Who Was SHAKESPEARE?

SCIENTIFIC AMERICAN

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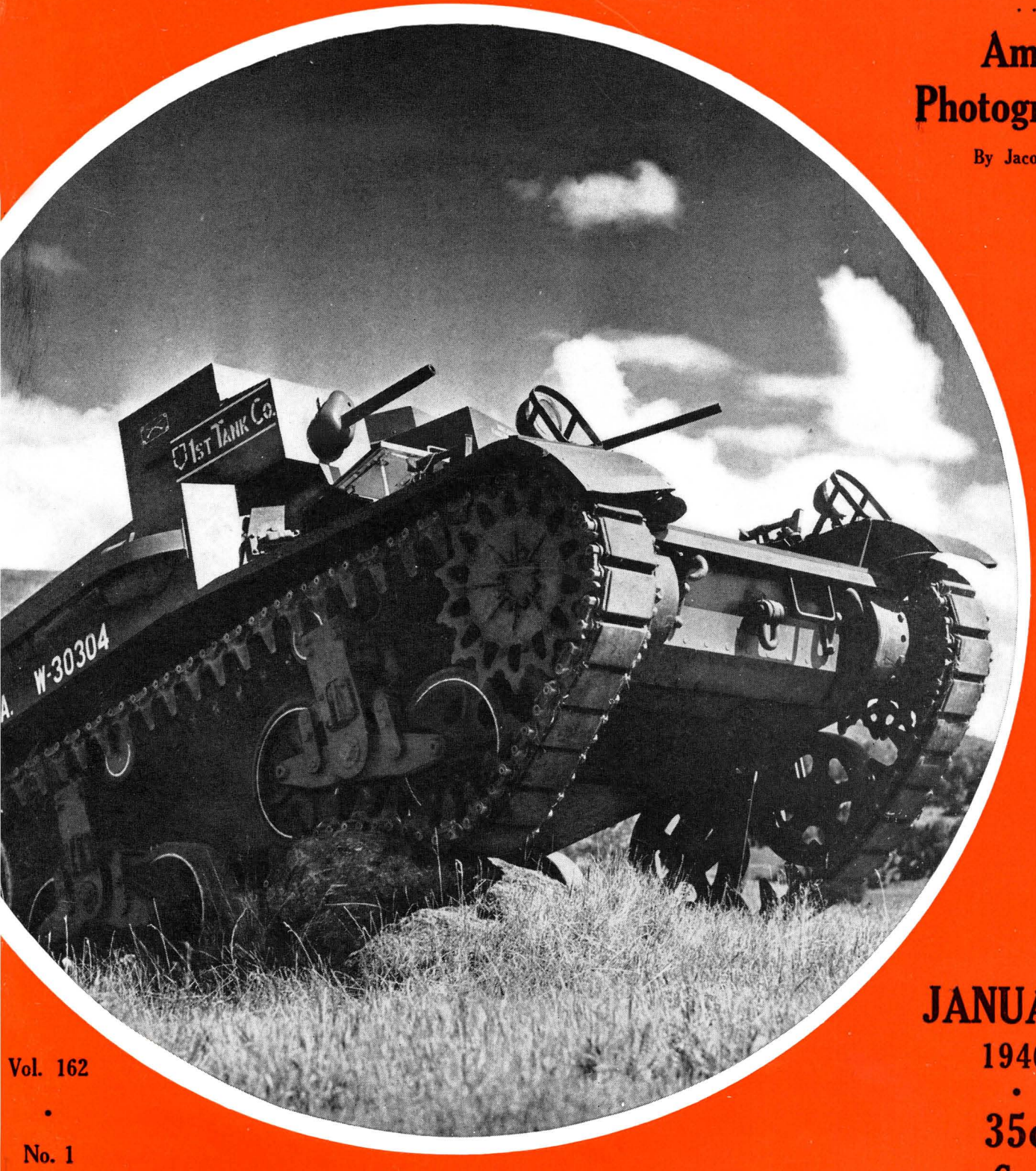
By Jacob Deschin



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JANUARY
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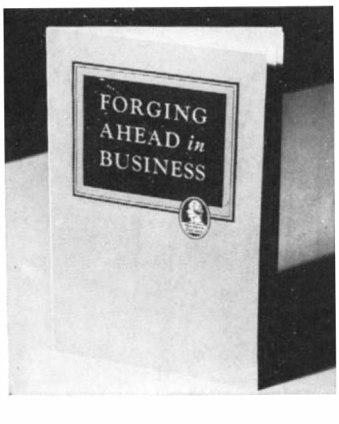

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NINETY-SIXTH YEAR • ORSON D. MUNN, Editor

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Mechanical Details of the Mobile Base Which Admiral Byrd Will Use in His Present South Pole Expedition

THE fighting power, speed, maneuverability, and armor of modern tanks have been enormously improved over their wartime ancestors. Yet anti-tank defenses and anti-tank guns have also been improved so that a tank-corps man's job is still next door to suicide. The modernized 75mm gun discussed on page 16 will not make it less hazardous—if the tank is on the receiving end.

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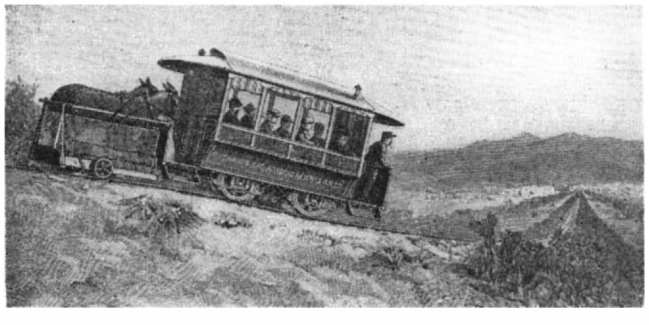
50 Years Ago in . . .

Scientific American

(Condensed From Issues of January, 1890)

SPARK PHOTOGRAPHY—"Rifle bullets are now photographed in their course by means of the electric spark. The camera is taken into a dark room, which the bullet is caused to traverse. As it passes the camera it is made to interrupt an electric circuit and produce a spark, which illuminates it for an instant and enables the impression to be taken. The wave of condensation in the air before the bullet and the rarefaction behind it are visible in the photograph, and can be studied by experts, thus enabling the form of ball or rifle which minimizes the resistance of the air to be selected."

TRAMWAY—"We illustrate a novelty in tramway practice, taken from the railroad operated in the beautiful town of Ontario, San Bernardino County, Cal. The railway passes through the middle of Euclid Avenue, a broad and beautiful street, bordered with orange and lemon trees. The avenue is some 6½ miles in length, with



heavy grades as it approaches the hills. The car is drawn up hill and over the levels by a pair of mules, but in going down grades the mules ride and the car moves by gravity, as shown in our engraving. A platform with folding sides is provided, which is supported near one end upon a pair of wheels . . . When the mules are the tractive power the sides of the platform are folded down and the whole rolls back under the bottom of the car, where it remains and is drawn along the track with the car."

SAFETY—"In his recent message to Congress, President Harrison laid much stress on the need for adopting means for insuring the safety of railroad employes. An annual death list from accidents in service of over 2,000 railroad employes, with ten times the number injured, was cited by him as illustrating the urgent nature of the case. He suggested congressional action, requiring uniformity in the construction of cars used in interstate commerce, and the use of improved safety appliances upon such cars."

SHIPS—"Shipbuilding on the Maine coast was more active during the past year than it has been since the palmy days before the war, when the fleet had the pick of the carrying trade. Yards which for years scarcely paid expenses are doing a thriving business, and others for long deserted echo with strokes of adz and caulking mallet."

LIGHTING—"The controversy now in progress between the promoters of the rival systems of incandescent lighting, though some will think of doubtful expediency, so far as the companies are concerned, admirably serves to acquaint a public now grown timorous, with the detail of operation and with the nature of the precautions which, if employed, would render both systems entirely safe, at least to the user."

PIPE-LINE—"The oil pipe-line which was recently constructed from Cygnet, Wood County, Ohio, to Cleveland, is one of the best in the country, yet it is necessary to watch it vigilantly to prevent any leaks. Track walkers pass over every mile of the line each day, about 15 miles being assigned to each man. Every walker is a telegraph operator and is supplied with a pocket instrument. Should he discover a leak in the line, he immediately telegraphs the division superintendent. At stated intervals along the telegraph lines wires run down the poles into locked boxes, the key of which is carried by the walker. Opening the box, he attaches his instrument and wires a report to headquarters."

FORTH BRIDGE—"The practical completion of the great bridge over the Firth of Forth was effected on Thursday, November 7, when the interesting operation of joining in the center the girder which forms the connecting link between the Inchgarvie and North Queens Ferry cantilevers was successfully accomplished."

HAND MINING—"When two men can take out $100,000 in less than a year from a quartz mine, they are doing a pretty good business. Yet this is what two young men, Messrs. Grant and Appel, have done in the Chipps Flat pocket mine, between Moore's Flat, Nevada County, and Allegheny, Sierra County. And they have no mill, either, simply pounding the rich rock up in a mortar by hand."

WAR SHIP—"The new British war ship *Blake*, lately launched, it is calculated, will be the fastest war vessel afloat, and, for her class, the strongest fighting ship. Displacement, 9,000 tons; length, 375 feet; beam, 65 feet; draught, 25 feet 9 inches; twin screws, 20,000 horse power; maximum speed, 22 knots, or over 25 miles per hour. As a ram, at this high velocity and her great weight of 9,000 tons, it is doubtful if any vessel could withstand the shock. The Blake is constructed of steel throughout, has six-inch armored turtle-back steel deck, covering the magazines, torpedo rooms, engines, and boilers. Fuel space, 1,500 tons. She is to carry two 9 inch 22 ton breech-loaders and ten 45 pounder quick-firing guns, each capable of firing 12 times per minute."

MUSCLE SHOALS—"The obstructions known as the Muscle Shoals, in the Tennessee River, which cover about 23 miles out of the 453 between Chattanooga and Paducah, at the mouth, are at length overcome by means of locks and dams built by the government, and the river is now open so that boats loaded at New Orleans can at all times proceed to Chattanooga and most of the time to Knoxville. The distance from Chattanooga to New Orleans is 1,601 miles."

AND NOW FOR THE FUTURE

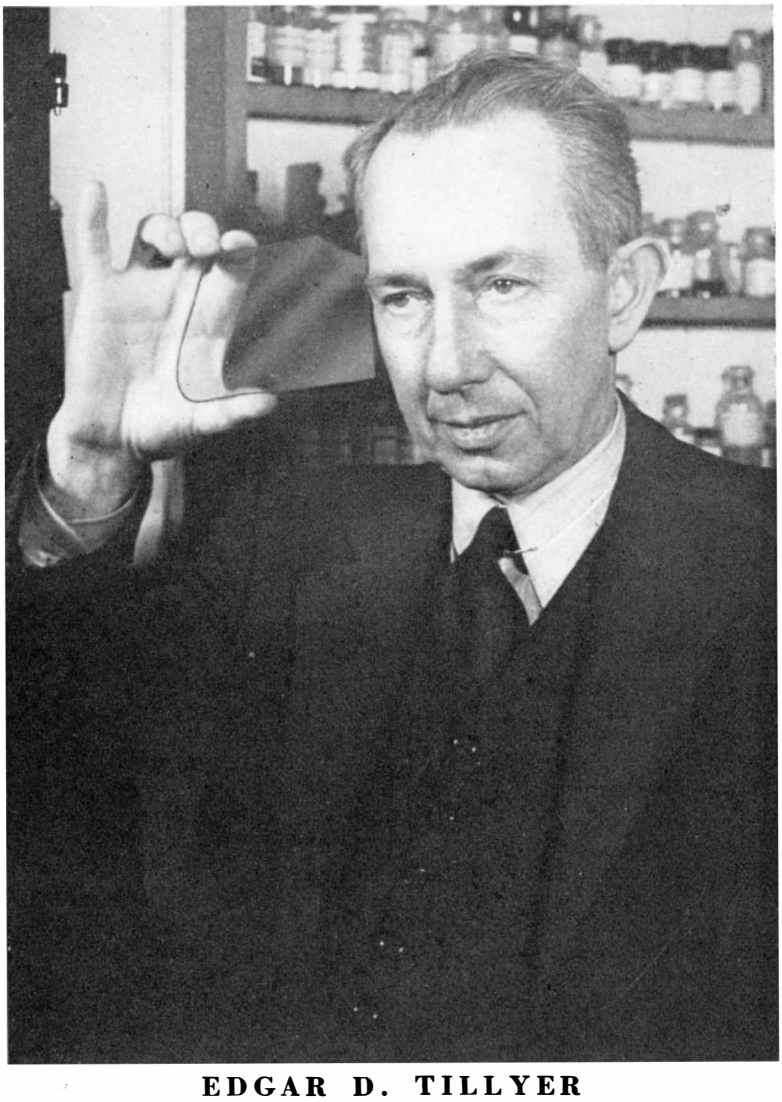
¶Nylon, Newest Contribution of Chemistry to Industry, and What It Promises for the Future.

