in combination with moisture reacting with the acid of the vegetable oils, causes saponification, or breaking down of the paint film. Rubber resins overcome this handicap to some extent. Other methods of coloring floors have been confined to the addition of a mineral color to the top.

A new system, called the Truscon Flor-Dye System, developed by the Truscon Laboratories, may be used on old and well-matured floors. The only limiting condition is that the floors must be dry at the time of application. This is called a "system" because it consists of two materials: (1) Flor-Dye, a penetrant which stains, seals the pores, and helps bind the particles at the

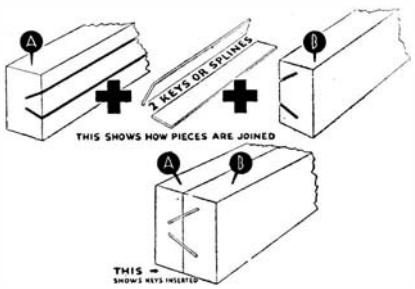
surface; and (2) Flor-Dye Dressing, which protects the Flor-Dye and affords a polish or sheen to the surface. In some cases, Flor-Dye may penetrate a mere 1/32 of an inch and in others it may penetrate as much as 1/2 inch. Because it does penetrate the concrete, the concrete still takes the wear.

Both materials come in four standard colors—tile red, Spanish green, light brown, and maroon—and both materials should be used as a complete system on any floor coloring job. The system is not affected by moisture or alkali in the concrete. It is acid-proof, oil-proof, non-staining, but not gasoline-proof. It cannot be applied over paint, varnish, or lacquer. Such materials must first be completely removed.

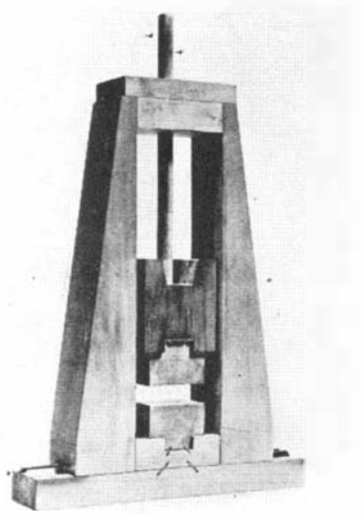
Simple Joint Lock

WHEREVER any two solid materials are joined, a new device will find application and in many cases will do a better job of joining. This new device is the Homer Spline Lock, which those who have investigated it believe will find many uses in industry. It supplants expensive tongue and groove connections, dowels, nails or screws, dovetails, rabbetting, and lapping in woodworking. Eventually it may supplant also nuts, bolts, and cap screws for connecting parts of even the heaviest metal machinery.

The basic simplicity of the Homer Spline Lock may be seen in the small diagram which accompanies this item. The splines (or keys) are inserted in the matched grooves of blocks A and B in an angular relationship to each other. The result is that



Above: **Two blocks are firmly joined together by means of a simple pair of keys or splines inserted in the positions shown in the lower part of the drawing.** ***Below:*** **How the spline lock system may be applied to a drop forge or pile driver**



the two blocks are bonded firmly in the desired face-to-face position. Depending upon the kind of wood used, this method yields three to ten times more strength in the joint than is obtained by ordinary means. By decreasing the width of the grooves or by increasing the thickness of the metal, wood, or plastic splines, it is obvious that friction and tension are increased in direct ratio, even to the point where the two pieces A and B become immovable in relation to each other.

It may readily be seen that splines of this type, but made of steel, could be used, for example, to fasten the cylinder head of an automobile engine or the parts of a heavy pile driver. Already they are being adopted in the manufacture of window sashes, doors, and inlaid floors. In this latter use the splines lock the pieces of flooring rigidly and thus eliminate the movement and squeak so often encountered. Furniture of all kinds may be given greater rigidity with Homer Spline Locks than with any amount of bracing with screws.

Apes Not Stupid—Just Human

MRS. APE can learn by aping Mr. Ape but he can't learn from her so well—not because of sex difference but apparently because it is hard for a dominant animal to take lessons from a submissive one. This observation of ape ways, of possible implication in education of their human relatives, was reported to the Southern Society for Philosophy and Psychology by Dr. James H. Elder, of the Yale Laboratories of Primate Biology at Orange Park, Florida.

Despite popular notions, it is quite a trick for an ape to crack open a stubborn coconut. He can roll it around and fumble with it for a long time without getting anywhere. Only once did Dr. Elder find a chimpanzee that could crack the nut by his own efforts; that seemed to be a happy accident.

It takes a firm hold and a sharp pound against the concrete floor to crack a coconut. After Dr. Elder had allowed his chimpanzees to struggle alone until they gave up the problem, he showed them how. Two apes learned in just one demonstration. They could then show other apes how, and they can learn just as quickly from each other.

But in two cases where the ape "instructor" was demonstrating for a dominating animal, the pupils could not learn even after as many as 16 demonstrations. These two poor learners were not stupid, either; one, in particular, was very intelligent.—*Science Service.*

"Z" Nickel

COMPARABLE with oil-tempered steel in strength, stiffness, and hardness; tensile strength from 2¼ to 4 times that of structural steel; resistance to wear equivalent to that of hardened steel—such are the claims made by the International Nickel Company for their recently announced "Z" nickel wire and strip.

Being 98 percent pure nickel, the metal is rustproof and highly resistant to corrosion and oxidation. It is suited for parts which must have a high order of mechanical properties, together with corrosion resistant and rustproof properties. It is useful for springs,

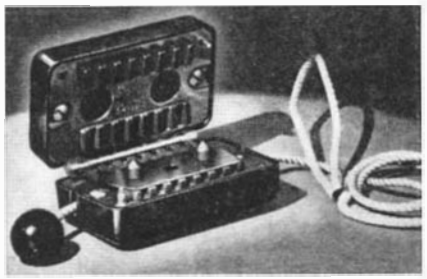
spring washers, diaphragms, wire brushes, leader wire, fish hooks, camera parts, airplane strut wire, portable aerials for cars and boats, and other parts of electrical and mechanical equipment.

Because of higher strength and stiffness, "Z" nickel is useful for improving performance, reducing weight of parts, or both.

Ingenious Razor Blade Sharpener

A NEW blade sharpener, with rotary honing action, hones and strops both sides of both edges of any Gillette type blade in one operation. It is a precision instrument, engineered to improve a blade edge and keep it in smooth shaving condition.

Refer to the illustration. The tooth shaped hones are inclined inwardly so that the grinding surfaces of the inter-engaging grind-



Just slide the case

ing teeth together form a grinding angle corresponding to the cutting angle of the razor blade.

With a blade in position on the pins and the case closed, the blade rests with equal spring pressure from all four inclined grinding surfaces for simultaneous operation on the four sides of the cutting edge. Then, sliding the case up and down the string, the eccentric pins cause the blade to force apart alternately the two sets of hones, producing a reciprocatory movement of the blade on the hone surfaces. Result: a smooth edge for every shave. New blades are improved by honing off the tiny metallic "fuzz" often left on them.

The case of the Blade Master is smart and compact, being of durable Bakelite. The hones are made of a mild abrasive material with a binder, built to last indefinitely. The metal parts are cadmium plated and rustproof.

Trichinella Spiralis

THERE seems to be a widespread misunderstanding regarding the life cycle of the trichina parasite, *Trichinella spiralis*. This false impression was reflected in our recent article "Animals Bring Us Diseases," in which the author wrote that those parasites ingested by the eater of pork products are the only ones to be found in the human body. The editor who handled that story unfortunately let the statement stand. We are glad, therefore, that we can give below an authoritative statement regarding the life cycle of this parasite, from the U. S. Public Health Service:

"Following the ingestion of uncooked or undercooked meat containing viable trichina larvae, the larvae are freed from the cysts by the action of the gastric juice. They then migrate from the stomach to the small intestine of the host where they develop rapidly

to maturity. The sexes mate within the course of a few days and the adult females begin to produce living young on or about the fifth day after infection. These young larvae very promptly enter the general circulation of the host and are carried by the blood stream to all, or nearly all, of the voluntary muscles of the body. Larval production by the adult female worms continues to take place for a period of approximately six weeks following the beginning of parturition."

Oil-Proof Industrial Tire

WITH the rapid development and wider uses of mechanized material handling equipment, there has been a marked increase in the use of rubber tires on trucks and trailers used in intra-plant hauling, according to Wilson C. Bray, manager of The B. F. Goodrich Company truck and bus tire department.

"A new industrial tire, specially compounded to resist the action of animal, vegetable, and mineral oils, to be known as 'Oil-Pruf,' is now introduced," reports Mr. Bray.

"Tires of ordinary construction, when subjected to oils, disintegrate and become soft and spongy. Under such conditions, they are susceptible to rapid tread wear, cutting, and chipping. Tests carried on for several years in steel mills and by meat packing companies prove that these new tires retain their original physical properties approximately 30 percent better than others tested when used in the presence of oils and other solutions usually classed as rubber solvents.

"The 'Oil-Pruf' tire should be a boon to companies operating industrial equipment over floors saturated with oils and greases. Tests actually prove that the added service to be expected more than offsets the small additional charge necessary to cover the high cost of special materials which give the tire unusual properties," the rubber company sales official said.

Seedless Watermelons

SEEDLESS watermelons have been produced by treating the unpollinated flowers with naphthalene acetic acid. The melons were all seedless but varied in shape. Some, however, were normal in shape and size. The texture of these fruits was firm and solid. No difference in flavor could be detected from normally pollinated fruits. The work on these fruits is being done by Cheong-yin Wong at Michigan State College.

Plastics Fuse "Woven Wood"

PANELS made with permanently finished wood veneer, fabricated by treating skilfully woven strips with plastics, are now available to furniture designers, interior decorators, architects, and others interested in a finishing material which combines durability with beauty. The Parkwood Corporation, in conjunction with engineers of General Electric's Plastics Department, made the new panel material available.

The veneer is coated and impregnated with G-E Textolite resin varnishes and a remarkable toughness is the result. After cutting

the veneer into strips of the desired width, close, accurate weaving is possible. But further treatment is necessary to fuse the woven sheets into satin-surfaced, durable panels that can be cut and worked within practical application.

In order to produce such panels, the woven sheets of impregnated wood veneer are cut to the desired sizes and are bonded to Textolite laminated material under heat and pressure. The desired tough, resilient, and smooth surfaces are the result.

The finished panels, in thicknesses of 3/64 or 0.020 inch, have a variety of applications. Mounted on ordinary plywood or other solid

Table top of woven wood

backing, Parkwood Textolite constitutes a fine new finish for such objects as desks, card tables, cabinets, bars, walls, and ceilings. Unaffected by moisture, alcohol, fingernail polish, and most common acids, the material is also resistant to cigarette burns. In the 0.020-inch thickness, it is surprisingly flexible and can be stitched, stapled, and cut with ordinary shears, like a piece of leather. In either thickness it can be formed, cut, and applied by ordinary woodworking methods.

A panel of Parkwood Textolite, after the final treatment, has a surface almost as smooth as glass and a pattern that looks like a fine, highly polished mosaic. Numerous effects are available through the combination, in weaving, of various light and dark woods. Panels are ordinarily made with light or dark red mahogany; avodire, a golden-shaded wood imported from the Ivory Coast of Africa; birch, either red or white; New England maple; and walnut.

Bacteria In Water Mains

IT has been found that bacteria multiply in hemp. For this reason a rubber compound made in tubular or wedge-shaped sections is replacing jute and hemp as caulking materials for water mains. Tests have shown that sterilization of hemp and jute can be accomplished, but bacterial multiplication starts again as soon as the germicidal action ceases.

New Lightweight Insulation

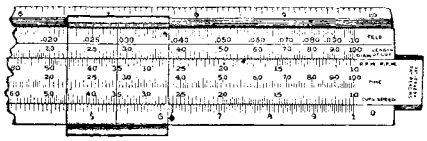
A NEW product named Celotex Superlite Insulation, which should be of special interest to the refrigeration field, has just been announced. It weighs less than 7½ pounds per cubic foot but high insulation and sound absorption values are claimed for it. It is of board form, but is a soft, nonstructural insulation. It may be fabricated, cut, or bent to moderate curvatures to fit

any space desired in constructing refrigeration apparatus. The light weight of the product will enable designers to reduce total weight of all types of refrigeration equipment where rigid insulation had previously been used.

Industrial Slide Rule

THE Langsner Industrial Slide Rule, manufactured by the Eugene Dietzgen Company, is designed to solve an unusual range of industrial problems, yet in a simple way, with only one movement or setting of the slide in the majority of cases.

The Langsner Rule was developed to the practical requirements of mechanical engineers, industrial engineers, shop men, time study experts, and machine designers. It is simple to read even for the person who is not a slide-rule expert. It is 10 inches long,



engine-divided on white celluloid, with glass "frameless" indicator, and is packed in a case with book of instructions.

The Langsner combines many rules in one although there is only one slide. The face has six scales: Two of them above the slide represent feed, length of cut, and diameter; three of them on the slide represent revolutions per minute, time, and cutting speed; the regular D scale is below the slide. The reverse side of the slide contains the usual B, CI and C scales, for standard slide-rule calculations. Three of the face scales are numbered in red, the remaining three in black, for convenience in use. The table on the back presents familiar constants.

With the new slide rule, solutions to many problems are obtained at a glance, such as surface speeds, cutting speeds, diameters of cutters, drills, and so on; required revolutions per minute of any work; feed ratios; length of cut; time required; time-study data; and other factors.

Nickel from Chloride Solution

TO replace the conventional sulfate electrolyte used in nickel plating, a process has been developed employing a nickel-chloride-boric acid solution. The new chloride bath is said to produce a deposit which is finer grained, smoother, harder, stronger, and somewhat less ductile than ordinary nickel-plating deposits.

In addition to the above advantages, a 50 percent reduction in tank voltage and power consumption is permissible; control of the bath is easier; and high anode and cathode efficiencies are attained. The plating is more readily buffed, has less susceptibility to pitting, and has less tendency to form nodular growths and trees on thick deposits.

Streamlined Turkeys

THE aim of certain turkey-breeding work is to develop a small turkey to fit the modern small oven and suitable for the modern small family, according to Berley Winton, in charge of the Department of Agriculture's poultry-husbandry investigations. There is a

growing demand for small market turkeys, he says. The smaller turkeys out of the annual crops of the standard varieties sell at a premium of ½ to five cents a pound.

It will take probably another five years before the desired characteristics are "fixed" in the new small-type turkey, Winton points out. For that reason, the Department will distribute no breeding stock, hatching eggs, or poults until the geneticists are satisfied that the small-type turkey is "genetically pure" for small size and other desirable qualities, and able to reproduce itself, true to type, in the future.

The Department geneticists want to establish in the new turkey the small size of the white Austrian variety imported from Scotland and of strains of wild turkeys from Virginia, Pennsylvania, Michigan, and Arizona. They hope the new turkey will also inherit the meaty breast of the wild turkey.

To reinforce the inheritance for white color, the geneticists are using the white Holland in the breeding program to produce the small-type turkey. They are also counting on the white Holland—and two other domestic varieties, the bronze and the black—to contribute early maturity and other desirable characteristics.

If the Department men succeed, the small-type turkey will be white, with a compact body, short legs, a long keel bone, and plenty of breast meat. It would mature in 24 to 26 weeks, the young hens weighing 6½ to 9 pounds dressed, and the young toms between 11 and 15½ pounds dressed.

Other goals for the new turkey are that hens kept for breeding purposes be able to produce a reasonably large number of eggs by June 1. Ninety percent or more of the eggs would be fertile and 80 percent or more of the fertile eggs would hatch.

Insulation of Glass Flux and Mica Dust

In the German electrical industry, a new insulation material, now in use, is composed of a combination of glass flux and mica dust. It has the advantage of being extraordinarily firm, maintaining a high heat content and a minimum of dielectric current loss. This material is important in high-frequency technique and in the manufacture of electric switches.

Cosmetic to Protect Working Hands

A NUMBER of skin protective creams—sometimes called liquid gloves—have been on the market for years. These have been used to protect the hands of workingmen against the action of various kinds of chemicals, paints, and solvents.

A new compound for this purpose, called "Shelltex," is made of such pure ingredients that the manufacturers claim that it is even safe to eat. In using this, the workman first washes his hands thoroughly and dries them, after which he applies a liberal quantity of Shelltex and rubs it in until the sticky feeling disappears. This one application shields the skin from dirt, gasoline, paints, inks, lacquer and lacquer thinners, and most solvents. The flexible film on the hands does not interfere with work and is easily removed by washing with warm water and soap.

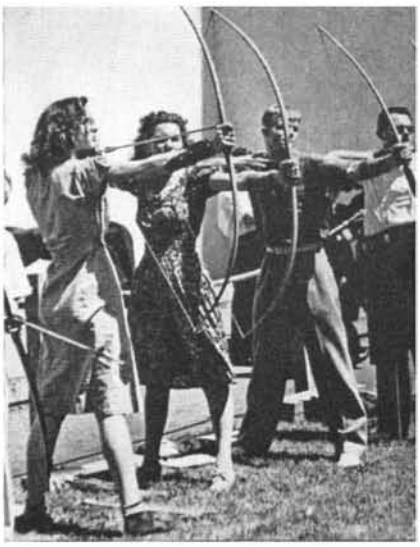
Conducted by JACOB DESCHIN, A. R. P. S.

Photogenic New York World's Fair

THEY just couldn't restrict the amateur. The New York World's Fair was too full of good picture material to say to photographic visitors: "Thus far may you go and no farther." As a result, the amateur cameraman at the World's Fair may shoot anywhere, at any time, any subject he takes a fancy to. Not even the indoor girlie shows are banned, as they are in town. Some of the barkers even go so far as to make a point of this largess of freedom: "Come in with your cameras and shoot all the pictures you want!"

But the best stuff is outdoors, and that is all to the good because there is nothing to beat sunlight for general shooting. There is one hazard in this connection, however, and that is the fact of dependence on the vagaries of the weather. Clouds are needed to help fill in blank areas and lend a beauty and grace to shots of the Fair buildings. In lieu of clouds, for these seem always to be absent on just the day you happen to visit the Fair, a contrast filter such as the orange will go a long way by providing a dark tone to the blank sky, thus avoiding the white-paper effect that is the bane of pictures which include the sky in the view. Such a filter was used in making the shot of the principal illustration for this article. The crescent shadow of the Trylon cast across the 'Sphere invited photographic attention but it was not until the viewpoint shown was reached that an interesting composition presented itself. Clouds seemed imperative, but the orange filter supplied a good substitute; in fact, a substitute that was very appropriate to the scene.

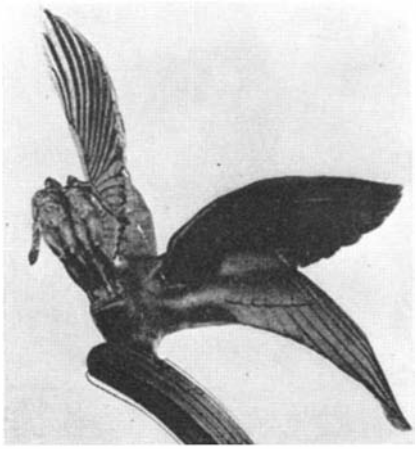
The Theme Center, consisting of the Perisphere and Trylon, may be seen from most sections of the Fair grounds in majestic



"Archery at the Fair"

"Pageant of Stone"

reign over all the activities within the vast area. Doubtless the majority of pictures taken of the Fair either include the Theme Center within the view or make it the sole subject of the picture. One might easily make up a whole series of shots tying up some feature of the Fair with a view, near or remote, of the Theme Center. Small stops will often be necessary, as in the case of "The Theme Center Pervades All," but small stops are easy at the Fair, where the presence of so many light-toned buildings under a vast sky makes small stops or very short exposures a necessity, particularly if you



"Flight"

use the new fast films in order to take care of indoor situations and the possibilities to come at night.

Frequently one runs across isolated bits of sculpture such as that of the winged subject illustrated here. This was taken against the sun, with the latter positioned directly behind the base support of the subject.

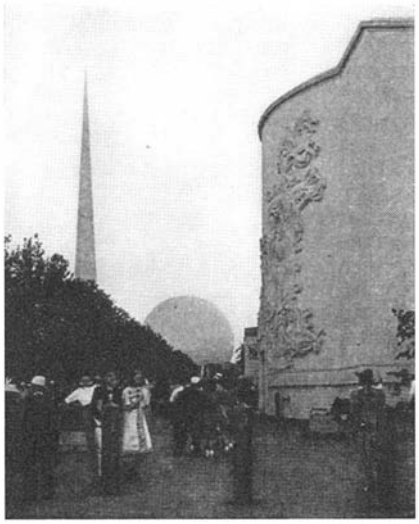
"Archery at the Fair" is an example of the sort of picture that will require several shots in order to make a later selection of the most interesting arrangement. In this particular case, the three most attractive figures in the line-up were chosen as the main point of focus.

Night shooting at the Fair is easily accomplished with the fast films and fast lenses. Most shots will be in black and white, but you will be missing the "opportunity of a lifetime" if you do not attempt some color. Exposures are relatively long but the buildings may be had at 1/10 of a second with stop *f*/2.8, while other subjects, such as the color displays in the fountains, will call for exposures at this stop ranging from 1/5 or ½ to 1/25. Chest or similar camera supports are in order. For many cameramen the World's Fair is most attractive at night chiefly because of the color lighting.

Needless to say, a good film supply is the best insurance against running short just when you're getting into the swing of the thing. If you plan to carry an extra camera for color, plus accessories, one of the popular combination "catch-all" zipper bags will be found handy.

Uses for Blue and U.V. Filters

ALTHOUGH little publicized as compared with the yellow, red, and green filters, the U.V. and blue filters are found useful in several different ways. The U.V., for example, is employed to cut out haze when it



"The Theme Center Pervades All"

is not possible to employ other filters for the purpose because of the longer exposure required. For example, if the lens is stopped down considerably and the meter says to give 1/25 of a second, it would not be possible to use a filter unless a tripod were available, for the yellow or red filter would call for a longer exposure than could safely be given with the camera held in the hand. The U.V. filter comes in handy in such cases because it does not require any increase in exposure.

The blue filter finds its greatest usefulness in indoor photography. When subjects having a fair skin are photographed by artificial light on panchromatic film, the results do not always show pleasing flesh tones. We have found that the use of the blue filter placed over the lens greatly improves the results. Another use for the blue filter is in the projection of two by two-inch color slides. With some processes we occasionally find that the projected image is much too warm in tone. Slipping a blue filter over the lens has resulted in improvement of the color values.

How Cartoon Movies Are Made

THE inside story of cartoon movie making is depicted in a Universal 16mm film, "Cartoonland Mysteries," by Lowell Thomas, now available on rental from the Bell & Howell Filmosound Library. Told in complete detail is the story of the making of an Oswald Rabbit cartoon, entitled "Softball Game."

Two film stories are spliced and mounted in the desired sequence, the "how" story first and the complete cartoon second, or the reverse.

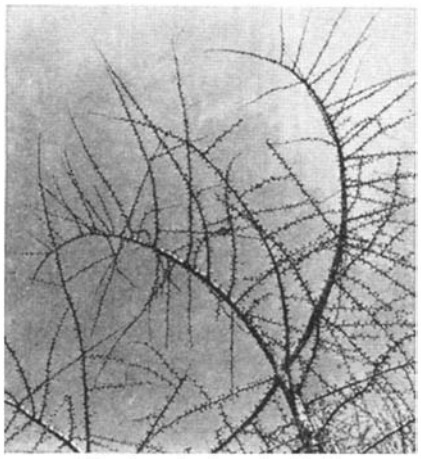
The Camera in the Hospital

PERMANENTLY attached to the light unit above the operating table at Brooklyn's Peck Memorial Hospital is a Robot camera equipped with the Robot Electric Remote Control Release. The camera is kept loaded and ready for instant action, permitting photography during all stages of an operation. The operating surgeons are thus provided with facilities for photographing unusual occurrences or taking educational pictures showing various phases of their work, taken while it is being done.

In use, the camera is pre-focused, thereby obviating disturbance during an operation, and exposures are made by a nurse stationed at a distance from the operating table. Upon order from the surgeon she presses an electric push-button which trips the camera release; the camera shutter thereupon automatically sets itself for the next exposure. The camera is coupled to the operating room light and follows the center of illumination to any part of the table.

Design Against the Sky

THE extreme usefulness of the reflex camera under particular circumstances was demonstrated the other day when, strolling in the park, we gazed upward and saw outlined against the sky the beautifully curving branches reproduced here. The peculiar formation was directly overhead, and, with the reflex camera we happened to be carrying, it was a simple matter merely to hold the camera so that the lens was pointing directly upward, while we observed and composed the subject at eye-level position without straining the neck.



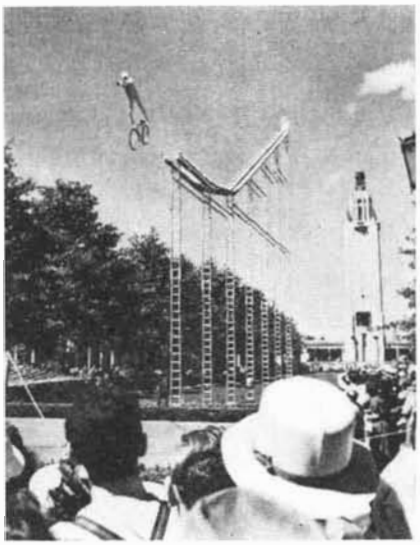
"Design Against the Sky"

Shooting After a Damp Night

AMATEURS sometimes complain of unsharpness appearing in one picture while the very next exposure seems to be perfectly satisfactory. This may be due to any one of a number of causes but one of the reasons not ordinarily realized is that when a loaded camera has been exposed to a night of dampness or rain, the film is inclined to warp a little, causing unevenness of surface. The remedy is to waste one shot and thus get rid of the first film frame, going on to the next for the actual exposure. Or make your shot with the first frame and then follow it with another just to see what the results are.