¶Atom Smashers — What They Are, What They Do, and How They Do It. By Douglas W. F. Mayer.

¶Application of Engineering Principles to Dentistry Makes for Better Dentures. By A. W. Jessup.

¶A Four-Lane Highway Bridge that, for a Mile of its Length, Floats on the Surface of the Water. By Charles F. A. Mann.

Personalities in Science



EDGAR D. TILLYER

EVERY person who wears glasses owes to Dr. Edgar D. Tillyer, internationally known lens authority, a debt of gratitude so great that mere words cannot express it. His brilliantly creative mind has contributed more than a hundred important developments in the field of optical science.

Intricate scientific problems are always tempting to Dr. Tillyer. A small man with a large domed head crowned by a mop of gray hair, he'll seize a pad of paper and cover it with an astonishing array of mathematical computations. Out of these complex calculations will come a new lens system, a new eye-testing instrument, a new lens-measuring device or, just for relaxation, new developments in the motion picture or radio fields.

Dr. Tillyer was born at Dover, New Jersey, December 7, 1881. A graduate of Rutgers University, his first position was that of Computer with the Nautical Almanac Office at Washington, D. C. In 1907, he became an Astronomical Observer in the Naval Observatory at Washington. Four years later, he entered the Bureau of Standards in the same city. Then, in 1916, he accepted the invitation of the American Optical Company, Southbridge, Massachusetts, to direct its Research Laboratories.

While at the Naval Observatory, Dr. Tillyer designed and built the clock vault temperature control and also designed a pair of astronomical photographic lenses for the observatory.

As a member of the Bureau of Standards, he performed a notable service: He revised the old types of submarine periscopes and wrote the then standard periscope specifications of the United States Navy. He also determined and wrote gunsight specifications for the Navy.

During the World War, Dr. Tillyer did splendid work for the United States Government. One of his conspicuous achievements was re-designing a telescopic sight for the French 37-millimeter tank-repelling gun. The barium crown glass used in the former gunsight was not obtainable here in sufficient quantities and several of the largest lens manufacturers declared that this gunsight had to be made of barium glass. But Dr. Tillyer re-designed the lens system, using plain optical glass. Trials showed that the telescopic sight using ordinary spectacle glass was more efficient than the French barium glass sight.

Perhaps the best known of the scientist's developments is the Tillyer lens, a highly significant development which took years to perfect.

Only a few weeks ago Dr. Tillyer announced the latest development to come out of the American Optical Company Research Laboratories—the successful grinding of Polaroid sun glasses to prescription after five years of intensive experimentation.

In the motion-picture projection field, Dr. Tillyer is the inventor of the automatic heat screen—a lens in the projector system which will transmit the light rays and retard the heat rays, thereby preventing the film from burning when the machine is stopped. In the radio field, among other things, he devised one of the widely used methods of cutting quartz crystals for radio frequency control.

Dr. Tillyer's supreme delight is the development of new types of glass. At the present time, he is working on radically different glass compositions. Tantalizingly, with a twinkle in his eyes, he refuses to talk about these new glasses, but does admit that one group has the property of not dissolving in hydrofluoric acid which dissolves all ordinary glasses.

Seemingly, Dr. Tillyer lives for science alone, but this is far from the truth. Genial, possessed of an excellent fund of stories, his tastes are catholic and his hobbies many. Intensely interested in photography, nothing pleases him better than to project his excellent collection of colored photographs for his friends. He loves to fish and cheerfuly admits the fish generally elude him. His badminton is not what it might be, but he enjoys the game anyhow. As for bridge, rumor has it that he has developed a new system which, unfortunately, does not prove infallible. In respect to literature, he states with refreshing candor that he likes nothing better than an exciting detective yarn.

Panchromatic photograph by Arthur G. Eldredge

X RAYS REVEAL THE SECRETS BENEATH ITS PAINT

Above: The famous "Ashbourne" portrait of William Shakespeare, owned by the Folger Shakespeare Library, Washington, D. C., now, for the first time, dissected with infra-red and X-ray photography. The small picture at the left is Dugdale's engraving (1656) of the skull symbol on the Stratford monument to the Bard, and is reproduced here for comparison with the skull in the "Ashbourne."

Figure 1: Left: Edward de Vere 17th Earl of Oxford and Lord Chamberlain of England. Born April 12, 1550, died June 24, 1604. Painted in 1575 when this mysterious poet-peer was 25 years of age. From the original owned by the Duke of Portland

Figure 2: Right: A heretofore unpublished portrait of Lord Oxford, identifiable as the work of Marcus Gheeraedts. "It has frequently been reported," says A. Wivell (1827), "that Marcus Gheeraedts had painted Shakespeare, but nobody knows whence it originated." Painting owned by the Duke of St. Albans

IDENTIFYING 'SHAKESPEARE'

Science in the Shape of Infra-red Photography and the X ray Brings to Light at Last the Real Man Beneath the Surface of a Series of Paintings of the Bard

By CHARLES WISNER BARRELL

A SENSE of mystery has always surrounded the personality of Shakespeare, the prince of dramatists, as compared with the citizen of Stratford-on-Avon who signed himself—evidently with painful difficulty—Willm Shakspere. The latter left no letters, manuscripts, books or other relics of creative endeavor. Both of his parents, as well as his own 26-year-old daughter, were so illiterate that they could not write their own names, as the village records testify. Will himself is stated by two 17th Century investigators to have been working as a butcher's apprentice up to the time he left his wife and three small children to seek his fortune in London. There is no contemporary citation of his ever having attended school a day in his life or of having received any training whatever in any of the liberal arts with which Shakespeare, the dramatist, shows such intimate familiarity. Finally, during the heyday of the playwright's creative career, the Stratford citizen appears in the annals of his native town as malt dealer, money lender, and land speculator.

While it is entirely possible that this jack-of-all-trades may have had some

Figure 3: Lord Oxford's head, enlarged from the Portland portrait

Figure 4: Shakespeare's head. To be compared with those of Oxford

Figure 5: Lord Oxford's head enlarged from the St. Albans painting

THE accompanying article, on a subject which may at first strike the reader as literary rather than scientific, is published in Scientific American because its major premise is in the realm of science: the recent findings of the X-ray and infra-red photography.

Was Shakespeare really the man of Stratford-on-Avon, or was he someone else? Why go out of the way to question the familiar belief that he was simply himself—do we not know his life? Unfortunately, we do not. As George Steevens, early English Shakespearian scholar, once said: "All that is known with any degree of certainty concerning Shakespeare is, that he was born at Stratford-on-Avon, married and had children there; went to London where he commenced actor and wrote poems and plays; returned to Stratford, made his will, died and was buried."

In the perennial and at times bitter war about the identity of Shakespeare, likely now to enter a fresh phase based on the new findings of science, the editors of this magazine remain neutral.—*The Editor.*

business connection with the London theaters, it has been difficult for many students of his personal life to see in him the profound philosopher and cosmopolitan artist who wrote "Hamlet" and some 30 other masterpieces.

As a result, fully a thousand volumes have been published in the past hundred years, vigorously disputing the claims of Willm Shakspere to the rank of Number One literary genius of the race.

The main contention of these anti-Stratfordians is that "William Shakespeare" was a pen-name, like "Moliere," "George Eliot" and "Mark Twain," which in this case cloaked the creative activities of a master scholar in high circles who did not wish to have his own name—or title—emblazoned to the world as that of a public dramatist. It is a well-known fact that the stage was held in social disrepute in the Elizabethan age. On the statute books, "vagabonds, thieves, and players" were lumped together as undesirables. Creative poets then were not by any manner of means accorded the same degree of reverence that they now command as "classics." "The Arte of English Poesie" (1589), first comprehensive analysis of the subject, makes the following significant statement: ". . . in these days (although some learned Princes may take delight in Poets) yet universally it is not so. For as well Poets as Poesie are despised, and the name become of honourable infamous, subject to scorn and derision, and rather a reproach than a praise to any that useth it." This work is but one of many testifying to the low estate occupied by Elizabethan poets generally.

DURING the course of the debates relating to the real personality behind the Shakespearian works, much contemporary evidence discovered in the past 20 years has led modern investigators to believe that Edward de Vere 17th Earl of Oxford really had a much more intimate connection with the immortal plays and poems than has been realized heretofore. More than 30 volumes have been issued in presentation of Lord Oxford's claims.

The same mysterious incongruity that surrounds the disputed personality of the dramatist also shrouds the paintings that have been known for many generations as "life portraits" of the Bard.

There are at least 12 of these, some on canvas, some painted on ancient wooden panels, which many art experts agree

Figure 6: **Oxford's hand, St. Albans portrait. Note long thumb and wild boar device**

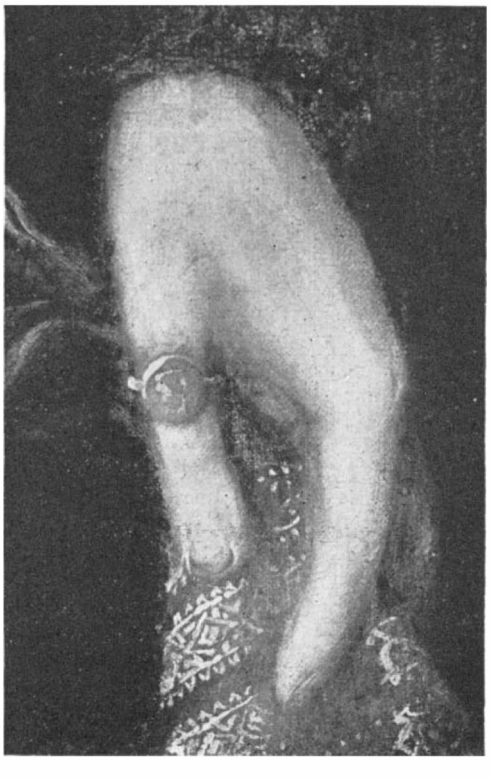
Figure 7: **Shakespeare's "Ashbourne" hand. Note long thumb, signet-ring, gauntlet**

are of undoubted Elizabethan or Jacobean composition. Several of the pictures are inscribed with dates that fit into the Shakespearean chronology, though none of approved technical ancientry bears any discernible name or artist's mark on its surface.

Until the early part of the 19th Century, six of these paintings had been held for unknown periods—evidently from the same age in which the Shakespearean plays originated—by various members of the old English aristocracy. It is significant that none of them can be shown to have had any Stratfordian ownership connections whatever. Moreover, very few of the works had until comparatively recent times ever been put up for sale or otherwise exploited publicly. One of the most interesting of them, which pictures the poet richly garbed, was taken from the Tudor collection in Windsor Castle by Queen Victoria for presentation to Lord Lytton, the novelist. As a matter of fact, eight out of the 12 genuine Renaissance studies of Shakespeare, as listed by the "Encyclopaedia Brittanica," depict him wearing the unmistakable attire of a nobleman.

To explain this remarkable circumstance, Stratfordian writers have conjectured that Willm Shakspere may have been painted in stage costume. But this theory lacks corroboration from contemporary sources. Among the six or eight authenticated portraits that exist of other prominent figures in the Shakespearean theater, such as Richard Burbage, Ben Jonson, Ned Alleyne, William Sly, and John Lowen, not one is delineated in any such fashion. On the contrary, Elizabethan actors and dramatists—with the one outstanding exception of Shakespeare—sat for their likenesses in sober, unobtrusive garb. During the days of Good Queen Bess, as official annals state, sumptuary laws regulated the wearing apparel of the classes quite as strictly as our modern statutes regulate the use of police uniforms.

So when we find a number of traditional portraits of the Bard which show him sporting the dress clothes of the Elizabethan nobility, excellent *prima facie* evidence would appear available to suggest that he may actually have been a member of the privileged class, just as the Baconians, the Oxfordians, and other heretical disbelievers in the conventional



Stratford legend have been contending, all along.

Acting on this hitherto strangely neglected hint, and having familiarized myself with much of the essential testimony in the case of disputed personalities, pictorial and otherwise, I secured permission about two years ago from the owners of some of the best-known Shakespeare paintings to investigate them with the modern scientific media of infra-red and X-ray photography.

It seemed possible that underneath the outer coats of one or two of these ancient works might lie concealed some key to the mystery that has puzzled so many students throughout the centuries.

The paintings finally selected for dissection include the half-length panel owned by the King of Great Britain at Hampton Court Palace; the head-and-bust panel, known as the "Janssen," owned by the Folger Shakespeare Library at Washington, D. C.; and the three-quarter length canvas, generally called the "Ashbourne," which is also now the property of the Folger foundation.

In each instance, my technical associates and I have uncovered clear-cut evidence to show that details of the original portraiture have been changed and that certain areas which previously displayed symbols of personal identification have been completely painted over.

The manner in which this work of concealment and disguise was carried out, the character of the brush strokes employed, and the present condition of the surfaces of all three pictures, make it apparent that the changes were made at some remote period. It also seems evident that the hand of the same furtive craftsman was utilized throughout.

Figure 9: **Infra-red closeup, Shakespeare's head. Note raised forehead, under-surface outlines of original ruff**

Comparative research on recovered details of the original compositions and on all personal symbols of both the sitter and the artists who painted him, now for the first time brought to light, show beyond reasonable doubt that the Shakespeare who appears in these works must have been the mysterious Elizabethan court poet, Edward de Vere, 17th Earl of Oxford, and not the member of the illiterate Shakspere family who was buried at Stratford-on-Avon, April 25th, 1616.

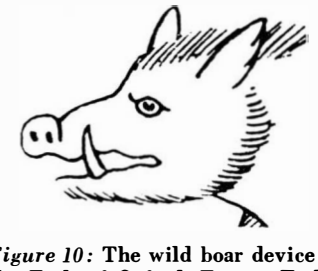


Figure 10: **The wild boar device of the Earls of Oxford. From a Tudor MS. published by Lord Howard de Walden. Compare with Figure 12**

Before discussing in detail the evidence brought to light by study of these paintings, it is appropriate that certain background facts be given on this poetical Lord Great Chamberlain of the Shakespearean age. As contrasted to Willm Shakspere the elusive business man, Edward de Vere, who "wasted his substance" and squandered his patrimony on men of letters, was intimately associated with many of the best known playwrights of the day, acted himself, patronized several companies of players, and was acclaimed by leading Elizabethan critics as the "most excellent" of all the Court poets—"the best for comedy among us." The personal drama of Lord Oxford's own life is realistically presented in a dozen or more of the Shakespeare plays, while the literary nobleman's personal letters have been found to abound in situations, points of view, and more than 150 dramatic figures of speech that reappear in the plays and poems.

SHAKESPEAREAN scholars have never been able to account for the Bard's obvious knowledge of Italian and French literature in the original. Shakspere of Stratford never traveled on the Continent. Edward de Vere, however, not only visited France, Italy, Germany and the Lowlands; he spoke, read and wrote Latin, French and Italian fluently. His social position as the premier earl of his era would account for his familiarity with manners, customs and speech at Court. Presented with an honorary degree at Oxford, he was told by the orator of the day—who later figured as an early commentator on Shakespeare's works—"*thy countenance shakes a spear.*" A member of Gray's Inn Society of legal lights, he had an intimate knowledge of law—reflected in all the plays. Largely because of his addiction to the company of bohemian writers, poets, musicians and mountebanks, Lord Oxford fell afoul of the taboos of his class. Shakespeare in the "Sonnets" bitterly laments the loss of "good name" and social prestige. This would account for the

Figure 11: **Shakespeare's signet-ring. Note under-surface shadows, plus broken surface outlines, forming design of a wild boar's head**

Figure 12: **The original boar's head design of Figure 11, restored by outlining under-surface shadows on the matrix with white paint**

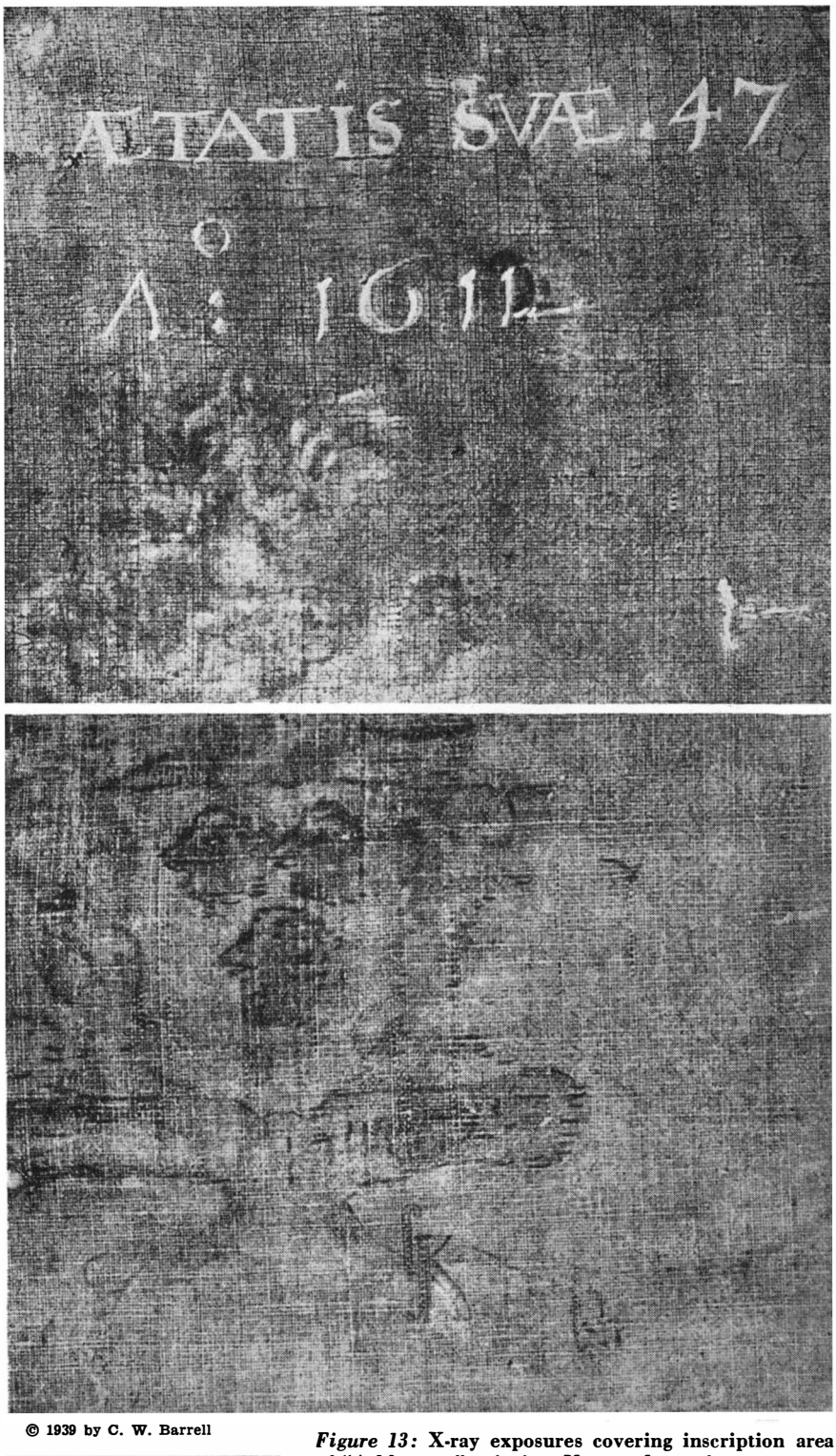
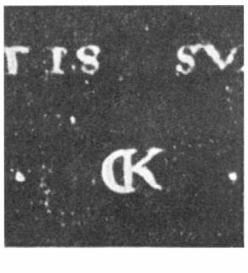
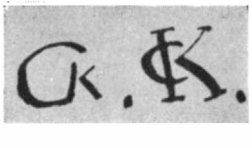


Figure 13: X-ray exposures covering inscription area of "Ashbourne" painting. Note under-surface remnants of original lettering; also family crest and shield of arms, with artist's monogram below phantom scroll

Figure 14: Left: Close-up of the X-ray monogram, C K. *Below, center:* Cornelius Ketel's monogram from his portrait of Sir Martin Frobisher in Bodleian Library. *Directly below:* Two more examples of Ketel's monogram, showing his habit of combining the initials C K in varying forms





adoption of a pen-name by the author of such sentiments.

Through the courtesy and co-operation of the present Dukes of Portland and St. Albans, our investigation has been provided with complete technical descriptions and photographic copies of the only known paintings of the Earl of Oxford which bear his name, dates and personal symbols, undisguised. Study of these two pictures, Figures 1 and 2, in direct comparison with any one or all three of the dissected Shakespeare paintings, discloses not only an extraordinary similarity of the features in the original drawing but—allowing for the fact that different artists with different points of view turned out the works—an absolutely convincing repetition in physical color schemes. Lord Oxford has reddish brown or auburn hair, a complexion merging from pink to carmine, eyes of light hazel, that is, blue-gray with inner rings or flecks of copper, high-arched eyebrows, a Roman nose with well-defined nostrils, a long upper lip, a well cut mouth of generous proportions and mustache and beard

Figure 15: The shield of arms of Lord Oxford's second wife. From the 16th Century Lane-Trentham monument in St. Peter's Church, at Wolverhampton, Staffordshire. Compare placement of the three griffins' heads in profile with remnants of the heads on the hidden coat of arms in the Shakespeare painting which X rays disclose

running through shades of sandy-red to dark auburn.