The Diving Cyclist

AT a stated hour, announced long in advance, certain "acts of daring" and so forth are performed in the amusement parks. The picture of the diving cyclist was made at Rye Beach's Playland. A position was assumed that would include some of the spectators, and a small enough stop was used —$f/11$ being found sufficient—to show in satisfactory sharpness both the rapidly moving subject and the spectators near the



"The Diving Cyclist"

camera. The reflex miniature camera used was held high above the head with ground glass upside down and the shutter snapped as the bicycle left the runway. Since it was desired to get a somewhat off-sharp image in order to retain the effect of movement, a shutter speed of only 1/100 of a second was used.

The Morning Stroll

JUST after the hose had been played over the sidewalk, about 7 o'clock of a June morning, the sun, reaching over the city buildings, swept the stones with its smile. A viewpoint was adopted by the photographer

"The Morning Stroll"

which would bring the light in his direction. This afforded a better tonal effect and the shadows of subjects passing to and fro came in the diagonal direction desired. A man and a dog out for a stroll was an agreeable subject, and the picture you see is the result.

Ray-Del Photo Contest

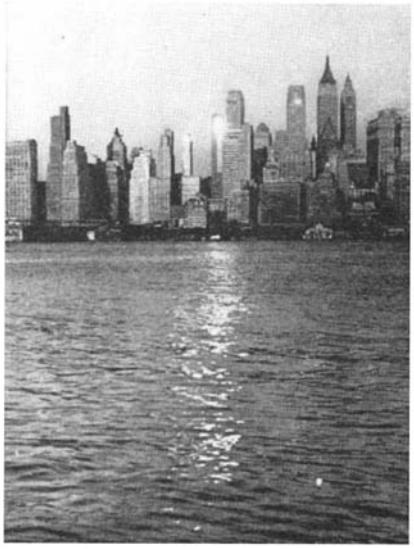
A PHOTOGRAPHIC contest open to all photographers and not restricted to any make of camera or type of film used, is announced by the manufacturers of Ray-Del Negative Developer. Because of the self-balancing characteristic of the developer featured by the manufacturers in their advertising, the sponsors require that all photographs

submitted must depict the theme of balance in some way. For example, a photograph of a boy balancing himself on a narrow fence, a newborn baby being weighed in a scale, or the balance of a sailboat turning gracefully in the wind. Cash prizes will be awarded.

The sponsors say: "The balance idea offers many suggestions to the photographer. During the summer season, the traveling circus and the county fairs offer many opportunities for getting pictures illustrating balance. The acrobats, jugglers, and bareback riders all lend themselves to pictures eligible for entry in the contest." Closing date for the contest is November 1, 1939.

By Proxy for the Sun

A STRONG reflector of light will behave in practically the same manner as the light source itself. For example, we are all familiar with the path of light cast by the sun across a body of water. In the picture reproduced here, taken from a ferryboat as



Light reflected from windows of one of the tall buildings in the background was strong enough to produce this "sun path" effect

it approached downtown New York City late one afternoon, the windows of the tall buildings all reflect the sunlight, but in one or two places, this effect was particularly strong. In those places the result was a glare, and the long "beam" cast upon the water is very similar to that which the sun itself would have cast from the same position.

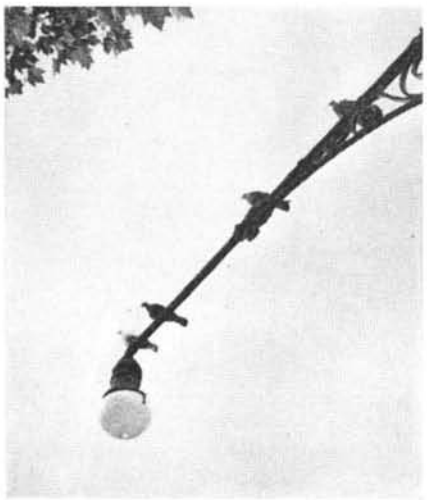
Proof of the Pudding

WHEN it's your "yes" against the other man's "no," let the picture decide the issue. At least that is the way one determined chap looked at it. Recently, a camera owner who had found that the foot scale on his outfit did not check with the ground glass, came with his complaint to the camera importer. There the repair man told him that he had checked the camera and found it to be O.K. The customer had his doubts. He set up his camera on a tripod and used for subjects a number of books set on end, the jacket cover side facing the camera. The books were carefully spaced, with a ruler, six inches apart, and the distance from each volume to the camera also similarly measured. A photograph of the set-up showed that whereas the scale read five feet, the book

at this distance was out of focus, although the book at six feet was in perfectly sharp focus. When he brought in this "evidence" he did not have to say a word. The picture told the story.

Pigeons at Rest

IN the city pigeons are everywhere, most appropriately in the public parks. With the squirrels and the ducks, they are continually being fed, and often photographed. Frequently they may be seen lined up in a row, as in the illustration. An angle shot,



"Pigeons at Rest"

with the lamp offering an agreeable accent, and the few leaves in the upper left corner "filling in" for balance, brought the subject into a reasonable composition. Too, the pigeons are nicely spaced so that the interest is spread across the entire length of the diagonally placed lamp-post extension.

Handy Record Book

REFERENCES to formulas, methods, and other photographic data are made easily accessible with the Redi-Record, a visible card-index system available in pocket size. The individual cards measure 2½ by 3 inches, a quarter-inch edge of each being left uncovered for the index. The card, while rather small, affords enough room for a formula or process, as well as flash exposure data, and so on. The book may be carried about in the pocket and whenever one runs across a new formula or other information that may prove useful later either in shooting pictures or darkroom work, the record can be made immediately. At work such a notebook can sometimes prove invaluable.

Better Get Started!

CONTEST closing dates have a way of creeping up on one in a manner that gives rise to the old expression: "Where has the time gone to?" In the case of the Fourth Annual Scientific American Photographic Contest, the closing date was purposely placed far enough in advance to enable everyone to make adequate preparations for submitting their pet prints. But therein lies a possible source of difficulty. With the closing date set at December 1, 1939, there is always the chance that some amateurs are going to think that there is so much time for preparations that they will put things off until the last minute and hence fail to reap the in-

tended benefit of the preparatory period permitted. Therefore this warning:

Now, right now, is the time when you should be looking for subjects that will be eligible under the rules of the contest, published in full in our May 1939 issue. With no dead-line pressing, you can select and reject at leisure, improving your technique as you go along, every improvement increasing your chances of winning one of the major prizes. Then, too, last minute dark-room rushes are not usually up to the desired standard. Take your time to turn out work of which you will be proud. But, above all, don't fail to enter the contest, and be sure that your prints are in the hands of the judges in time.

WHAT'S NEW

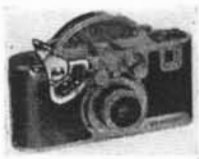
In Photographic Equipment

If you are interested in any of the items described below, and cannot find them in our advertising columns or at your photographic dealer, we shall be glad to tell you where you can get them. Please accompany your request by a stamped envelope.

F-R Exposure Meter ($1): Extinction type photographic exposure meter. May be set for any film and for any light condition. Useful for both still and movie cameras, readings showing both regular still aperture numbers and shutter speeds plus movie frames per second. May also be used to determine exposure with various filters, without calculation or guess.

Univex Cine Telephoto Lens *f*/3.5, 1 inch ($10.95): In micrometer focusing mount. For use on Univex Cine cameras. Gives two-times magnification, making it suitable for sports, portraiture, and so on.

Mercury Rapid Winder ($2.50): Accessory for Mercury camera, converting it into unit for rapid sequence shots. Permits shutter to be set and film transported without removing camera from eye, making possible a dozen shots in few seconds. Winder is attached by unscrewing shutting winding knob, replacing it with special geared knob and screwing bracket into cable release socket on top of camera. Entire unit detachable in less than one minute.



Skinner Restitutional Enlarger: Features negative adjusting device enabling operator to tilt negative from horizontal plane, optical system always remaining in perfect alignment; double condensers; takes negatives from 2¼ by 3¼ inches down to 35mm.

New Standard 6 by 6cm Rolleiflex ($128.50): Taking lens is Zeiss Tessar *f*/3.5; finder lens, *f*/3.1. Compur shutter speeds to 1/500. Shutter speeds and diaphragm openings visible from above, through one window, adjustments being made with two levers, one on each side. Automatic film transport after locating No. 1 in red window.

Double exposure avoided because crank will not turn until shutter has been released and shutter cannot operate again after making an exposure until crank has been turned. Shutter fully enclosed. Camera provided with folding mirror (concealed in finder hood), permitting eye-level focusing and composing. Camera includes leather carrying case. Camera introduced to fill gap between Model II Rolleicord and Automatic Rolleiflex.

ELECTRICAMERA ($8.75): Is a complete box camera with an electrically operated shutter synchronized with an Abbey Flashgun.

Because of the basically new principle involved in synchronization it is practically impossible to miss the peak of the flashbulb. Any flashbulb may be used, regardless of timing characteristics, because the electrical shutter automatically catches the peak. Electricamera allows for side lighting, remote control, and other features associated with more expensive equipment.

VICTOR ADD-A-UNIT ANIMATOPHONE: 16mm motion picture and sound apparatus permitting adding additional units as desired. Starting with small basic sound projector, complete in itself, outfit of any size can be secured by adding auxiliary units. Basic projector provides silent or sound motion picture, microphone facilities, and phonograph record amplification for average size room. Adding amplifier and another larger size speaker furnishes ample sound motion picture or public address facilities for large auditorium. Broadcasts, recordings, and announcements may be relayed to as many rooms as desired when Central Radio P. A. Sound System unit is added.

ZEISS TENAX I ($60): Makes 50 pictures one by one inch on 35mm Contax daylight loading spools. Features a lever that winds both film and shutter. Exposures possible at rate of one per second for sequence picture-making. Equipped with Novar *f*/3.5, 3.5cm focal length lens. Example of depth of field afforded by this lens: when focused at 8 feet and stopped down to *f*/16, depth of field extends from four feet to infinity. Compur shutter from 1 second to 1/300, and bulb. Fitted with large eye-level optical view finder. Rewind device provided for other than Contax spools. Exposures automatically counted. Lock prevents double exposures. Dimensions 1¾ by 2½ by 4½ inches; weight 12 ounces.

MELLOWBEAM LIGHT DIFFUSERS ($1.75 to $6): Features new "light-carrying" material Lucite. Can be supplied for all models of Victor Lighting Units. Use of Lucite in combination with Fibreglas held to be of particular value when used in color photography. Tests show Mellowbeam Diffusers will not change color of light source. Claim is made that these diffusers provide good light distribution properly diffused, retaining its original characteristics under prolonged use without disintegrating or discoloring from heat or age. Exposure time recommended is twice that of undiffused light.

X-ACTO AUTOMATIC MAT CUTTER (three sizes, $6.50, $10.50, $15): Precision instrument for bevelling, cutting, scoring, embossing, trimming. In cutting picture mats, pre-marking is eliminated. Device features "Mechanical Wrist," made of solid bronze and slotted at angles of 55 or 90 degrees. All metal construction.

AGFA MINIPAN: New film for documentary recording. High resolving power. Speed, contrast, color sensitivity, anti-halation in proper balance. Capable of resolving up to 135 lines per mm. (3400 lines per inch), varying with precision of recording equipment used. Available in following units: 100 and 200 foot rolls, 35mm unperforated, darkroom loading; 100 and 200 foot rolls, 35mm with single perforation, darkroom loading: for Photorecord Camera—100 foot rolls, 35mm perforated or unperforated, daylight loading, with leader and trailer.

SOLAR COPYING STAND ($24.50): For use in copy work, table-topping, macrophotography, and so on. Provides platform for mounting subject in perfect focal plane with camera. Camera support affords universal adjustment of camera position, both vertically and horizontally. Camera supporting arm fully counterbalanced. Movement up or down the post controlled by oversize wheel knobs operating friction clamps to lock all units in any desired position. Vertical adjustment to 36 inches from baseboard.

KINGSLEY SQUEEGEE PLATE CLEANER (6-oz. bottle, 30c): For all ferrotype plates—chrome or japanned.

WILLO FAVORITE EASEL ($9.75): All-metal combination easel and paper cabinet. Easel forms cover of light-tight cabinet. Margins controlled by drawing out lever. White surface facilitates focusing and image arrangement on easel. Enlargements up to 11 by 14 inches directly on easel. Cabinet permits storage of paper up to 14 by 17 inches. Ribbed rubber padding on bottom of cabinet insures against accidental skidding during enlarging.

DE JUR-AMSCO PRECISION SUPERIMPOSITION IMAGE RANGE FINDER ($5.50): American made, incorporating large, sharp-focusing method. Extending viewing eyepiece for rapid centering and reading of image. Focusing of lens finder by micrometer ball-bearing adjuster revolving in bronze bearing. Uniform dial markings. Moving parts of steel. May be fitted to any camera. Internal construction allows for large light area. Complete with sling and leather carrying case.