With the exception of a somewhat shortened nose and a partially bald head, the crude stone memorial effigy of Shakespeare which was set up on the wall of Trinity Church, Stratford, some time prior to the publication to the First Folio, originally displayed exactly the same facial color scheme that appears in the Lord Oxford portraits. We know this from a record made by

(Please turn to page 43)

OUR POINT OF VIEW

Science Transcends War

JUST as two boys, starting from a trifling injury committed by one against the other, work themselves by progressions into a full-fledged fight—first a light slap, then a heavy swat, next a solid cuff, then a kick and soon a clinch with nothing dirty barred—so do two opposing nations at war work by downward steps into methods which do not bar hitting in the clinch, biting off ears or tips of noses and gouging out eyes. The present war shows normal evidences of progressing in these directions despite the probable wish of each side that the play might be kept clean, so to speak; for in the nature of things, or until nations miraculously take to saying "You bit my ear off so we will slap your wrist, and then let's both change to calling names and making faces," this is inevitable.

It is therefore a satisfaction to the scientific to observe that their own kind among the warring nationalities are not so childlike. In the journal of world science, *Nature*, published in London, we find the following as a comment on the 60th birthday of the noted German physicist von Laue: "We take the opportunity to congratulate him on his brilliant scientific work which has led to the development of more than one new and important branch of science." The spirit of science.—*A. G. I.*

"As She is Spoke"

APOLOGISTS for slovenly use of the English language by many Americans say that such use is a sign of virility, of a healthy, growing language. Usage, they say, gives a patent of respectability. The inference is that if slang words are not frequently adopted into the language and other words and phrases are not consistently misused, the language is decadent.

We disagree violently with these condoners of mental sterility and lassitude. We could cite scores of cases in point—from everyday speech, articles, business letters, novels—to show that sound English and robust words would have been more expressive and, certainly, less ridiculously infantile. But this journal is interested in the humanization of science, and so we will confine our remarks to one of our particular *betes noire* in that field. This humanization requires skilful, accurate reporting of facts, the use of apposite analogies, and such a simplification of technical description that the result will be lucid enough for the average newspaper reader's understanding. It is in this attempt to simplify a scientific subject that this beast often rears its ugly head.

Over and over again one reads that something is "three times smaller than" something else when "one third as large as" was intended. Or it may be "two thirds closer than" as the New York newspapers distorted the recent report from a great university that certain heavenly bodies were believed to be only "one third as far from" the earth as had been previously estimated.

"Three times smaller!" "Two thirds closer!" How small is small? How close is close? One may as well ask the little boy's question: "How far is up?" By what simple rule of arithmetic does one multiply downward, multiply a unit —whether it be a number or an object —and get a fraction thereof? There is nothing absolute about "small" or "close." Both, indeed, are abstractions, and we can see no sane reason for any writer to go through all sorts of mental contortions to give them new, definitive rôles. We have simple fractions already assigned to the jobs that would be foisted off onto such meaningless phrases. We should use them. We should, in fact, do everything in our power —we science writers—to make lucid for the layman, *and accurate*, the science which we wish him to think of as being human.—*F. D. M.*

Accomplishment

OCCASIONALLY even a supposedly blasé editor, whose daily task involves participation in a critical survey of the passing parade of science and industry, stops short with a mental gasp of sudden realization. Day by day he has seen in the parade examples of progress in some one industry, has accepted and helped to report them as part of the usual routine. Then comes the gasp. Something happens to make him acutely aware that these individual examples have coalesced into a whole, the implications of which are so far reaching as to challenge the imagination.

Such has been the case with the plastics industry; the shock which produced the mental gasp was the recent announcement of the results of the annual *Modern Plastics* competition. For years Scientific American has followed the course of plastics through ashtrays and airplanes, industrial applications and home uses, yet nowhere has there ever before been brought out so vividly the impression which the entire plastics field has made on so many phases of our everyday life—at home, at work, at play.

Here is an industry, if there ever was one, that owes not only its very existence but its present importance to individual initiative and a keen desire to produce new materials that will do old jobs better, as well as to create new products for new purposes. First came Celluloid, made in an effort to replace ivory in billiard balls. Then a long hiatus until Bakelite sprang from a laboratory marriage of two liquids and firmly established itself in the electrical field. Later developments with this last-named plastic opened new and varied uses for it. Then came other plastics, other developments, other applications.

This brings us to the latest *Modern Plastics* competition, in which over 800 entries made from a wide variety of plastics strove for the attention of the judges. Here were displayed plastics parts for machine tools, large casings for various types of business machinery, beautiful decorative pieces in wide color ranges, molded door liners for refrigerators, plastics tools and dental plates, jewelry and automotive parts . . . Over it all hung a tremendously encouraging aura of progress, of accomplishment. What the scientists of the plastics industry have done in creating new ideas is typical of the spirit of industrial progress that has made our civilization the worthwhile thing that it is today. Our sincere congratulations to the men who have made possible this remarkable development; that they will attain even greater heights in the future is completely assured.—*A. P. P.*

Air Power

AIR speed records don't always mean what they seem to mean. In the United States, the top speed of a plane is determined by flying a measured course, the plane entering the course from a level flight and continuing so. In Germany, on the other hand, the plane enters the measured course *from a power dive*. The Germans thus make it a handicap race favoring themselves!

Perhaps this fact may partly explain why 27 German Messerschmidts, supposedly such superior fighting planes, were so easily defeated (with nine downed and the other 18 routed) by only nine Curtiss fighters piloted by Frenchmen. And that brings up other conjectures. Has this "handicap method" been widely employed in estimating other aspects of Germany's air power? It may have been; and if so, it may explain Germany's few air successes in recent weeks. We wonder.

To Combat Noise

One Device Dissects Noises, Analyses Them . . . A Second Finds Vibration Sounds . . . A Third Determines Expansion of Metal Which Makes Hum

By JAMES A. BAUBIE

FOR decades men were too busy pushing along our industrial advance to be concerned seriously with new noises that came with new machines; these were a necessary evil, and that was that. But in recent years they have come to learn that there is more to noise than the sound we hear. Some noise is fatiguing to men and the machines they run. It may seriously affect normal digestion of persons continuously exposed to it and it frequently is a sign that the machine is not performing all of the work of which it is capable.

In noisy industrial employment it is not unusual to find as many as 50 percent of the workers under 30 years of age with some degree of impaired hearing, according to Dr. Carey P. McCord of Detroit, chairman of a special noise study committee of the American Medical Association. In addition to ear injuries, this authority points out, there are many more scarcely measurable effects such as loss of sleep, excessive fatigue, and emotional disturbances, which are brought about by noise. Fatigue caused by noise probably effects the initial injury to the ear in such cases of industrial deafness, the doctor states, with the changes taking place in the tissues of the ear, their location and extent of damage depending on the type of noise and the duration of the exposure.

STUDIES have indicated that high-pitched tones are more damaging to the health of workers than low-pitched tones. The din in a boiler works is more injurious than the lower-pitched roaring in a cotton spinning mill. The report of small caliber artillery and machine guns is more injurious than the boom of heavy cannon.

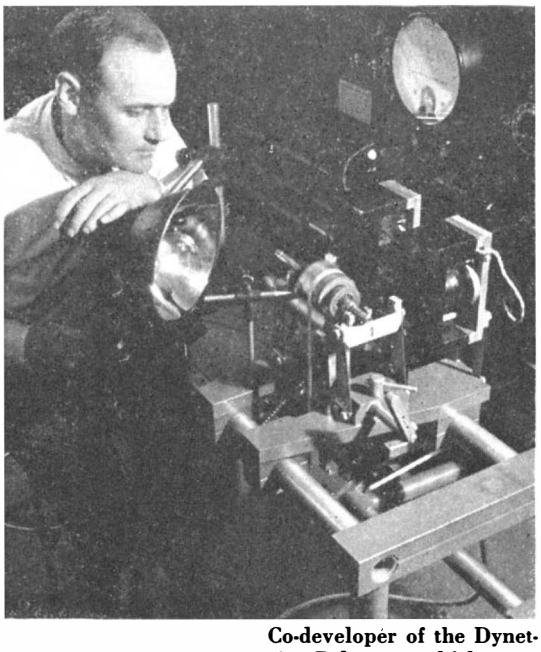
All recent noise studies indicate not only that workmen do better work when freed from the most disturbing noises but that most of us would lose some of the jitteryness of 20th Century living if we were inoculated with a little more quiet.

Now, consider the machine for a moment. Sound is the result of something vibrating within the audible range. We hear it because the vibrating object causes alternate expansion and contraction of the atmosphere surrounding the object, and these pressure changes are transmitted in waves to all points in the neighborhood of the source of the sound, exerting a pressure on any object, such as an eardrum, within its sound field. If the vibrations are excessive and are coming from a machine, they are more than likely a warning that the machine is laboring under some difficulty, is not working efficiently.

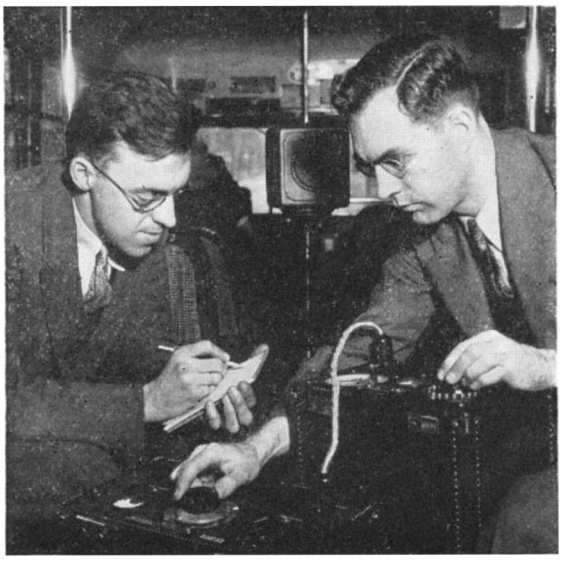
As a result of these demonstrably harmful effects of noise on the tools of industry, the worker, and in fact the entire citizenry, engineers, physicians, and municipal administrators are battling noise today as never before, attacking it in hundreds of laboratories and council chambers. Dr. McCord is of the opinion that 90 percent of industrial noise could be reduced to one half of its present intensity, if the causes of noise were discovered and corrected.

Today this goal is within the realm of possibility partly because of the work of a group of research engineers in a dozen laboratories of the Westinghouse Electric & Manufacturing Company. Out of these laboratories has come a mechanical detective to search out unwanted sounds. This noise detector, developed by W. O. Osbon, not only measures the intensity or loudness of a sound but diagnoses its noise, separating it into its different parts and measuring the pitch and intensity of each part.

The noise analyzer looks and acts something like a radio receiving set of an earlier vintage. On its panels are



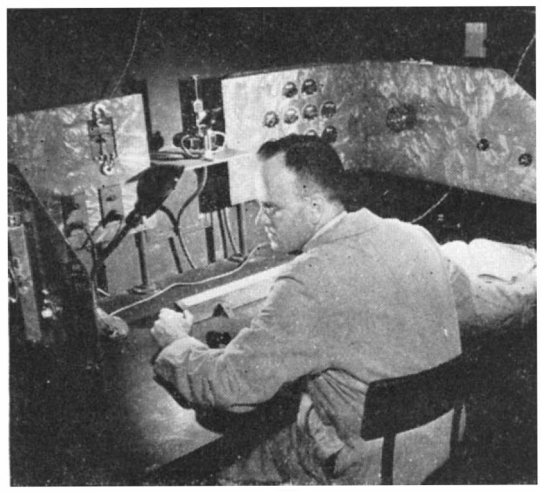
Co-developer of the Dynetric Balancer which sees and feels where and how much a rotor is off balance, F. C. Rushing focuses a Stroboglow lamp on a rapidly revolving rotor



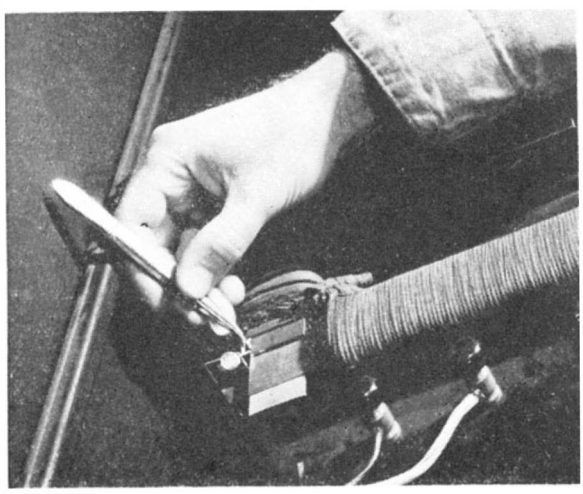
The inventor of the portable noise analyzer, W. O. Osbon, right, is shown measuring and diagnosing the noise inside a motor coach. This is the machine that breaks noises into all their parts for close study

switches, dials, and meters. Inside are vacuum tubes, condensers, and transformers. But to understand how it works, it is first necessary to inquire a little more into the cause of noise.

Technicians in the science of sound have agreed upon a barely audible sound of 1000 vibrations a second as their standard of reference. Such a sound as this presses upon each square centimeter of an eardrum with the force of one five-thousandths of a dyne or approximately three billionths of a pound per square inch. As the sound increases in loudness, the pressure exerted on the eardrum increases tremendously. For example, if a barely audible sound of 1000 vibrations is increased in loudness to the threshold of pain it will exert a force of 3000 dynes or about one twentieth of a pound per square inch. Its pressure has been increased about 15 million times.



The control panels of the unique device which measures the lengthening effect of alternating current on magnetic metals, and developer S. L. Burgwin



Half the size of a dime, the tiny mirror at the left reflects a light beam into photo-electric cells to measure the amount of "stretch" of steel. The mirror is on a needle which rolls under the bar to the right of the pincers

BUT pressure or intensity alone does not determine the loudness of a sound. This depends rather upon the combination of the sound's frequency (number of vibrations) and its intensity. If two sounds are of equal loudness but have different frequencies, the one with fewer vibrations will, in general, have a greater intensity at its source and exert a greater pressure on the eardrum.

The human ear is sensitive to a range of frequencies from 16 to 22,000 cycles a second, but is most sensitive between 1000 and 5000 cycles. If the intensity of sound increases 10 times, its intensity level rises one bel, in acoustical terminology. The decibel is one tenth of a bel. Some noises become so intense that they are felt as well as heard; they are then said to be on the threshold of feeling. This occurs only in the upper limit of audibility, near 120 decibels for some sound frequencies. The purring of the family cat rates about 25 decibels. A pneumatic drill at a distance of 10 feet produces a noise level of about 90 decibels.

These are the elements of sound that are tuned in by the noise analyzer. The frequency of every component or contributor to noise is balanced by this hearing mechanism against its own mechanical filter's frequency of 7000 vibrations a second.

As the sound engineer sweeps through the analyzer's frequency range, its decibel dial indicates loud noises at specific frequencies, instantaneously recording all the varying contributors to the total noise output of a machine or apparatus under examination. It singles one element out of a dozen possible elements that make up a noise.

Already the supersensitive ears of the analyzer have uncovered elusive noises in street cars, airplanes, trains, and electric motors. It has separated the motor's noise, diagnosing it and placing the blame where it belongs. It tells how much noise is caused by unbalance in the rotor, how much by the commutator bars and the slots in the rotor, and what part is gear noise.

Housewives usually have scant interest in rotors, generators, and the machine noises of factories, but today they have the analyzer to thank for the quiet operation of their electric refrigerator, washer, ironer, vacuum cleaner, and many other small motor-driven home appliances. In all these, the analyzer has done yeoman's service in uncovering noise sources.

In another laboratory at East Pittsburgh, engineers recently set a new electrical sleuth on the trail of noise. It is a dynetric balancing machine, developed in part by F. C. Rushing, which routs noise by detecting vibrations resulting from states of unbalance in rotors, which are the whirling parts of motors and generators. "Unbalance" is a first cousin to noise.

STILL another newcomer to the ranks of noise detectors is a device developed by S. L. Burgwin, a Westinghouse research engineer, as a means of studying the property of magnetic metals to lengthen and shorten in an electromagnetic field. Engineers have long known that in most electrical machines using alternating current the iron is first magnetized in one direction, demagnetized, and then magnetized in the opposite direction. Frequently the resultant lengthening and shortening of the metal set up vibrations which create midget pressure waves in the air, audible as buzzing or humming noises.

In working out his machine, Mr. Burgwin sidestepped several handicaps by developing an "electric eye" yardstick, using direct current to measure the simple change in length of steel test strips, detecting improvements and failures in new electric metals. Stripped of its technical dress, this measuring machine consists principally of a tiny roller, about the size of a darning needle, on the end of which is fastened a mirror about half the size of a dime. A divided photo-electric cell and a light beam complete the setup.

When a test strip is placed on the roller and magnetized by direct current, it lengthens. The light beam focused on the mirror is reflected to the photo-cell, registering the amount that the roller turns, determining the elongation of the test strip. The deflection of the light beam may be as small as four ten-thousandths of an inch at a distance of about 39 inches from the source of the light beam; by using a galvanometer, the photo-cell magnifies this deflection 100 times, makes it readable.

Fifteen years ago engineers knew very little about noise. Paradoxically, they learned how to stop noise by developing means of producing it in radio receivers, virtually building the modern science of sound around the radio microphone. From this beginning the industrial research laboratories have come to solve noise problems that were not even dreamed of in 550 B.C., when Pythagoras founded the science of sound with his mathematical explanation of the musical scale.

Dust Clouds of Space

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

SINCE Barnard's classic work, more than 20 years ago, it has been realized that the dark "rifts" and "lanes" in the Milky Way, and the smaller black spots which are found here and there, are not gaps or holes in the star-clouds, through which we look into the black depths of space beyond. They are obscuring clouds, which lie in front of the stars and hide them.

If a cloud of this sort were perfectly opaque, we might expect it to appear as a black, starless spot in the heavens; and so it would, if it were only a few light-years away. But a black cloud at a distance of 100 light-years or more would have many stars in the clear space in front of it, and these would appear scattered over the dark patch in the sky. But if the cloud were only partially opaque we would also see, in the obscured region, stars lying behind the cloud, diminished in brightness by the absorption of their light but not extinguished.

How may one distinguish between these two possibilities? The task would be easy, if the stars were all of the same real brightness, for then the apparent brightness would be a direct clue to the distance. If a black cloud lay at the distance at which the stars (on our momentary assumption) would appear of (say) the eighth magnitude, we would find as many stars brighter than this limit in this part of the sky as elsewhere, and none at all which were fainter. But if the cloud let through one sixth of this light—that is, made a star seen through it appear two magnitudes fainter—the stars behind it, at such a distance that they would appear, in clear space, of magnitude 9, would be reduced to magnitude 11, and so on. We would still find faint stars in the region but in reduced numbers—as many tenth magnitude stars per square degree as there were twelfth magnitude stars outside, and the like. By simply counting the number of stars, for equal area, inside and outside the obscured region, we could thus find very easily the distance and opacity of the cloud.

Actual conditions are, of course, much less simple—the cloud may be a thin fog, extending to a great depth and obscuring more and more the stars which lie deeper in it; and the stars themselves differ enormously in real brightness. These complications—especially the second—smear out the sharply defined effects which would appear in the first case, and make the calculations much more complicated. But, with accurate observations of the brightness of stars in obscured and unobscured regions—numerous enough to get good average values, and running down faint enough to get away from most of the smearing effects—it is possible to determine pretty reliably the distance, the total absorption, and even the thickness of the foggy region. We must start with knowledge of the relative numbers of stars of different degrees of real brightness, in the same volume of space; but this can be found in other ways.

It is rare to find a really black cloud. There are a few spots where hardly 1 percent of the light from behind gets through, but in most regions—such as the Coal-Sack near the Southern Cross—the background stars are still visible but appear reduced to from a quarter to a tenth of their proper brightness. The total light of all the stars—except the foreground—is reduced in this proportion, so the dark patch will be conspicuous, provided that it is near enough to us so that the "foreground" stars give only a moderate percentage of the whole light. This happens, in the Milky Way, for clouds which are only a few hundred light-years distant. But a cloud—even a very big and black one—two or three thousand light-years away would have such a lot of unobscured stars in front of it that its existence would not be obvious, and careful counts of stars, down to very faint magnitudes, would be required to find it.

THERE is one way, though, in which these distant clouds can be detected. They hide the spiral and other extra-galactic nebulae, which lie far, far away, enormously outside the outermost confines of our own Galaxy. It has been known since Herschel's time that very few such nebulae were found in the parts of the sky near the Milky Way; and Hubble, by detailed surveys, has mapped out a "zone of avoidance" extending all around the heavens in which none at all of these distant bodies can be observed. Evidently, in the outer regions of the Galaxy, or perhaps beyond most of its stars, there must be gigantic obscuring clouds, which shut out hopelessly from our sight a great portion of the remoter Universe. There are a few places, though, not far from the central line of the Milky Way, where Hubble has photographed extra-galactic nebulae. Here there must be "holes" where the incoming light passes between the clouds, whether near or far, and reaches us.

These obscuring clouds are the hugest things known to astronomy, except the great spiral nebulae themselves. Even our near neighbors among them—in our own Galaxy and but a couple of hundred light-years away—have length, and breadth and thickness which must be measured in light-years.

Their enormous size, however, must be compensated by an excessively low density. The only known thing which can be at the same time so rarefied and so opaque is an enormous, thin, cloud of dust. An easy calculation shows that the light-obscuring power—per pound per million cubic miles — becomes greater and greater, if we imagine the material in the cloud to be broken up into finer and finer dust, until the dust particles are reduced to a diameter of about 1/150,000 of an inch—so that their circumference is equal to a wavelength of light. Still smaller dust gets a decreasing grip on the light-waves and the opacity rapidly diminishes as it gets finer.

When we say that the obscuring clouds are composed of such fine dust, we do not mean to suggest that other particles may not be present—from chunks like meteorites down to minute dust and separate molecules of gas—but that the dust particles of diameter roughly from 1/30,000 to 1/300,000 of an inch are so very much better smoke-screen-forming materials per pound that they will take over practically the whole job, unless the general mixture should have a much smaller percentage (by total weight) of particles of this size than of the others.

There is an important difference, though, in the properties of a cloud, according as it is composed of particles decidedly larger than 1/150,000 of an inch, of particles decidedly smaller, or of a mixture of both.

In the first case, the obscuration is by ordinary opaque-body obstruction, and light of all colors is affected to the same degree. In the second, when the particles are much smaller than the waves of light, they have far more influence in scattering short waves than long, and the blocking power varies inversely as the fourth power of the wavelength. For red light, say of 6300 ang-

Despite Unavoidable Complications, It Has Proved Possible to Determine the Distance, Light Absorption, and Size of These Obscuring Clouds

stroms, the effect is only one fifth of that for violet light (4200 A).

Now it has been known for many years that a good many stars in obscured regions of the sky appeared abnormally red. This adverb suggests another complication. Stars of different temperatures naturally give off light of very different average colors; but, fortunately, there is a close correspondence between the color and the type of spectrum as defined by the lines in it. By finding the normal color for stars of each spectral type, in regions clear of absorption, we can get standards with which to compare stars in the obscured regions, and, fortunately, we have a good test for freedom from absorption—namely the visibility of extra-galactic nebulae. The "color excess" measures directly this abnormal reddening and hence that part of the obscuration which varies with the wavelength.

An admirable research of this sort has just been reported by Stebbins, Huffer, and Whitford, who have for years been making highly precise photometric measures with photoelectric cells, first at the University of Wisconsin, and later also at Mount Wilson. It has been no small labor: their present paper summarizes results derived from observations of 1332 stars, all of spectral class B. This class includes many of the brightest of all the stars and so affords a powerful method of carrying the investigation to considerable distances.