CAMERA ANGLES ROUND TABLE

JACOB DESCHIN, *conductor of our "Camera Angles" department, will answer in these columns questions of general interest to amateur photographers. If an answer is desired by mail, enclose a stamped, addressed envelope. Queries should be specific, but Mr. Deschin cannot undertake to draw comparisons between manufactured products nor to advise on the purchase of equipment or materials.*—The Editor.

Q. **We are obtaining equipment to take pictures in color of pathological specimens such as livers, hearts, lungs, and so on, of poultry for the purpose of projecting same on screen. All work will be done by Photoflood illumination because of the constancy of the light source. Reflected light from the object will be measured by an exposure meter at 12 inches. Questions: 1. Should the object be illuminated by one Photoflood lamp directly over the center or two lamps so placed as to illuminate from the sides? Since the specimens are moist, there will be streaks or spots of intense light on them. How can these be eliminated? 2. What general or specific rules would you suggest in respect to the color and type of background, and what kind of material would be suggested for the background? 3. The writer has been advised that the smallest opening or higher "*f*" value gives the greatest detail in the picture. Is this the general rule and may the smallest opening be used? What difference would there be in the resulting picture between an object strongly illuminated at short exposure or moderately illuminated at a correspondingly longer exposure? 4. What "tricks of the trade" are recommended for obtaining third dimensional effects? 5. On the table of film speeds we have, two values are given, one for sunlight and one for tungsten. In which classification would Photoflood and Photoflash fall? 6. Is Photoflood illumination satisfactory for Kodachrome film in bringing out good color copy?—S. A. R.**

A. First, we must question your use of the word "constancy" in describing Photoflood light. The intensity varies with use, growing weaker from one time to the next. The measuring distance will depend on the size of the area being photographed. Generally speaking, the measuring distance should be roughly equal to the width of the subject; that is, if the subject measures six by eight inches, hold the meter about six inches from the subject, being careful, of course, not to block the light with your hand or the meter. 1. Even illumination from the sides is, in general, preferable to the use of a single light source. The use of diffusers over the light sources should do the trick of cutting down the effect of strong light on moist specimens. 2. Use a background of medium gray or somewhat lighter tone. The purpose of a background is to afford an area of contrasting tone to that of the subject being photographed so that the latter will stand out clearly. The material used is of no consequence. It may be cardboard or felt cloth; the latter is most widely used by photographers. 3. The greatest sharpness of a lens is generally about two stops smaller than full aperture, but greater depth of field and more details in sharp focus are obtained by stopping down the lens considerably, even to the smallest opening. For subjects such as yours and particularly since you are photographing in color, where sharp detail is important, the smallest opening is to be advised. Strong illumination as compared with moderate illumination is not entirely a matter of exposure; better tonal quality and diffusion of light into the shadows will be had with moderate lighting—and usually the reverse with strong lighting. 4. The best "trick of the trade" we can think of is to use a stereo camera. Short of that, we might suggest "playing" around with the lights, making one a little weaker, or moving it farther away, than the other. 5. Photoflood lighting comes under the tungsten heading. Photoflash cannot be measured, exposure being governed chiefly by a table of distances available from your dealer or the manufacturer of the flash lamps you are using. 6. Photoflood lighting is the most widely used type employed in color photography.

Q. **Does an automatic film transport permit a camera to take sequence shots? If not, what does determine if a camera will take sequence shots? After all the film is exposed, isn't it best to develop it right away? A friend says it does not matter if it is developed a month or more later. Who is correct? What other kinds of range finders are there besides the split image type?—J. N. B.**

A. It is not merely the automatic film transport that permits a camera to take the rapid sequence type of pictures you evidently have in mind, but the fact that shutter wind and film transport can be accomplished with unusual rapidity. Sequence pictures can

be made with any camera having the convenience of automatic film transport combined with shutter wind, the number of shots within a given period depending on the type of shutter wind and the ability of the photographer to work the controls rapidly. Special sequence cameras are available on the market giving pictures one inch square and 50 to the roll. Strictly speaking, these are the only true so-called sequence cameras, with the exception of two miniature cameras which have as an accessory a rapid film winder.

It will do no harm to delay development of a roll of film for a reasonable time, say a month or so.

The coincidence type of range finder, in which two overlapping images appear, sharp focus being achieved when the two are superimposed or coincide, is the other principal type.

***Q.* Can you give me a rough idea of how many four by five-inch prints can be developed in 16 ounces of metol-hydrochinon developer before it has to be discarded?—C. W. G.**

A. Under favorable conditions—that is, unhampered by such hazards as accidental transfer of hypo by the finger tips, and so forth—about 75 prints of the size you mention can be developed without change in developing time or print quality, using 16 ounces of M-Q developer.

***Q.* Enclosed is a negative showing the reflection of a lighted electric sign projected onto the sky in a night view of a city landscape. Can you tell me the cause of this reflection and how it can be remedied in the final print?—L. J. K.**

A. The reflection you refer to is exactly the same as that obtained when shooting directly into a light source. Internal reflection between the lens surfaces is the cause. However, because of the light tone of the reflection, it will be an easy matter to spot it out if printed on non-glossy paper.

***Q.* I am going to purchase a folding type camera with *f*/4.5 lens that takes pictures 2¼ by 3¼. May I have your opinion on the quality of the lens and shutter equipment of the cameras I am listing? How do the three lenses and shutters compare?—C. V.**

A. Since we are not in a position to set one camera up against another, it is not possible to give a recommendation. However, it should not be too difficult to choose between the three cameras you mention. For example, you may like the idea of having a top speed of 1/250 of a second as against 1/175 on one of the other cameras. As for the lenses, you should be able to make good pictures with any one of them. All other things being equal, the deciding factor will be an individual one: how do the cameras appeal to you from the point of view of convenience and pleasure in handling?

***Q.* My . . . camera stops and speeds do not correspond with those on my . . . exposure metter. Can you advise me how to use this meter scale with my camera?—C. G.**

A. It is generally more advisable in photography to give the longer exposure rather than the shorter one. We would suggest, therefore, that since the meter does not indicate a speed of 1/75 of a second, you either use your 1/50 speed and ignore the 1/75 or adjust your diaphragm indicator between stops, should you want to use the latter speed. Similarly for the 1/200 speed, which does not appear on the meter scale. As for the stops, the scale stop *f*/2.8 can be used for both *f*/2.5 and *f*/3 on your camera; the scale stop *f*/4 for *f*/3.5 and *f*/4.5, and the scale stop *f*/5.6 for *f*/5.5 or *f*/6.3. Also, for scale stops *f*/8, *f*/11, and *f*/16, use the following stops on your camera: *f*/9, *f*/12.5 and *f*/18, respectively.

***Q.* In order to obtain dark sky effects I wish to buy either an orange or a red filter. Will you please advise me which is the better one to buy?—L. K. M.**

A. Sometime ago the red filter was usually recommended for this purpose, but more recently the orange filter has taken its place in the popular favor. One of the reasons is that the orange filter has a lower exposure factor than the red; in fact, it is usually about half, the red requiring about eight times the normal exposure, the orange only four. Another reason is that the red filter shows a tendency to eliminate detail in the shadows.

***Q.* When I wish to cut off part of a 35mm roll in my camera in order to develop a strip of film before the entire roll has been finished, how many frames must I lose in reloading the unused portion?—D. A.**

A. We estimate that in reloading the unused portion of the roll of film after cutting, you will necessarily lose about three or four frames.

It does sometimes happen that a few prints are desired in a hurry. Many photographers, however, buy bulk film and load their own reels with lengths of film which will be economical and convenient for the subjects to be shot.

***Q.* Can you explain the meaning of the term "genre" when used in describing a type of picture?—A. F.**

A. This term refers to a picture that tells a story. For example, two children at play, a laborer at work, the portrait of a woman knitting or engaged in some kitchen chore, are typical genre pictures. In short, any picture that shows a person engaged in doing something is properly classified as of the genre type.

***Q.* I am enclosing some prints and films; the prints have dark spots caused by corresponding light spots in the films. I have my developing done by a local concern and these spots seem to occur at random on different rolls. Some have suggested the spots were caused by error in developing and some by dirt or dust on the lens.—B. V. C.**

A. An examination of the negatives shows that the light spots to which you refer are undoubtedly caused by incomplete development at those points. This may have been due to negatives sticking together at the particular point and preventing full development or development blocked locally by some other interference. The fact that the image is almost fully revealed at these points would indicate that the image was recorded but that partial development at the particular point in question prevented a density comparable with the rest of the negative.

TELESCOPTICS

A Monthly Department for the Amateur Telescope Maker

Conducted by ALBERT G. INGALLS

ENTIRE space in this month's department is given to an informative article on "Some Applications of the Schmidt Principle in Optical Design," by D. O. Hendrix and William H. Christie, of the Mount Wilson Observatory of the Carnegie Institution of Washington. The former is Assistant Optician in the Mount Wilson Observatory Optical Shop and Optician for the Foundation for Astrophysical Research. The latter is an astronomer on the Observatory Staff, specializing in stellar spectroscopy and computing. He also takes active interest in instrument design. The following is the article by Hendrix and Christie:

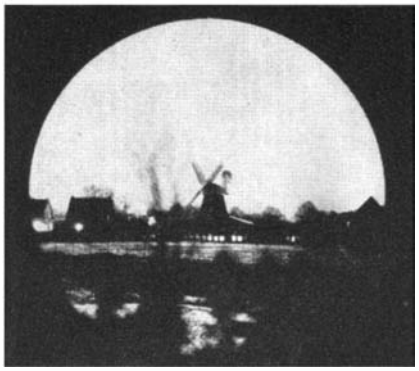


Figure 1: Bernhard Schmidt's first Schmidt camera photo, now historic

ONE of the most outstanding inventions in optics of modern times is to be credited to Bernhard Schmidt, late optician of the Hamburg Observatory in Bergedorf. The first Schmidt camera saw the light of day one sultry afternoon in the late summer of 1930. Using the camera as a telescope, Schmidt and a friend amused themselves that afternoon by reading the epitaphs on the tombstones of a nearby cemetery, and by looking at various buildings in the distance. Among other objects was a windmill about two kilometers away; in Figure 1 the reader will see the reproduction of a photograph of this windmill, made by Schmidt with the first Schmidt camera. This photograph was made on a *moonless* night with an exposure of two hours. On the original print one can actually count the twigs on some of the distant trees.

As in most great inventions, Schmidt's method of eliminating coma and aberrations from reflecting telescopes is simplicity itself and, as one looks back, it seems incredible that no one appears to have thought of this simple solution long ago.

Several articles have been written about the Schmidt camera since the inventor set forth its principles in 1931, but little that is new has been included in these discussions. Since there are many ramifications of the Schmidt principle it has seemed worth while to discuss this remarkable camera and its applications fairly completely, for it will be found that there are but few fields in optics where this invention cannot be applied to some advantage.

The outstanding defects in the images formed by lenses and mirrors are spherical aberration, coma, astigmatism, curvature of the field, distortion, and for lenses we have, in addition, chromatism. *Of these defects, only one is distributed uniformly over the whole field;* this defect is spherical aberration; all other defects are proportional to their distances from the axis.

Now *a spherical mirror has no axis* and, furthermore, a mirror is perfectly achromatic, so, could we but find a method of eliminating spherical aberration from the images produced by a spherical concave mirror, such a system should prove ideal.

Spherical aberration is caused by rays from various zones failing to come to the same focus; the more distant the zone is from the central ray the closer its focal plane is to the mirror. This defect, for spherical concave mirrors, is shown diagrammatically in Figure 2, at *A*. Suppose, now, we place a very small aperture in a screen at the center of curvature of a spherical concave mirror, as shown at *B*; this aperture will limit the size of the incident beam so that the center and outer zones will come practically to the same focus, for it can be shown that, for small apertures, and focal ratios less than $f/10$, the Rayleigh limit of $\lambda/4$ is not exceeded. If the incident beam be swung about the point *o*, all parts of the mirror will be illuminated in turn, and the focus will trace out the spherical curve, *ff*, which has its center at *o*. It will be seen that each point source of light toward which such an optical arrangement might be turned would form its image on the focal curve *ff*.

On increasing the size of the aperture the focus is no longer sharp; spherical aberration is now appreciable, but we can eliminate this defect by introducing equal and opposite aberrations into the incident beam, as shown in *C*. These opposite correcting spherical aberrations may be produced by a suitably shaped lens, or mirror, placed anywhere in the parallel beam *for one particular point source* of light, but when we are dealing with more than one source it becomes imperative to place the correcting plate in a position common to all rays; that is, with the optical center at the center of curvature of the mirror. For many purposes a large field is not required and it becomes more convenient to move the correcting plate away from this position and perhaps incorporate it with some other optical surface, such, for example, as the face of a prism or the collimator of a spectrograph. The corrections, of course, are not identical for all positions of the correcting plate.

On introducing the correcting plate into the incident beam of light we also introduce chromatic aberrations. For moderate apertures this defect is negligible, but when we attempt to make a camera with an aperture greater than its focal length we run into difficulties; how these may be partially surmounted will be discussed later. Of course it is possible to design an achromatic correcting plate by using two plates of different indices of refraction. It is also possible—and practical—to distribute the required corrections between several surfaces when it is desirable to avoid deep or steep curvatures.