WORKING with two color filters, transmitting violet light of average wavelength 4170 A, and bluish-green at 4710, and with a thermionic amplifier to magnify the minute photoelectric currents, they have made precise measures of stars fainter than the tenth magnitude, though in general they stopped at about the ninth. The color excess of a star thus measured has a probable error of 0.01 to 0.02 magnitudes—about 1/50 of the difference in color between Vega and Arcturus, which, on their scale of measurement, is 0.7 magnitude.

Outside the Milky Way, and, indeed, in the portions of it well away from the central line, there is not much abnormal reddening. The strongly reddened stars are close to the central line, and a plot of these alone would suffice to map out the galactic circle. Moderately reddened stars (with a color excess less than 0.30) are found all round the Milky Way. But the strongly reddened stars not only cluster close to this circle, but are numerous in the region of Sagittarius (which lies in the direction of the galactic center) and are absent from a long stretch of the Milky Way in the opposite part of the heavens, where we are looking away from the center, and toward the edge of the great, roughly disk-like assemblage of stars. It is close to the center that the reddest B-stars are found. One has a color excess of $0^m.67$; that is, though it ought normally to be whiter than Vega, it looks almost as red as Arcturus.

In both parts of the heavens, strongly and slightly reddened stars of nearly the same apparent brightness are found, suggesting that the obscuring clouds are patchy, with some nearly clear gaps between them. This is confirmed by a detailed study of regions where bright star clouds lie close to dark and obviously obscured regions. In the bright patches, the stars are slightly reddened, indicating that there is some absorption all over this part of the sky. In the moderately bright regions adjoining, the B-stars are conspicuously redder—the absorbing layer is denser—while in the darkest regions no B-stars are found at all. The obscuration has made them so faint that they drop below the limiting brightness of the survey.

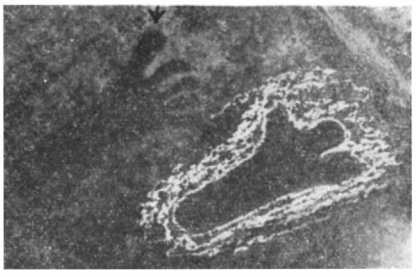
SO far, we have considered only the effects of these clouds in reddening the light which passes through them. It is of great interest to find, if one can, how much they weaken the light of various colors. To attack this problem, Stebbins and his associates have chosen pairs of stars close together in the sky, and with very similar spectra, one of which was abnormally red and the other not. If the spectra are substantially identical (as regards the intensities of the lines) we may assume that the real temperatures, and colors of the light, are substantially the same. These pairs of stars were then observed with a spectrophotometer, measuring the relative brightness of the two in many separate small regions of the spectrum. To measure these small separated parts of the radiation of a seventh-magnitude star must have demanded extraordinary precautions; the authors only remark "A cesium oxide cell refrigerated with dry ice was used."

The reddened stars, of course, give relatively more red light; but, when the excess brightness was plotted against the wavelength, it became evident that the rate of change with color was not nearly as great as it would have been for an absorbing cloud composed entirely of gas and exceedingly fine dust. The variation was not inversely as the *fourth* power of the wavelength, but inversely as the *first*. This is not theoretically troublesome—it can perfectly well occur for light which has traversed a mixture of dust particles of varying sizes. But the practical consequences are interesting. With this law of variation the obscuration is only 13 percent greater for violet light than for blue-green. For visual light ($\lambda 5100$) the absorption is a little less; but it is seven times the differential effect which produces color excess. For the most highly reddened stars, with a color excess of $0^m.6$, the obscuration of their visual light would exceed four magnitudes—if the clouds could be cleared away they would look 50 times brighter. In the Milky Way in Sagittarius, even the bright cloud, where the color excess E is 0.10, loses half its light by passage through the obscuring veil between it and us. This may not really be a star cloud at all—only a region seen through a "window." On the edge of the dark area, $E = 0.4$; only 4 percent of the light gets through.

THE absorption has to be considered in calculating the true brightness of these stars. Allowing for it (on a basis of the observed color excess) Stebbins and the rest conclude that the "earlier" and hotter B-stars are about 30 percent brighter than had previously been supposed. The brightest of all are the so-called C-stars, with very sharp lines, like Rigel or Alpha Cygni, which come out 12,000 times as bright as the Sun.

Allowing for the absorption, our authors calculate that the most heavily obscured stars in Sagittarius are at distances of 1200 and 1500 light-years. In the bright cloud, we can see through the "window" as far as 3500 light-years—and probably to fainter stars beyond. In the opposite part of the sky, the situation is curious. Stars at moderate distances, not exceeding 2000 light-years, show a reddening of $0^m.3$, corresponding to an obscuration of 85 percent of their light. But stars with the same spectrum, and much fainter, are no redder. It looks as if the absorbing clouds stopped at about 2000 light-years' distance, and space beyond, up to 6000 light-years, was practically clear.

This is a powerful method of investigation. It has been carried about to the limit for the moment, because the spectra of the fainter and more distant stars have not yet been catalogued. It will be of important service in the great task of mapping the observable portions of the Galaxy—in distance as well as direction—and also the obscuring barriers that prevent us from seeing farther.
—*Princeton, November 6, 1939.*



Arrow points to unchalked print

The chalk is for added visibility

Three more mysterious footprints

THE CARBONIFEROUS MYSTERY

Prints Roughly Resembling Human Footprints, and Found in Very Ancient Rocks, Would Greatly Add to Man's Antiquity—If Only They Were Human

By ALBERT G. INGALLS

ON sites reaching from Virginia and Pennsylvania, through Kentucky, Illinois, Missouri and westward toward the Rocky Mountains, prints similar to those shown above, and from 5 to 10 inches long, have from time to time been found on the surface of exposed rocks, and more and more keep turning up as the years go by. What made these prints? As yet the answer is unknown to science. They look like human footprints and it often has been said, though not by scientists, that they really are human footprints made in the soft mud before it became rock.

If man made these prints in this manner, then man's antiquity is no matter of a mere million years or so, as scientists think, but a quarter of a billion years, for they are found in rocks of the Carboniferous Period and those rocks were laid down about 250,000,000 years ago.

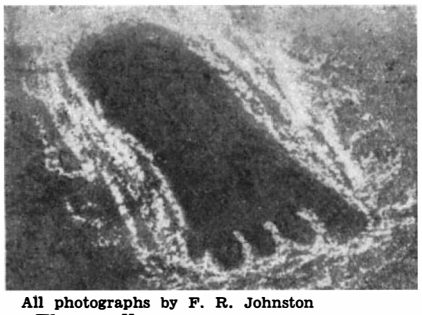
Confronted with this claim, the scientist exclaims, "What? You want *man* in the *Carboniferous?* Entirely and absolutely—totally and completely—impossible. We admit we don't know exactly what made the prints, but we do know one agency that didn't, and that is man in the Carboniferous."

To this a listener, perhaps a bit fed up with the surety of some laymen who seem to defend the tentative findings of science more vociferously than the scientists themselves, quietly replies, "Nothing is impossible. How many scientifically settled 'impossibilities' have later been proved to be possible—splendid theories demolished by mere facts? How often has science reversed itself?"

Science has.

It always will.

Science is like the streets of New York: it is never finished, and is always being torn up, often in a major way. Science is a process of learning by making guesses and then testing them, correcting and re-correcting, approximating and more closely approximating, with never the comfortable certainty that a major structure painfully assembled will not have to be entirely scrapped because of newer knowledge. In pre-scientific times, when man knew that he knew, he was often wrong but always comfortable; now he is often right but always uncomfortable, for he is never sure of the finality of his knowledge.



All photographs by F. R. Johnston

The small toe sets up conjectures

Nevertheless, asking the scientist for man in the Carboniferous is like asking the historian for Diesel engines in ancient Sumeria. The comparison is no exaggeration but an understatement. If man, or even his ape ancestor, or even that ape ancestor's early mammalian ancestor, existed as far back as in the Carboniferous Period in any shape, then the whole science of geology is so completely wrong that all the geologists will resign their jobs and take up truck driving. Hence, for the present at least, science rejects the attractive explanation that man made these mysterious prints in the mud of the Carboniferous Period with his feet.

BUT he could have made the prints with his hands, and that is the explanation offered by the ethnologist David I. Bushnell of the Smithsonian Institution, who has examined a number of them. He states that every one of them which he has seen was unquestionably a carving made by the Indians. As they are always found near water, he suggests that the human foot was a symbol which some ancient Indian people associated with a watering place. He points out that some of the Indian artists were extraordinarily realistic sculptors. This then becomes scientific theory No. 1.

Scientific theory No. 2 is that the tracks were actually made in the soft mud in Carboniferous times, a quarter billion years ago, though not by man but by some extinct and as yet unknown animal. There are numerous other cases in which animals left plentiful and excellent fossil footprints without leaving fossils of their actual selves. Many of these even have names, and so the present intangible mystery animal has been named by Dr. Frank Thone *Phenanthropus mirabilis* ("looks human; remarkable").

At the time when the later Carboniferous rocks in which these tracks appear were first laid down as mud there were several kinds of giant, toad-like amphibians crawling out of the water and around on the mud and leaving innumerable clear tracks vaguely resembling those of man—that is, they had five toes and a "heel." Science has no proof that these tracks were not made by one more of these animals—one with which it is not yet familiar—for it does not know everything. Professor W. G. Burroughs, Berea College, Kentucky, geologist, champions this theory, supported by the palentologist Charles W. Gilmore at the United States Museum.

What science does know is that, anyway, unless 2 and 2 are 7, and unless the Sumerians had airplanes and radios and listened to Amos and Andy, these prints were not made by any Carboniferous Period man. What did make them may appear with certainty later.

Or it may not.

Four Fastest

FOUR hundred miles an hour in an automobile! That's how fast man will be traveling in a few years from now, according to a prediction by John Cobb, of London, England, who recently drove 368.85 miles an hour to set a new world's land speed record in Utah.

His prophecy raises once again the question of how long speed progress in automobiles, ships, airplanes, and trains can continue. For, despite all that has already been accomplished, there is greater stimulus to speed advancement today than ever before and far better facilities to achieve it. As each day brings new demands for swifter transit, it brings also some development of science which pushes back the speed horizon just a little farther, and the speedometer needle creeps on forward. The photographs on this page show the four fastest vehicles of their kinds—when this page was prepared!

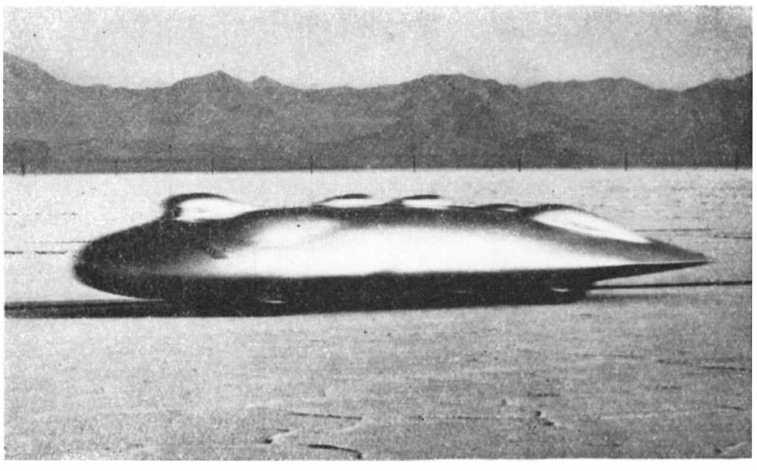
Demands for military planes, together with increasingly longer commercial flights, are giving impetus to speed progress in the air; the battle between the nations for world trade supremacy has stimulated it on the water. Railroads on land, in order to maintain their dominant position against competition from other forms of travel, are now speeding up their schedules with streamline design and modernization.