The curvature of the field may be removed (approximately) by means of a simple plano-convex lens placed immediately in front of, or in contact with, the photographic plate, the plane side facing the emulsion. The radius of this lens is $f/3$ for glass with an index of refraction of 1.50. This is satisfactory for cameras having an f ratio of $f/5$ or less.

Applications of the Schmidt Principle: In the accompanying diagrams, Figure 3, we have portrayed some of the numerous adaptations which may be made of the Schmidt principle. Unfortunately, Schmidt left no account of the various ramifications of his camera of which he must have thought, and we do not know, in most cases, who originated the various arrangements we present; most of them have been devised here, but we do not claim priority. In a few cases, where the originator is known, we have appended his name to the diagram, although it is probable that others interested in fast cameras may have independently thought of them.

In the central column of the diagrams we have arranged illustrations of the fundamental types of Schmidt cameras and, to the right and left, some adaptations of these

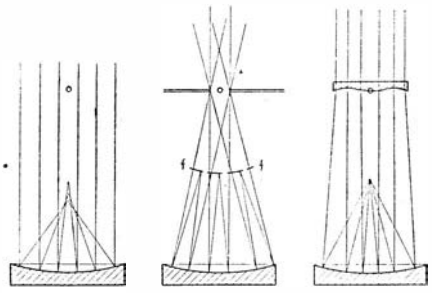


Figure 2: Spherical aberrations and Schmidt's remedy for them

types, most of which need no explanation. No. VI, which shows the diaphragm replaced by a correcting mirror, is shown, as are most of these diagrams, in an exaggerated form; in practice it is necessary to reduce the angle between the incident and reflected beams to a minimum in order to reduce the foreshortening effect. A perfect correcting mirror should be figured in an elliptical form but, since such a figure is very difficult to produce, we must be satisfied with an approximation in the form of a circular correcting mirror. If the aperture ratio of a camera using a correcting mirror is small, the foreshortening will be negligible, and here we have a perfectly achromatic arrangement which should be exceedingly useful in working at the extreme limits of the spectrum.

When a Schmidt camera is constructed with an aperture greater than its focal length, the curves in the correcting plate

become steep enough to introduce appreciable chromatic aberration. If, however, we use a thick mirror, R/2 in thickness, silvered on the back surface, as shown at IX, we increase the speed of a Schmidt camera by a factor of 2½ to 3 times, depending upon the kind of glass used, because, on passing from one medium to another, the energy-density of a cone of rays is changed by a factor equal to the square of the inverse ratio of the indices of refraction of the two media. To put this in other words: since the rays, after passing through the surface of the mirror, are refracted toward the normal, they appear, *as seen from the surface of the mirror*, to emanate from a point closer to the axis; hence the angle subtended by an object is reduced, and the image formed by the mirror is correspondingly diminished in size. The geometrical focal length, however, has been changed but little, and thus we can obtain the speed of an $f/0.66$ camera with a field and correction-plate curvature of an $f/1.0$ camera. This is shown clearly in Figure 4, where an ordinary Schmidt camera is compared with one of the thick mirror type.

In such a camera the correcting plate is placed at a distance of $R/2n$ from the front surface of the mirror, where R is the radius of the mirror and n the index of refraction of the glass. This position is the *apparent* center of curvature of the mirror as seen from the mirror surface. (In all cases where the focal curve lies at the surface of the glass the photographic emulsion should have a film of oil between it and the glass, in order to make optical contact. Coal-oil will be found quite suitable for this purpose.)

In XII, Figure 3, we have the extreme

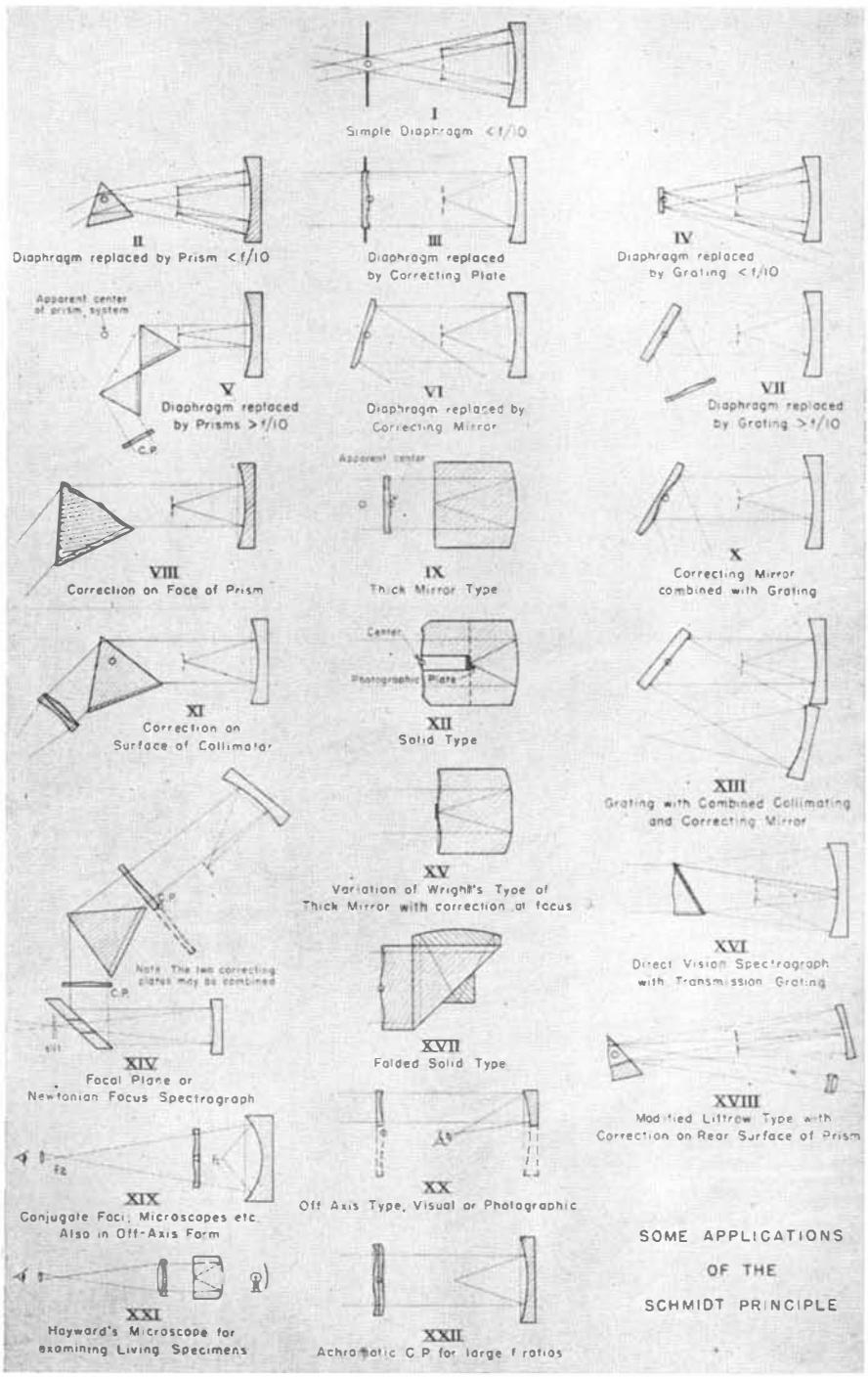


Figure 3: The Schmidt principle has many varied and interesting applications

form of solid type—one in which there is no medium other than glass between the correcting surface and the focus. This was first suggested to us by the late Sinclair Smith. We do not know of such a camera having been made and there are some practical optical difficulties to be surmounted in constructing a solid Schmidt; furthermore, the increased absorption of the thick glass becomes important, and, since it must be sufficiently homogeneous for its purpose, such large blocks are very expensive. The two parts, separated by the dotted line in the diagram, should be figured separately, but when cemented together they must be accurately co-axial. The photographic plate could be introduced into the focal curve through a hole in the half containing the

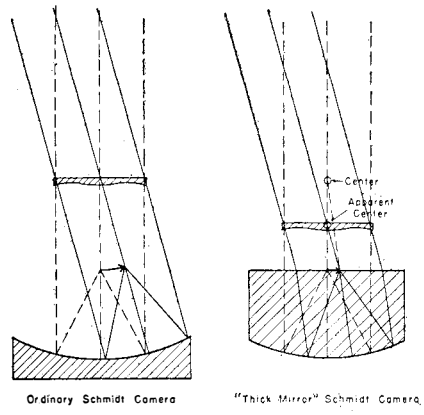


Figure 4: **Ordinary and thick mirror Schmidt cameras compared to scale. Index of refraction assumed to be 2**

correcting surface, either from the side or along the axis as shown.

The difficulties of the extreme thick mirror types may be overcome by a variation of Wright's ("Amateur Telescope Making—Advanced") system; that is, by placing the correcting surface at the focus as shown in XV; but here we are confronted with two non-spherical surfaces, extremely difficult to figure in conjunction with each other. An experimental camera of this type, with an aperture ratio of $f/1$, was constructed here, but it was not a success because the higher order aberrations rendered the images unsatisfactory. It is possible that a camera, geometrically $f/4$, or with an equivalent focal ratio of $f/3$, would be entirely satisfactory.

One of the neatest of all solid types is that shown in XVII—the folded solid Schmidt, designed by Hendrix. Here we have few practical optical difficulties, although there are four components. Of the seven plane surfaces only the hypotenuse of the large prism must be worked to a high degree of precision; the cemented surfaces are sufficiently accurate if worked to a wave, because the cement, which should have an index of refraction equal to that of the glass, fills in the irregularities between the surfaces. Small errors in the thickness of the components may be rectified when adjusting the small prism during the final assembly.

The "off-axis" type, illustrated in XX, is exceedingly useful in practice because, with this arrangement, the photographic plate or film may be placed outside the light beam. This system also is adaptable for visual observations. Making a single off-axis correcting plate of large dimensions is, unfortunately, somewhat wasteful of time and material, because it is necessary to figure a correcting plate of more than twice the required diameter. If more than one camera of the same focal length is required, the waste is reduced, because several off-axis plates can be cut from the original one. This type seems to be the only practical one for mass production.

In XIX the Schmidt principle is used in the form of a microscope. Such an arrangement might prove useful for low-power work where a large field is desired, such as in microphotometry; but perhaps the most ingenious arrangement is that of Hayward, XXI, in which he suggests a thick mirror with the focal curve ground out of the mirror face, and serving as a reservoir for small living organisms. An unsilvered portion of the spherical mirror serves to admit light for dark field illumination.

The Design and Construction of Correcting Plates: The deviation, Δ, of the surface of a correcting plate from a plane is given by the biquadratic parabola formula

$$\Delta=\frac{x^4-kr^2x^2}{4(n-1)R^3} \quad \ldots\ldots (1)$$

where x is the radius of the zone; k, a constant; r, the radius of the correcting plate; R, the radius of curvature of the spherical mirror; and n, the index of refraction of the glass.

Now, let $4(n-1)R^3=\frac{1}{K}$ then (1) becomes

$$\Delta=x^2(x^2-kr^2)K \quad \ldots\ldots (2)$$

which is in a convenient form for computation. Giving k various values from -1.0 to $+3.0$, we obtain the series of curves shown in Figure 5. When $k=0$ we have a lens with a sharply turned up edge and flat in the center. This form is one of the most

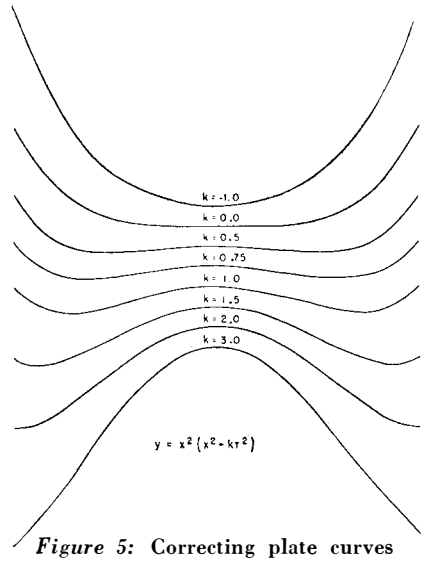


Figure 5: **Correcting plate curves**

difficult to figure, yet the writers have seen it recommended for amateurs! As k is increased the center rises and the edge is depressed until, when k is unity, edge and center are equally high, and the depressed zone lies 0.707 r from the center. In this form the amount of glass to be abraded from the lens surface is a minimum and it is this figure which we have found most satisfactory for general purposes; it is also the easiest to construct. When $k=1.5$ we have a correcting plate in which the effect of chromatic aberration is at a minimum. This is the type of correcting plate which we have used for our "thick-mirror Schmidt" cameras; several of which have been con-

structed here. When $k=2$ the neutral zone is at the edge of the plate and the figure becomes difficult to achieve in practice. In all plates the edge gives some trouble while figuring, because of the flexible nature of the tools used in this work, hence it is best to make the plates at least 1" larger than the required diameter; the troublesome edge can then be masked out when the camera is assembled. It is estimated that the cost of labor in making a correcting plate is reduced at least 50 percent by making a generous allowance for the edge.