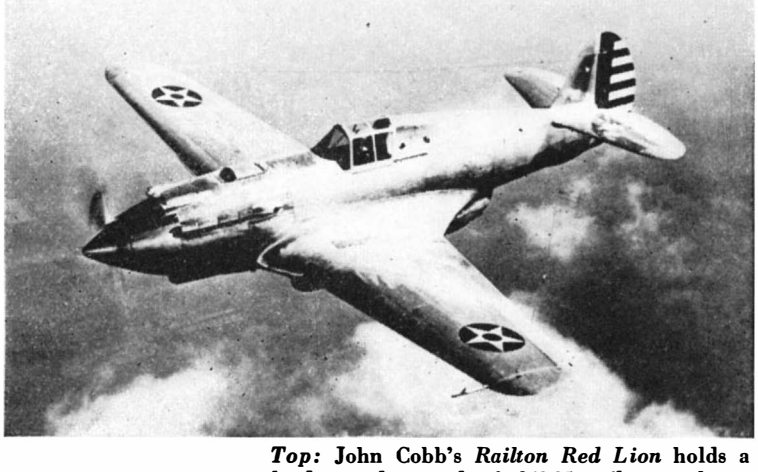
Their latest development is the greately expanded use of several types of roller bearings—a mechanical refinement of which most passengers are unaware.

Reducing the resistance of friction to less than 0.3 percent, while the train is in motion, these roller bearings almost entirely eliminate one of the greatest obstacles which hindered speed progress in former days.

Years ago, when automobiles were chugging up Main Street at 15 miles an hour and scaring the daylights out of the horses, some people thought cars would never be able to go much faster because of the increasing force of air resistance at higher speeds. And we once believed that speeds of even 15 miles an hour were impossible on the theory that no one could breathe while going so fast!

Perhaps man cannot go on cutting the minutes into seconds forever, but it looks as though it's going to be a long time before he stops. It may even happen that, before this page is printed, the speed records it lists will be eclipsed.

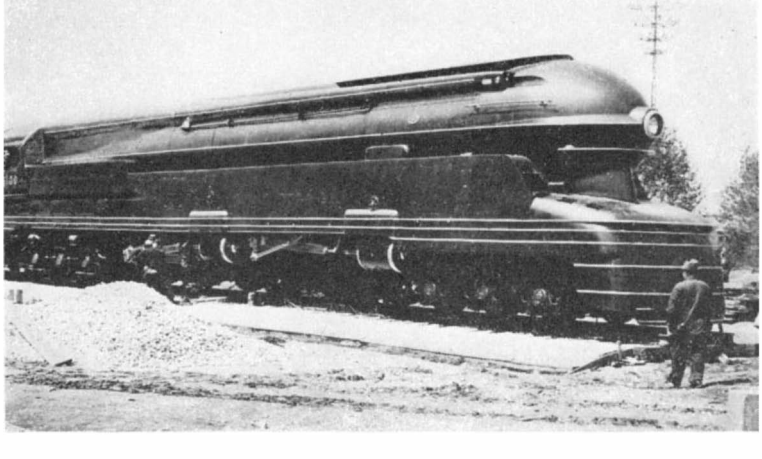




Top: **John Cobb's *Railton Red Lion* holds a land speed record of 368.85 miles an hour.** ***Above:*** **Curtiss P-40 pursuit plane, which is reputed to be the fastest in the world, may make from 400 to 450 miles per hour**

Below: **Sir Malcolm Campbell's *Bluebird II* which made a record of 141.74 miles per hour.** ***Bottom:*** **Largest, most powerful steam locomotive pulls 14 cars at 100 miles per hour**

Photographs courtesy Timken Roller Bearing Company



Our Superior Modernized 75's

Re-Construction of Our Large Stocks of Wartime 75mm Guns Would Give Them Longer Range, High Elevation, Wide Traverse . . . Work is Inexpensive

By G. M. BARNES
Lieutenant Colonel, Ordnance Department, U. S. Army

THE 75-millimeter gun, as modernized by the Ordnance Department of the U. S. Army, has been called by military men the best divisional field piece in the world today. Its range is 13,000 yards as compared with 7000 yards for the wartime model. Its arc of fire is 14 times greater; hence it may be expected to make many more hits on a moving target such as a tank.

Modernization of these guns costs $8000 each as compared with the $25,000-cost of manufacturing one 105-millimeter howitzer, toward the use of which there is now a definite trend. In the accompanying article, Colonel Barnes says, simply, we have "a very large supply of" the old 75's on hand. Another authority said recently that we have enough of them, with great quantities of shells, to supply a sizeable army in the field.—*The Editor.*

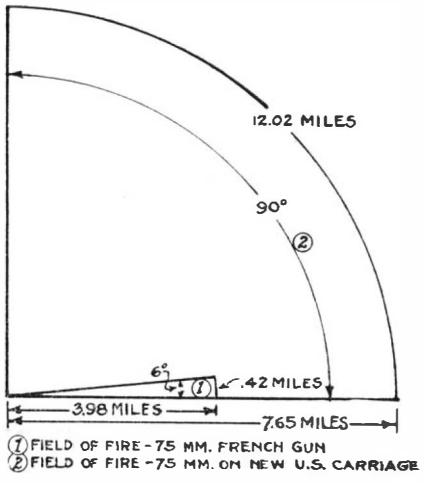
IN the early days of World War I, newspapers and magazines gave colorful reports of the startling successes achieved by the German Army in their rapid march through Belgium and France toward Paris. These accounts told of the great destructive power of the German guns and howitzers. The world was introduced to the new German heavy howitzers which quickly accomplished the destruction of the fortifications at Liege, Belgium. Of all the belligerents involved in World War I, only the German Army was adequately equipped initially with all the necessary types and calibers of artillery. The French and British lacked artillery and were particularly deficient in heavy types. The great destructive power of the German artillery can be gleaned from statistics of casualties. These statistics record that the German armies produced nearly twice as many as the allied forces and this was due, in great part, to the predominant power of the German artillery.

It was during these days of the World War that Americans first began to hear about the French 75mm gun, known as the "Soixante-quinze." It is scarcely an exaggeration to say that this gun stemmed the on-rush of the German armies in the early days of the war, preventing the rout of the French armies.

The French 75mm gun had been developed secretly and adopted in the year 1897. Its construction was a military secret which was successfully kept from the Germans. Contrary to popular belief, the great importance of this gun did not lie so much in its superiority as a piece of artillery, as in the fact that the French had an adequate supply of this one caliber. It was, however, a very excellent division gun of great reliability. The secret feature was the hydro-pneumatic recuperator which gave the gun stability and smoothness in firing. In this respect, it was superior to the German 77mm field gun.

At the time the United States entered the World War in 1917, it became known for the first time to the American people that our Army possessed but 900 pieces of mobile artillery of all calibers. This number did not include the splendid permanently emplaced seacoast artillery which had been provided for the defense of our country against naval attack. General Crozier, then Chief of Ordnance, and other Ordnance officers, had pleaded with Congress for years to provide an adequate supply of mobile artillery for the army, but prior to 1917 there was little interest in this subject. When the United States entered the war, our troops were equipped with a few 3-inch field guns, model 1902. This was an excellent piece of artillery and when tested by experts in comparison with the French 75mm, was held to be the equal, if not the superior of the French gun. In addition, a new type of American field gun known as model 1916 had just been tested at the Sandy Hook Proving Ground. It outranged the French gun and also had greater lateral traverse. At that time, the French, having been in the war for about three years, were manufacturing large numbers of 75mm guns and were in a position to sell to the American Government the number required for arming our troops as they arrived in France. Furthermore, as we were to co-operate with the French, there would be an important advantage in using the same caliber of ammunition which could be interchangeable. The British Army went to France with their 18-pounder field gun and were consequently not able to exchange ammunition with the French. The important decision was made in June 1917—and it appears now that this was a very wise decision—to abandon our 3-inch field piece; to manufacture a few model 1916 guns rechambered for French ammunition; but to manufacture mainly the French 75mm field gun and ammunition in this country, in addition to procuring an initial stock of guns and ammunition from the French Government. As a result of this action, the close of the World War found this country in possession of a very large supply of 75mm French guns.

AFTER the Armistice, studies were made by Boards of Artillery and Ordnance Officers of the artillery lessons of the war. The consensus was that a longer range field gun should be developed for use in the next war. Consequently, several years of research and development ensued during which a number of models of guns and gun carriages were manufactured. Some of these model 75mm guns were found to be most excellent and greatly superior in range to the famous French 75mm



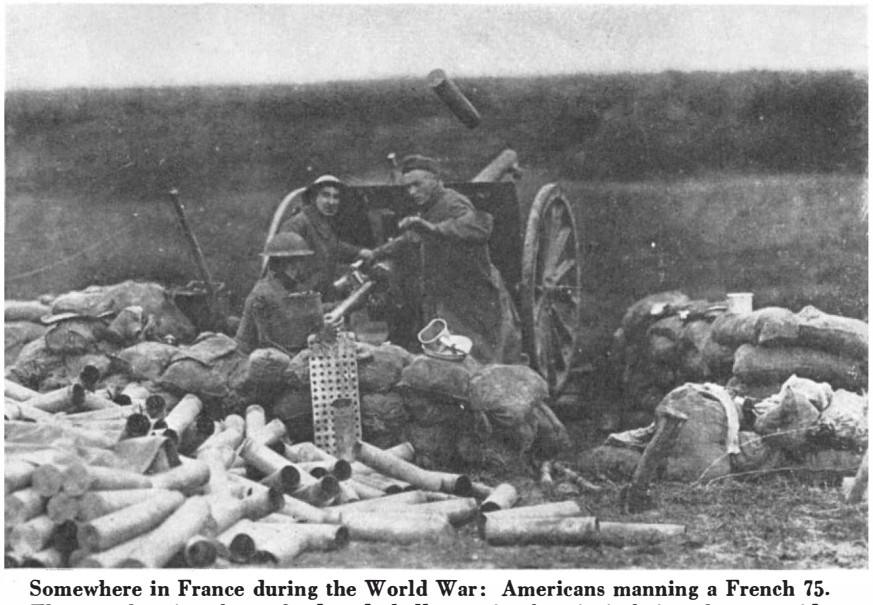
Range, elevation, and traverse of old and new 75mm guns compared

Released for publication by the Chief of Ordnance, U. S. Army. Statements and opinions are to be understood as individual expressions of their author, and not those of the Ordnance Department.

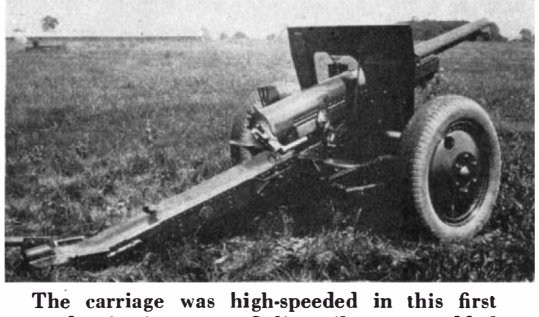
gun. However, realizing the large stocks of 75mm guns available in the country, Ordnance officers could not refrain from casting backward glances at this important stock of artillery and wondering if ways and means could not be found whereby these guns could be utilized.