Differentiating (2) and equating to zero, we have

$$x^2=\frac{kr^2}{2} \quad \ldots\ldots (3)$$

This gives the distance of the neutral zone from the center, and, by substituting this value for x, in (2), we obtain

$$\Delta=\frac{k^2r^4}{4}K \quad \ldots\ldots (4)$$

the depth of the curve at this zone. With these two dimensions, (3) and (4), at our disposal the correcting plate may be rapidly roughed out to shape, the depth of the zone being measured with a suitable micrometer.

The angular field, θ, of a Schmidt camera is given by the equation

$$\sin\frac{\theta}{2}=\frac{d'}{2f} \quad \ldots\ldots (5)$$

where d' is the diameter of the plate holder and f is the focal length of the mirror, and, in order to utilize all the light, the diameter, D, of the mirror must be

$$D=d+2d' \quad \ldots\ldots (6)$$

where d is the diameter of the correcting plate. For ordinary purposes d' should not greatly exceed

$$\frac{d}{3}$$

The correcting plate is made from plane-parallel glass plates free from striae. It is very important that the plates be plane-parallel, especially for telescopes used for stellar photography. If the plates are not plane-parallel, ghost images, caused by the internal reflections in the lens, will be formed to one side of the brighter stars. (It has been suggested to us that these ghost images might prove useful in stellar photometry.) When the plates are plane-parallel these spurious images fall on the image of the star causing them. For ordinary work a high-grade plate glass, such as Crystalex, may be used, but when high ultra-violet transmission is desired, glass such as Schott's U.B.K.5 or Vitaglass must be used. A satisfactory thickness for the correcting plate is of the order of 1/40 to 1/50 of its diameter.

The plates are best supported, during grinding and polishing, on a circular felt pad which should be shrunk before use; the pad should be a little smaller than the lens. For small lenses the glass is held in position by a metal ring slightly larger in diameter than the disk and projecting above the level of the turntable by an amount sufficient to hold it in place, but not high enough to interfere with the motions of the tool. During grinding and polishing the plate should be rotated frequently upon the felt base. In the case of large lenses the plate is best retained on the table by means of sets of vertical spring bronze "fingers" attached to the turntable; at least six such sets should be used.

It will be noted that a certain polishing action is going on, on the rear surface of the plate, during the polishing stage, due to

the motion of the plate upon its supporting pad which is difficult to keep free from rouge at this stage. The effect of this is eliminated, after the required figure has been approximated on the front surface, by making the final corrections on the back. During grinding no abrasive should reach the back surface of the correcting plate because of the protective gap between the felt and the edge of the lens. (This is the reason for cutting the felt disk smaller than the plate.)

The best form of tool we have found for grinding out the zones is constructed as follows. Three triants (120-degree sectors of circles) are cut from moderately stiff spring-bronze sheet in such a manner that the grain of the metal—that is, the direction in which the sheet was rolled—is the same in each. These sectors are then cut into radial "fingers," to the underside of the extremities of which are cemented the grinding facets. These facets are cut from unglazed ceramic tile, such as the small size used for bathroom floors. The sectors are then attached to a suitable hub and, if necessary, the fingers may be bent downward and outward, keeping the outer ends parallel to the surface of the plate.

Polishing is done with facets of moderately soft pitch attached to a sponge-rubber base about ¼″ thick, the rubber permitting the tool to conform to the zonal curvature of the correcting plate. Polishing tools with a sponge-rubber base will be found excellent for working on all optical surfaces where zonal curvature exists.

It will be realized, we think, that all but the smallest tools are of the ring form. For smoothing out irregularities in the curvature of the zones a small common tool, one quarter, or less, of the diameter of the plate may be used. This should be given a long elliptical stroke in the direction of the zone.

Schmidt's method of polishing correcting plates was to place them concentrically on the lip of a shallow circular metal pan, the edge of which was ground so that an air-tight seal could be made between the glass and the metal. The air was then pumped out of the pan, causing the center of the plate to be depressed; then, by the use of a spherical tool of the correct curvature, the zones were automatically polished to shape. This method is not to be recommended, however, except for mass production, when it becomes ***the*** *modus operandi.*

The figure of the plate may be examined during the grinding stage by dipping it into a solution of ethyl cinnimate and Xylol, mixed in a proportion of 4:1. This forms a smooth coating which has approximately the same index of refraction as the glass. After a little experience it is surprising how readily one can detect small irregularities in the curvature, or the displacement of a zone, by direct visual inspection of the form, using a good straightedge held in contact with the plate as a guide for the eye.

The Chinese mirror effect is sometimes useful in correcting local irregularities, and even in polishing and figuring plates with small curvature. The lens is here supported on suitably shaped pads of semi-cured rubber, such as that used for patching automobile inner tubes; the part of the lens thus supported is abraded more rapidly than the unsupported regions.

A number of methods have been worked out here for testing correcting plates, some of which will now be described. The figure of the correcting plate may be readily examined with a knife-edge if one has a telescope sufficiently large to take in the collimated beam from the assembled camera, as shown in Figure 6 at *A*. Using this method, a point source of light is placed at the focus of the camera, and the knife-edge at the focus of the telescope. The sensitivity of this test is proportional to the square of the ratio of the focal length of the telescope to that of the camera.

Where a large telescope is not available for testing we can make use of a small one, in conjunction with a pentaprism or an

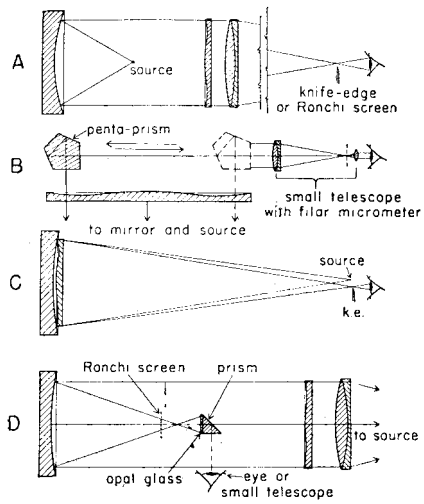


Figure 6: **Methods of testing correcting plates for Schmidt types**

optical square, as shown at *B*. Here we have a small telescope rigidly set up at right angles to the axis of the camera. The optical square, consisting of two plane mirrors mounted at an angle of 45 degrees, or a pentaprism, is set up in front of the telescope on a base which may be moved across the collimated beam of light. The image of the light source is focused on the intersection of a pair of cross-wires in the focal plane of the telescope. As the pentaprism is moved across the collimated beam the image should remain on the *vertical* wire; any *lateral* motion is due to the poor figure of the optical system; vertical motions may be due to irregularities in the motion of the pentaprism.

An excellent test for cameras having an aperture *f*/5, or less, is made by placing the correcting plate directly in contact with the mirror, as at *C*. The test is made on the axis of the lens, in a manner similar to that used for testing a parabolic mirror in the center of curvature; that is, by measuring the apparent radius of curvature of the various zones with a knife-edge at the focus. In this case the test is twice as sensitive as that for a parabolic mirror because the light passes twice through the lens. The formula now becomes $\Delta R = \frac{\gamma^2}{R}$; this, *when both knife-edge and light source move together.*

A Ronchi screen placed inside the focus of a Schmidt camera will form a series of fringes on a screen placed at a suitable distance from the focal point, as shown at *D*. By using an opal or ground-glass screen these fringes may be examined readily. Each fringe should be straight with parallel boundaries, but the presence of zones in the correcting plate distorts these fringes which are interpreted in the usual manner. The familiar Ronchi screen method of testing is excellent, also, for lenses with large aper-

ture ratios, or where the focus is too short for the eye to focus on the equivalent plane.

An illuminated, small, silvered glass bead serves as an excellent point source of light for testing purposes. The illuminating beam should be concentrated on the face of the bead facing the mirror or lens to be tested. Any stray light which passes the bead should be blocked off by a suitable diaphragm placed behind it—a totally reflecting prism is excellent.

To test a correcting plate made to work in the extreme regions of the spectrum (infra-red or ultra-violet) we can construct a testing mirror of radius R′ so that, in equation (1),

$$(n-1)R^3=(n'-1)R'^3$$

and thus make the tests in visual light which gives an index of refraction of n'.

There are, of course, numerous other methods of testing correcting plates, but those given here are sufficient, we think, for the average reader. It must be remembered that the plates, to begin with, must be plane-parallel, and they must be free from striae. In selecting plate glass for correcting plates, sheets should be first tested with a micrometer for uniformity of thickness, and then tested for striae by holding the sheet between a small bright source of light, such as an arc, and a white screen. Shadowlike streaks on the screen show the presence of these defects, and their positions can then be marked on the glass with a wax pencil. Unless a large plate is required an area large enough for the purpose usually can be selected from relatively cheap glass.—*Pasadena, California, March, 1939.*

THIS completes the article by Hendrix and Christie. In reply to a request, the latter states that Schmidt died about four years ago. His only article appeared in *Central-Zeitung für Optik und Mechanik, Bund 52, Heft 2,* and in *Mitteilungen Hamburg-Bergedorf, Bund 7, No. 36,* under the title of "Ein lichtstarkes komafries Spiegelsystem."

Because of his full occupation with important optical work now in progress at Pasadena, the senior author sincerely regrets that he will not at present find it possible to answer requests for further information.

Crystalex: Pittsburgh Plate Glass Co., 2222 Grant Bldg., Pittsburgh, Pa.

Schott's glass: Fish-Schurman Corp., 250 E. 43rd St., New York, N. Y.

Vitaglass: The Vitaglass Corp., 220 Fifth Ave., New York, N. Y.

The Schmidt camera gives great promise in astronomy, professional and amateur, and there is lots of work for the amateur to do with it. Heretofore a heavy discouragement in undertaking a Schmidt has been the interminable job of excavating the very deep curve of the primary—about ½″ deep on a 12½″ disk. It is hoped that plans under way as we go to press will make possible the purchase of pre-roughed-out 12½″ disks.

Last April this column stated that two off-axis mirrors had been made at the Mt. Wilson shops; we learn that two dozen is more nearly the correct number.

Stellafane convention, Sat., July 22.

Convention of amateur astronomers, including planetarium show and banquet, at Hayden Planetarium, New York, Aug. 19 and 20. Former day will also be Amateur Astronomers' Day at World's Fair; Professor Shapley will give a talk. A three-week exhibit of amateurs' work will be held at Hayden Planetarium July 30 to Aug. 20.

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.

ASTRONOMY

By William T. Skilling, San Diego State College and Robert S. Richardson, Mt. Wilson

MORE ideally than any of the general treatises on elementary astronomy heretofore available this new work seems suited to the isolated reader. Its senior author has long taught astronomy in the classroom and knows the corners where the beginner usually is perplexed—mainly in the parts having to do with the positions and motions of the heavenly bodies. He set out to make these things as easily comprehensible in a text as they are in a classroom discussion, and the result is success. The explanations are in simple, homespun words and phrases, and are illustrated with homely drawings that go to the heart of the chief difficulties. The whole of astronomy from the earth to the known limits of space is systematically covered to the reasonable depth to which the average layman cares to go. Contrary to a widespread misimpression, this book, like all other elementary textbooks of astronomy, does not contain more than 1 percent of mathematics—the mathematical parts of the science being reserved for special advanced books. (579 pages, 5½ by 8½ inches, 248 illustrations.)—$3.10 postpaid.—*A. G. I.*

BIRDS

By Gayle Pickwell

THIS volume might have been called "Birds at Home" for it contains 66 large black and white photographs of birds of many kinds, usually shown in their nests. The chapters carry such descriptive titles as: Why Know Birds; Homes of Birds; Bird Food and How Birds Get It; Bird Travels; Kinds of Birds; How to Know Birds; and others. There is one page of bird songs diagrammed, and another page of bird houses and other means of attracting birds. —(252 pages, 9½ by 11¾ inches.)—$3.60 postpaid.—*F. D. M.*

PRINT FINISHING

By William Mortensen

ADVANCED amateur photographers do not always consider a print to be a finished job when it emerges from the wash water. By the proper use of finishing methods, several of which are described in this book, the final product takes on an artistic appearance that may have been completely lacking in the original print. The author deals first with the preparation of the print, then with methods of control, and concludes with several chapters on presentation, which include trimming and cropping, mounting, framing, and so on. Under the heading of "Print Control" are discussed the use of powder tone, the carbon pencil, the spotting brush, abrasion-tone, and other secrets of the photographic technician. (128 pages, 7 by 10 inches, lavishly illustrated.)—$2.60 postpaid.—*A. P. P.*

PHYSICAL METEOROLOGY

By John C. Albright, Ph.D.

A TEXTBOOK containing essentially the same material as given in an elementary college course in meteorology, covering the atmosphere, its height and pressure; barometric observations; temperature and its measurement; principles of heat; insolation; water vapor in the air; atmospheric thermodynamics; wind directions and velocities; dynamics of air movement; atmospheric circulation; condensation of atmospheric moisture; precipitation; cyclonic storms; extra-tropical cyclones; atmospheric electricity, acoustics and optics. A well-rounded, dependable and scientific knowledge of weather basics would result from its reading. (392 pages, 6 by 9 inches, 246 illustrations.)—$5.45 postpaid.—*A. G. I.*

ANIMALS WITHOUT BACKBONES

By Ralph Buchsbaum

SIMPLY and non-technically, and with an unusual wealth of striking and revealing illustrations, this elementary college textbook presents the science of 95 percent of the whole animal kingdom. That is, the spineless animals such as amebas, sponges, corals, jellyfishes, worms, starfishes, insects, and not the vertebrate animals (amphibians, reptiles, mammals, and others) which together make up the more noticeable 5 percent minority in which falls a certain bumptious, egotistical primate named *homo*. (371 pages, 6½ by 9 inches, many illustrations.) $5.10 postpaid. —*A. G. I.*

CAMERA OVER HOLLYWOOD

By John Swope

A PANORAMA of life behind the silver screen is here assembled in a series of dramatic vignettes recorded by a miniature camera in the hands of an enthusiastic and understanding camera reporter. Of the many thousands of pictures which he has made from time to time in his wanderings around the world capital of the motion picture, 96 are reproduced in this book. These, however, provide a cross-section impression of the lives of the people who make up the world called Hollywood. (9 by 12 inches, 96 photographs.)—$3.60 postpaid.—*J. D.*

HOW TO THINK STRAIGHT

By Robert H. Thouless

THAT most arguments are futile, we all know, but those who wish to learn the science—and it is a science—of precisely spotting, laying open, and classifying under some one of 34 pitfalls, either the unconscious errors or the conscious crooked tricks of private arguers and rabble rousers, will find that this book, now a best-seller, contains all the necessary background. Even those of us who think we are straight thinkers will realize, after reading it, how extremely difficult it is to eliminate all emotion from our thinking and really think straight. A readable book full of practical examples, including two typical everyday arguments of the Pullman car smoking room kind thoroughly taken to pieces and analyzed for faulty thinking. (246 pages, 5 by 8 inches.) —$2.10 postpaid.—*A. G. I.*

THE DECLINE OF MECHANISM IN MODERN PHYSICS

By A. D'Abro

PHYSICISTS or others with equal mathematical background will find this a competent discussion of the questions of determinism, causality and the related philosophy of science. (982 pages, 6 by 9 inches, 61 illustrations.)—$10.10 postpaid.—*A. G. I.*

DESERTS

By Gayle Pickwell, Ph.D.

AN elementary, popular study of deserts, their causes, their suprisingly numerous plants and animals and the lives of these; all with especial regard to the deserts of California and Arizona. The fine large illustrations are striking. A book for the library table. (174 pages, 9 by 11½ inches, 64 illustrations.)—$3.60, postpaid.—*A. G. I.*

ALBERT EINSTEIN, MAKER OF UNIVERSES

By H. Gordon Garbedian

EXCEPT for two chapters in which the author stops to present a popular explanation of relativity, this is a straight biography of Professor Einstein, who also aided the author in its preparation and illustra-

We can supply our readers with any of the books reviewed in this department. Prices quoted include domestic postage. Foreign prices are necessarily higher due to increased shipping charges.

SCIENTIFIC AMERICAN
24 West 40th Street New York, N. Y.

FOR OTHER BOOKS YOU WANT, SEE PAGES 102 AND 114

tion. From it we learn the correct details about the subject's boyhood and early life, also a great many details that are not generally known about his life since the public became aware of him 20 years ago, and right up to the present year, thus correcting misimpressions. He emerges just as he is—half super-genius, half simple, natural, plain, ordinary man who dislikes poses, shams, dress-suits, high hats, and all other build-ups that most of us need because we aren't Einsteins. Good reading all through. (328 pages, 6½ by 9 inches, 19 illustrations.)—$3.85 postpaid.—*A. G. I.*

PHOTOGRAPHY AND THE AMERICAN SCENE

By Robert Taft

PHOTOGRAPHY has played a part in American history, a part that probably never has been thoroughly described until the production of the present book. Here is given a running story of the development of photography during its first half-century—up to and beyond the Civil War days. The entire book is an excellent example of the bookmaker's art, being presented on fine coated stock with a large number of half-tones, some of them fairly large reproductions of well-known photographs of Civil War scenes. Essentially non-technical, although a few descriptions of processes are included. The voluminous notes at the end of the book will prove of great value to any student of photography. (546 pages, 7½ by 10½ inches, profusely illustrated.)—$10.50 postpaid.—*A. P. P.*

ENGINEERING OPPORTUNITIES

Edited by R. W. Clyne

EVER so often there comes to our notice some new book which is intended to be a guide for boys who wish to enter engineering and for the parents and teachers of such boys. Of those we have seen, this seems by all odds the best. It covers a field of 25 engineering opportunities, the discussion of each having been prepared by some authority in that particular subject. Each discussion gives the background, scope, and modern practice of one engineering study in such a way that boys and their teachers and parents may judge its potentialities as a career for the boy. (Illustrated, 397 pages, 5¾ by 8½ inches.)—$3.10 postpaid.—*F. D. M.*

AUDELS NEW RADIOMANS GUIDE

By E. P. Anderson

IN this one compact book is given a comprehensive survey of the fundamental principles of radio, followed by a review of the entire technical radio field presented in understandable language. It covers modern construction and operation practice, as well as testing and trouble shooting. (Over 750 pages, 5 by 6¾ inches, a large number of drawings and photographs.)—$4.10 postpaid.—*A. P. P.*

CHAMPLIN ON FINE GRAIN

By Harry Champlin

THIS second edition of a book which has been very popular with amateur photographers explains in detail how to obtain the best results with the new formula Champlin 16. (160 pages, 5½ by 8 inches, a number of photographs.)—$2.20 postpaid.—*A. P. P.*

CURRENT BULLETIN BRIEFS

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

A TRANSPORTATION MIRACLE, by Edward G. Budd, is a 10-page booklet which describes briefly yet adequately the amazing growth of streamlined trains on American railroads, and the advantages which have accrued to the traveling public as a result. *Edward G. Budd Manufacturing Company, Philadelphia, Pennsylvania.—10 cents.*

TWIN SHIPS, by Alexander Crosby Brown, is a 90-page illustrated booklet containing a chronological history of the use of multiple hulled vessels, such as catamarans, for sail and steam. *The Mariners' Museum, Newport News, Virginia.—70 cents.*

LAFAYETTE CAMERA CATALOG is a 40-page thoroughly illustrated booklet which lists a wide variety of standard products plus the complete line of Lafayette accessories. Data sheets are included with information on film and paper speeds, an exposure chart, and a discussion of fine-grain development. *Lafayette Camera Corporation, 100 Sixth Avenue, New York City.—Gratis.*

HARDNESS CONVERSION TABLE FOR NICKEL ALLOY STEELS is a celluloid card which not only gives the conversion table but also presents S.A.E. standard specifications for nickel alloy steels of various types. *The International Nickel Company, Inc., 67 Wall Street, New York City.—Gratis.*

SOUTHWARK-EMERY TESTING MACHINES is a 44-page thoroughly illustrated booklet which tells briefly of the development of hydraulic testing machines during the past decade and then goes on to show and describe a large number of machines of this type which find wide applications in present-day industry. Bulletin No. 131. *Baldwin-Southwark Corporation, Philadelphia, Pennsylvania.—Gratis.*

THE ESSENTIALS OF RECORDING is a 22-page booklet which not only describes methods of making high-grade phonograph records in the home by the electrical process, but also lists the equipment necessary for doing the work, giving prices. *Allied Radio Corporation, 833 West Jackson Boulevard, Chicago, Illinois.—10 cents.*

QUIET EMERSON ELECTRIC FANS is a folded circular which describes an entirely new line of fans for a wide variety of applications. *The Emerson Electric Mfg. Co., Inc., 17 East 42 Street, New York City.—Gratis.*

APPARATUS FOR ELECTROLYTIC CONDUCTIVITY MEASUREMENTS is a 40-page illustrated catalogue which describes and lists the latest forms of equipment for making electrolytic conductivity measurements. It contains a general discussion of industrial measurements and research, and includes information on recent developments for precise measurements. Suggested combinations of equipment are illustrated and listed. Catalog EN-95. *Leeds & Northrup Company, 4911 Stenton Avenue, Philadelphia, Pennsylvania.—Gratis.*

IDEAL CATALOG AND HANDBOOK is an 84-page illustrated catalogue covering motor and other maintenance equipment as well as electrical specialties. Besides the listing of equipment, there are also presented a number of pages devoted to hints on commutator care, operation of direct-current generators, definitions of electrical terms, and many engineering tables of great value. *Ideal Commutator Dresser Co., Sycamore, Illinois.—Gratis.*

WATER ANALYSIS, METHODS, CHEMICALS, AND APPARATUS presents scientifically sound methods of water analysis. Includes directions for taking samples and use of burettes, as well as for all the usual tests made on industrial and boiler waters. *W. H. & L. D. Betz, 235 W. Wyoming Avenue, Philadelphia, Pennsylvania.—25 cents.*

THE PATENT PROBLEM FROM THE VIEWPOINT OF INDUSTRY, by Otto S. Schairer, is a 14-page compacted discussion which presents views based particularly upon experience in the electrical and radio industries. *RCA Institutes Technical Press, Radio Corporation of America, 30 Rockefeller Plaza, New York City.—Gratis.*

LINK-BELT OVERHEAD CONVEYORS is a 20-page booklet, thoroughly illustrated with photographs showing various types of industrial conveyors that can be used for handling a wide variety of products. Book No. 1630. *Link-Belt Company, 307 North Michigan Avenue, Chicago, Illinois.—Gratis.*

OPERATORS HANDBOOK is a 96-page pocket-size booklet designed to provide information for the users of all types of tires other than those for passenger cars. It covers such phases as tire problems, fitting the tire to the job, specifications for industrial tires, farm-service tires, load ratings, inflation pressures, and so on. *B. F. Goodrich Company, Akron, Ohio.—Gratis.*

LABORATORY GLASS BLOWING WITH "PYREX" BRAND GLASS is a 20-page pamphlet offered as an aid to the laboratory technician. It contains information on the working characteristics of this particular glass, an explanation of fundamental glass blowing operations, and recommendations of suitable tools and equipment. *Corning Glass Works, Corning, New York.—Gratis.*

SUCCESSFUL FARMING FOR ABSENTEE OWNERS, by Cornelius J. Claassen, is a 52-page booklet that is directed specifically to absentee farm owners who desire to make a reasonable income from their property. It suggests to such owners a way in which farm incomes can be improved and property protected from the hazards of operation by incompetent or irresponsible tenants. *C. J. Claassen, President, Farmers National Company, Omaha, Nebraska.—30 cents.*

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., LL.B., Sc.D.
New York Bar
Editor, Scientific American

Glass Houses

PEOPLE who live in glass houses not only should not throw stones but should make sure that they do not infringe a patent recently allowed by the Court of Customs and Patent Appeals.

The inventor of a glass brick applied for a patent on the brick and on a type of building construction using it. The patent was refused by the Patent Office and by the Board of Appeals. However, the decision of the Patent Office and the Board of Appeals was reversed by the Court of Customs and Patent Appeals and the patent was allowed. The brick in question was a hollow glass block having at least one side thereof fluted or ribbed so as to form prisms. The prisms were so formed that downwardly slanting rays of light such as sunlight, when passing through the brick, were deflected in an upwardly slanting direction on the opposite side of the brick. When bricks of this character were used in constructing a wall the sunlight passing through the wall was deflected onto the ceiling in the inside of the structure. Prior to the development of the brick in question hollow glass bricks had been employed but these bricks were not provided with prisms to cause the deflection of the light upwardly in the manner described above.

The Court pointed out that the indirect lighting effect caused by the prism arrangement on the new brick was not obtainable by the old type of brick. It was accordingly concluded that since the structure was new and since it produced a new result it constituted invention and that a patent should be granted. In support of its decision the Court stated:

"It seems to us that the concept of causing deflection of light rays in the manner which has been described was inventive. To consummate the conception and embody it in structural form must have required calculations based upon the physical laws relating to light, and, finally, experiments to determine whether the result desired had been obtained."

Air Spun

FACE powder and graphite were held not to be goods of the same descriptive properties in a recent decision of the Court of Customs and Patent Appeals involving the trade mark "Air Spun." A prominent manufacturer of graphite attempted to register the name "Air Spun" as a trade mark for graphite and the registration was opposed by a cosmetic manufacturer who used the same name as a trade mark for face powder. The reasons urged in support of the opposition were of a rather unusual character. Thus the cosmetic manufacturer asserted that graphite was used in lead pencils, that the public generally associated lead with lead pencils, and that lead, which at one time was employed in face powders and face lotions, was regarded as a harmful ingredient. Because of these facts it was argued that some customers might be led to believe that "Air Spun" face powder contained lead if the graphite manufacturer were permitted to use and register the trade mark "Air Spun."

The Court rejected this argument, however, and held that any damage that might result to the cosmetic manufacturer by reason of the use of the trade mark "Air Spun" by the graphite manufacturer was of such a remote and speculative character as not to justify refusal to register the trade mark. It was also pointed out that the goods were of an entirely different class, that they did not look alike, were used for different purposes, and were purchased by different classes of customers.

Disclaimer

ONE of the most unsatisfactory portions of the patent law is that portion dealing with disclaimers. The disclaimer statute provides that where a patentee, through inadvertence, has claimed more than his invention, he must without unreasonable delay disclaim that which is not his invention in order to reap the benefits of the remainder of his patent.

There has been considerable confusion as to when a disclaimer should be filed and as to the subject matter which should be disclaimed. Today it is generally accepted that when a court of last resort has declared some but not all of the claims of a patent to be invalid the patentee has a choice of either acquiescing to the decision of the court and filing a disclaimer or of rejecting the decision of the court and relitigating the question in a different court in a suit against a different infringer. Where the patentee elects to follow the second alternative he is risking the danger that the second court will agree with the decision of the first court and hold the same claims of the patent to be invalid, in which case the entire patent will be unenforceable because of the failure to file a disclaimer within a reasonable time after the first decision. Thus it will be seen that in every instance where a portion of a patent is declared to be invalid by a court of last resort a patentee is confronted with the none-too-pleasant choice of either emasculating his patent by disclaiming some of the claims thereof or of risking the validity of the entire patent by failing to file a disclaimer within a reasonable time after the first decision.

The United States Supreme Court in a recent decision has emphasized a further danger lurking in the disclaimer statute. The decision involved a suit for infringement of a patent on a washing machine. In a prior case several of the claims of the patent had been declared invalid and those claims were disclaimed. In the present case the Court held the remainder of the patent to be invalid and unenforceable because the patentee had failed to disclaim another claim which was not involved in the prior litigation but which the court found to be similar in scope to one of the claims which the patentee had disclaimed.

The Court held that the patentee had elected to disclaim the portion of the patent which had previously been declared invalid and having made that election he should have disclaimed all of the claims covering that subject matter. As a result, the suit for patent infringement was dismissed for the rather technical reason that in filing its disclaimer the patentee had failed to disclaim everything that he should have disclaimed. This decision represents one more reason why the disclaimer statute should be radically changed so as to prevent the forfeiture of a patentee's rights for seemingly technical reasons.

Rubber Fan

THE popular fans having rubber blades which waft summer breezes at us without benefit of a protecting guard were involved in a recent suit for patent infringement.

The owner of a patent covering a fan of this character brought suit charging that a somewhat similar fan made by a competitor infringed his patent. The patent disclosed a fan having rubber blades which were inserted in arcuate grooves provided in the hub which supported the blades. The arcuate grooves held the blades in cupped position so that they were sufficiently rigid to withstand the axial thrust required for rotation and at the same time were sufficiently resilient to yield when they came into contact with rigid objects. The rubber blade substantially eliminated the danger of injuries resulting from contact with the rotating blades of a fan.

One of the defenses raised in the suit was that the mere use of rubber in making fan blades did not constitute invention. The court rejected this contention, pointing out that the patent related to more than the mere use of rubber. It taught the use of a flexible material in the making of fan blades and the supporting of the fan blades in such a manner as to give them sufficient rigidity to preserve their usefulness while at the same time preserving the inherent resiliency of the material and the resulting safety characteristics.

In this connection the Court made the following statement:

"While the mere use of rubber in making fan blades was no invention, the use of a flexible material, which might of course be rubber, in the way the patentee taught how to use it to obtain the desired results by attaching it in his way to the hub to increase its utility as a fan blade without destroying in any appreciable way its inherent safety qualities, was what the patent law is designed to protect."

SCIENTIFIC AMERICAN ADVERTISERS

August · 1939

Advertising Manager
CHARLES H. STEINHART
New York City

Eastern Advertising Manager
EUGENE H. KRAEMER
New York City

Western Advertising Representatives
EWING HUTCHISON COMPANY
35 East Wacker Drive, Chicago, Ill.

BLANCHARD-NICHOLS-COLEMAN
Los Angeles, San Francisco and Seattle

Published by MUNN & COMPANY, INC.
24-26 West 40th Street, New York

ORSON D. MUNN, President JOHN P. DAVIS, Treasurer I. SHELDON TILNEY, Secretary

Vol. 161, No. 2, 35 cents a copy. $4.00 a year, postpaid in United States and possessions. Canada, $4.50; other foreign countries, $5.00, postpaid.

Printed at The Condé Nast Press, Greenwich, Conn., U. S. A.

Why miss *this year*—as you did *last year*—so many new books you would deeply enjoy?

—CONTINUED FROM OTHER SIDE

You Still Browse In Bookstores

Not only are you under no compulsion to take the book-of-the-month, scores of other recommendations are made to help you choose *among all new books* with discrimination. The advance report about the book-of-the-month comes to you (the service costs you nothing) along with succinct and highly clarifying reports about all the other books which have gone through the reading system described above.

If you want to buy one of these from the Club, you can get it by merely asking for it. Or you can use these reports (we find that most of our members do) to guide you in buying these miscellaneous recommended books from a favored bookseller.

In other words, instead of limiting your reading, this system widens it. You can browse among the books as always, but now do it intelligently; you know what to look for.

What's The Advantage

Once and for all this system *really keeps you from missing the new books you want to read.* You do actually buy and read those you want, instead of confessing sadly to friends, "I never got around to reading that!"

In addition, there is a great money-saving *whenever you buy the book-of-the-month from the Club.* Our judges' choices are usually at the top of every national best-seller list. Time and again they are books you ultimately find yourself buying anyway, whether you are a member of the Club or not, because they are so widely talked about. (Outstanding examples of these in 1938 were THE YEARLING, WITH MALICE TOWARD SOME, THE HORSE AND BUGGY DOCTOR, and a list of others too long to include here.)

By buying these books-of-the-month from the Club, you sometimes pay less than the regular retail price; and in addition *for every two-books-of-the-month you decide to buy you receive, free, one of the Club's book-dividends.*

Free Books You Get

These book-dividends represent a unique and remarkable system of saving. The explanation is that the Club does not buy books from the publisher, it buys *the right to print* the book-of-the-month its judges choose. So many of its members ordinarily want the book-of-the-month that an enormous edition can be printed. The saving on this quantity-production is large enough to enable the Club to buy the right to print *other* fine library volumes. These are then manufactured and distributed free among the Club's members—*one for every two books-of-the-month you buy.* The resulting economy is extraordinary. For every $1 you spend for a book-of-the-month you actually receive about 75c back in the form of free books, figured at retail value.

Some of the actual book-dividends distributed within recent months are the best indication of what can be done by this system: they include BARTLETT'S FAMILIAR QUOTATIONS (a special $6 edition); JOSEPH IN EGYPT (2 vols., $5); the Pulitzer Prize edition of ANDREW JACKSON, by Marquis James ($5); MADAME CURIE, by Eve Curie ($3.50); THE ARTS, by Van Loon ($3.95). These books were all *given* to members—not sold, mind you!

What's Your Obligation

You pay no yearly sum to belong to the Book-of-the-Month Club. *You pay nothing, except for the books you buy.* You simply receive a bill with each book sent.

Your only obligation as a member is to agree to buy four books-of-the-month a year from the Club. These may be either current or past selections.

FREE . . . TO NEW MEMBERS

Joseph in Egypt

By Thomas Mann

—or any of the other Book Dividends listed in the postcard

IF you decide to join the Book-of-the-Month Club now, we will give you free, as a new member, a novel which has been acclaimed as "perhaps the greatest creative work of the twentieth century"—JOSEPH IN EGYPT, by Thomas Mann (two volumes, boxed, retail price $5.00). This was one of the recent book-dividends of the Club. Or, if you prefer, you may choose one of the other recent book-dividends. They are listed in the postcard at the right. When subscribing, merely indicate your preference.

Please enroll me as a member. It is understood that I am to receive, free, the book checked below, that I am also to receive, without expense, your monthly magazine which reports about current books, and that for every two books-of-the-month I purchase from the Club, I am to receive the current book-dividend then being distributed. For my part, I agree to purchase at least four books-of-the-month a year from the Club.

Check title you prefer to receive as your free enrollment book

☐ JOSEPH IN EGYPT ☐ THE ARTS ☐ MADAME CURIE
☐ BARTLETT'S QUOTATIONS ☐ ANDREW JACKSON

Name Mr. / Mrs. / Miss .....
PLEASE PRINT PLAINLY

Address .....

City ..... State .....

Business Connections, if any .....

Please check whether you would like us to ship the current book-of-the-month with the free book above YES ☐ NO ☐

Books shipped to Canadian members, DUTY PAID, through Book-of-the-Month Club, (Canada) Ltd

Scientific American A-708

Commonest of All Excuses:

"I'm sorry—I never got around to reading that!"

HAVE YOU READ EVEN TWO OR THREE OF THESE BEST SELLERS– GOOD BOOKS NOT TO BE MISSED?

Why miss *this year*—as you did *last year*—so many new books you would deeply enjoy?

THE self-examination provided at the right will show *the degree* to which you may have allowed procrastination (it is nothing more, when analyzed) to keep you from reading new books which you want very much to read. How often have you promised yourself to do something about this!

There is something simple you can do, and as effectual as it is simple. Over 200,000 families—persons like yourself—have found it effectual. Become a subscriber of the Book-of-the-Month Club. This has become the most thorough-going service ever devised to help perspicacious book-readers save money on new books, and keep them from missing those they are most interested in.

You are not obliged, as a member of the Club, to take the book-of-the-month its judges choose. Nor (this is a frequent misapprehension arising from our name) are you obliged to buy one book every month from the Club. Here is the simple system:

Only Buy Books You Want

Publishers submit all their important books to us. These go through the most careful reading routine now in existence. It is not unusual for a single book to be read by nine different preliminary readers before it is even recommended to Club members. At the end of this sifting process, our five judges choose one book as the book-of-the-month.

But this choice is not in the least binding upon you as a member. You receive a carefully written report about the book *in advance of its publication.* If you decide from this report that it is a book you really want, you let it come to you. If not, you merely sign and mail a slip, saying, "Don't want it."

—CONTINUED ON OTHER SIDE

CHECK THOSE YOU HAVE NOT READ

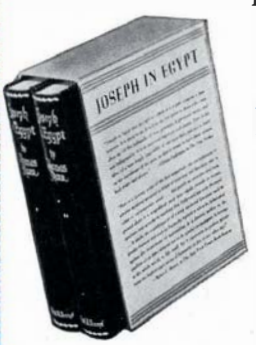
- THE YEARLING — *Marjorie Kinnan Rawlings* ☐
- JOSEPH IN EGYPT — *Thomas Mann* ☐
- BENJAMIN FRANKLIN — *Carl Van Doren* ☐
- MADAME CURIE — *Eve Curie* ☐
- THE HORSE AND BUGGY DOCTOR — *Arthur E. Hertzler* ☐
- FANNY KEMBLE — *Margaret Armstrong* ☐
- PHILOSOPHER'S HOLIDAY — *Irwin Edman* ☐
- LISTEN! THE WIND — *Anne Morrow Lindbergh* ☐
- OUT OF AFRICA — *Isak Dinesen* ☐
- RED STAR OVER CHINA — *Edgar Snow* ☐
- THE EVOLUTION OF PHYSICS — *Albert Einstein and Leopold Infeld* ☐
- THE SUMMING UP — *W. Somerset Maugham* ☐
- WITH MALICE TOWARD SOME — *Margaret Halsey* ☐
- THE COMING VICTORY OF DEMOCRACY — *Thomas Mann* ☐
- ANDREW JACKSON — *Marquis James* ☐
- THE PROMISES MEN LIVE BY — *Harry Scherman* ☐
- THE FIGHT FOR LIFE — *Paul de Kruif* ☐
- HELL ON ICE — *Commander Edw. Ellsberg* ☐
- THE FOLKLORE OF CAPITALISM — *Thurman W. Arnold* ☐
- A SOUTHERNER DISCOVERS THE SOUTH — *Jonathan Daniels* ☐
- DRY GUILLOTINE — *René Belbenoit* ☐
- THE IMPORTANCE OF LIVING — *Lin Yutang* ☐
- MY SISTER EILEEN — *Ruth McKenney* ☐
- THE GENERAL'S LADY — *Esther Forbes* ☐
- MAN'S HOPE — *André Malraux* ☐
- TESTAMENT — *R. C. Hutchinson* ☐

—and many others no less worth reading, too many to be listed here

FIRST CLASS
Permit No. 419
(Sec. 510 P.L.&R.)
New York, N. Y.

BUSINESS REPLY CARD
(No Postage Stamp Necessary if Mailed in the United States)

POSTAGE WILL BE PAID BY
BOOK-OF-THE-MONTH CLUB, INC.
385 MADISON AVENUE
NEW YORK, N. Y.



FREE... TO NEW MEMBERS

Joseph in Egypt,

By Thomas Mann

—or any of the other Book-Dividends listed in the postcard

SEE OTHER SIDE