The first step in this direction was to remove the wooden wheels from the 75mm gun carriage and to replace them with rubber-tired wheels having roller bearings at the axles. The carriage was thus high-speeded and converted from a horse-drawn vehicle, capable of traveling at a maximum of 15 miles per hour, into an artillery unit which could be drawn by a truck at speeds of 40 to 50 miles per hour. One type of modification was successfully worked out by the Ordnance Department; and another along the same line, known as the Martin-Parry Adapter, was found equally satisfactory. A considerable number of the latter units were manufactured by the Martin-Parry Company and placed in service.

While this modification permitted the gun carriage to be drawn at high speeds, it was only a partial answer to the problem, since the range and horizontal traverse of the gun had not been increased. The next step was to build a complete new carriage for the 75mm gun, utilizing both the gun and its hydro-pneumatic recuperator system. In this design, use was made of commercial developments in electric welding and the gun carriage parts were fabricated of welded alloy steel plates, replacing the former type of construction which consisted of steel castings and riveted plate sections. The new carriage was made of the so-called split-trail type permitting the gun to be elevated between two trails and allowing a high angle of elevation—45 degrees. The angle of traverse of the gun at the same time was increased from 6 degrees, permitted by the French carriage, to 90 degrees, obtainable with the split-trail carriage. An idea of the increase in range and traverse of the new weapon so found can be gained by reference to the accompanying drawing.

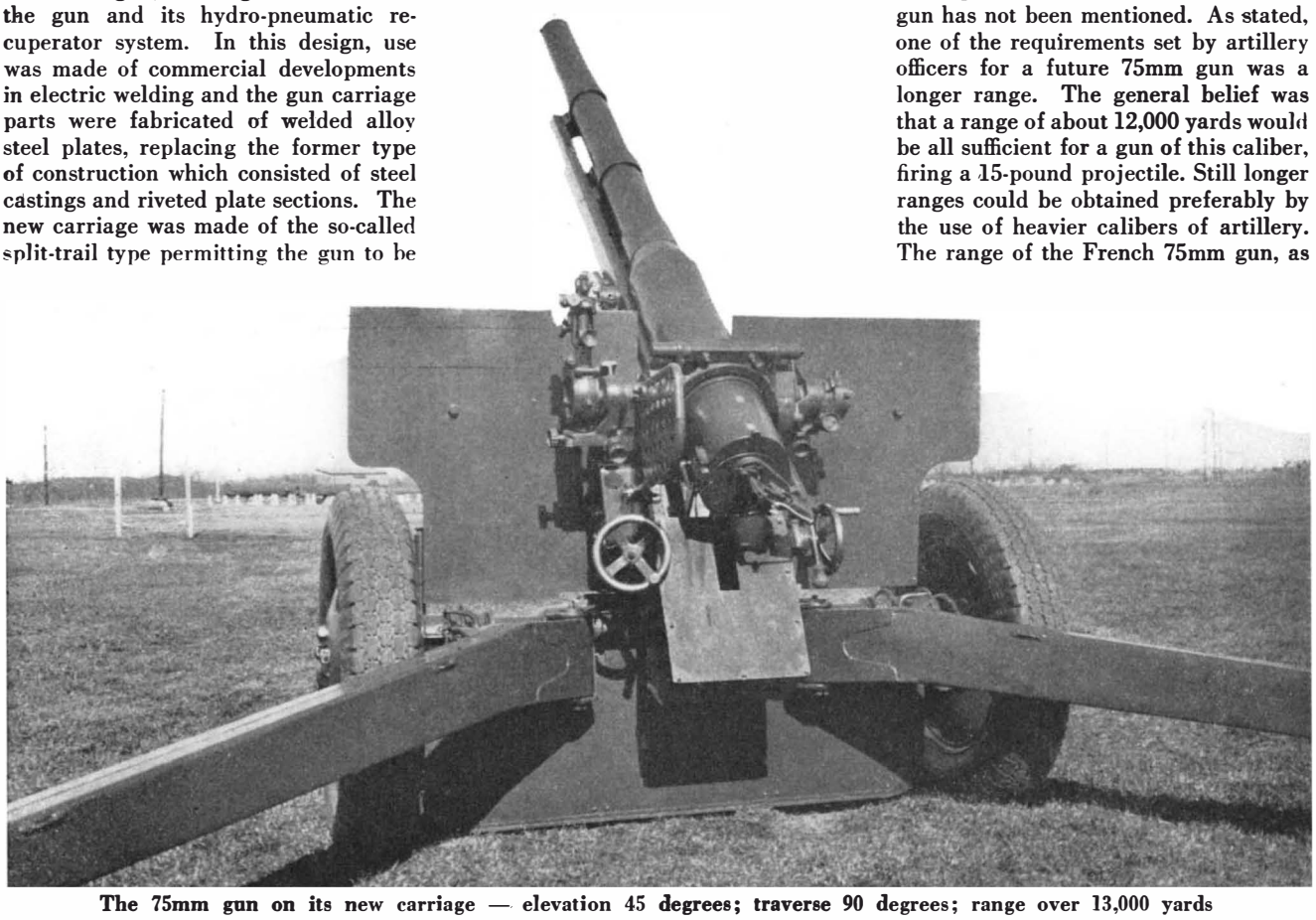


Somewhere in France during the World War: Americans manning a French 75. The gun has just been fired and shell case in the air is being thrown aside

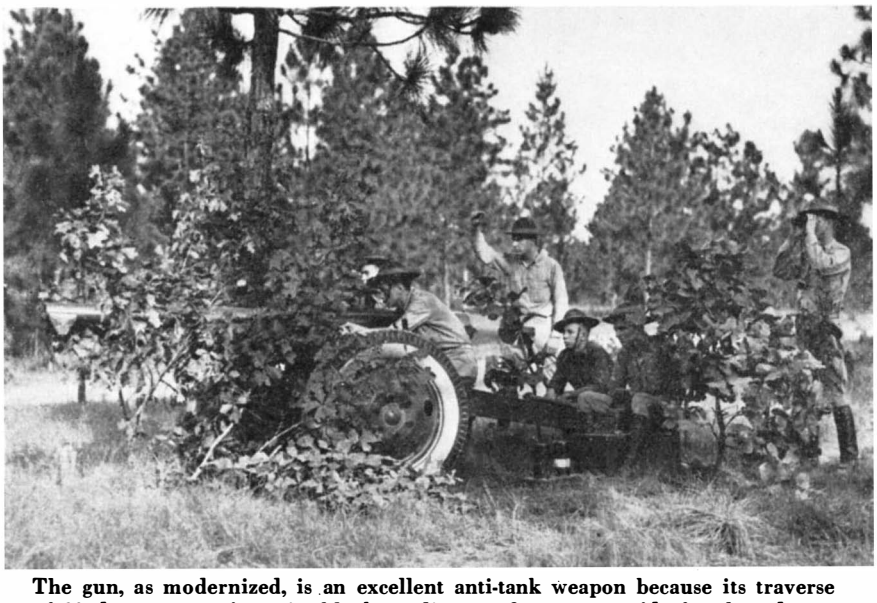


The carriage was high-speeded in this first modernization step. Split trail not yet added

In this recital of the improvement which had been taking place in the carriage for the field gun, the concurrent development in the ammunition for this gun has not been mentioned. As stated, one of the requirements set by artillery officers for a future 75mm gun was a longer range. The general belief was that a range of about 12,000 yards would be all sufficient for a gun of this caliber, firing a 15-pound projectile. Still longer ranges could be obtained preferably by the use of heavier calibers of artillery. The range of the French 75mm gun, as



The 75mm gun on its new carriage — elevation 45 degrees; traverse 90 degrees; range over 13,000 yards



The gun, as modernized, is an excellent anti-tank weapon because its traverse of 90 degrees permits point-blank or distance fire over a wide fan-shaped area

used during the World War, was approximately 7000 yards. Through a combination of changes in the design of the carriage permitting 45-degree elevation and by the improvement of the ballistic shape of the projectile, this range has been increased to over 13,000 yards. The design of the projectile has been refined by giving a better streamlined shape, and the resistance of the projectile in passing through the air has been greatly decreased. Thus, at a very small cost, it has been possible to convert our stocks of 75mm guns remaining from the last war into new weapons fulfilling all the service requirements for a modern division gun.

THE mission of field artillery is to assist the other arms, particularly the infantry and cavalry, in combat by fire power. In carrying out this mission, the division gun is used to produce many types of fire: destructive fire to render the target useless; neutralization fire for the purpose of lowering the fighting efficiency of the enemy personnel by inflicting severe losses; concentration fire by means of which a concentrated volume of fire is laid over a limited area; the various kinds of barrages, such as the standing, box, and rolling types.

In recent years, a new target requiring another kind of fire has appeared upon the modern battlefield—the high-speed tank. Most modern armies are now equipped with tanks capable of moving across country at high rates of speed, and are prepared to use these tanks in making mass attacks against opposing forces. Tanks now have been developed to the point where machine guns and other hand-carried weapons are no longer effective against them. Weapons of special design, such as the 37mm anti-tank gun, are required to penetrate tank armor. When tanks are used in large numbers there will usually be a deficiency of anti-tank guns to meet these mass attacks. Consequently, every available weapon must be utilized to assist in stopping them. The 75mm gun on its new carriage forms a very effective anti-tank weapon.

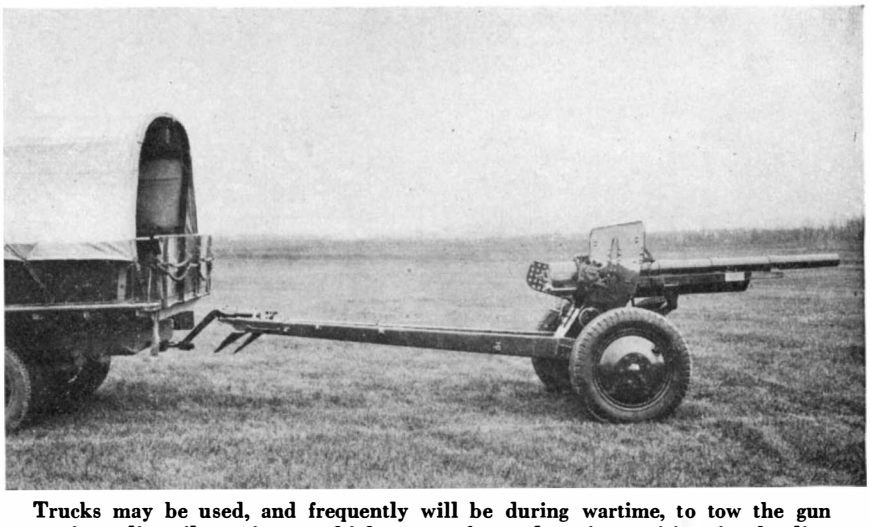
It will be appreciated that the French 75mm gun carriage with its limited traverse of 6 degrees could not have been employed for firing at a tank travelling across country at 15 to 20 miles per hour. It would have been impossible to shift the trail of the gun from one position to another rapidly enough to follow the movements of the target. The new gun carriage with its traverse of 90 degrees makes possible a type of fire with the 75mm gun not heretofore obtainable. The drawing shows the great field of fire which can be effectively covered with the 75mm gun. Artillery, in most situations, would be emplaced some distance behind the position of the 37mm anti-tank guns. But assuming that the tank attack should pass the line held by the anti-tank guns, the ability to bring rapid, effective fire upon high-speed tanks with the 75mm gun greatly enhances the value of this weapon in modern warfare.

To make this discussion of the division gun more complete, it should be stated that most armies, including our own, are now adding another division weapon to supplement the fire of the 75mm field gun—the 105mm howitzer. The advantages of the howitzer are principally increased weight of projectile—double that of the *gun* projectile, giving at the same time the almost equivalent range of 12,000 yards for approximately the same weight of weapon, and the further advantage of a plunging type of fire. As the enemy usually seeks concealment behind slopes and hills, the howitzer, through its curved-trajectory projectile, can bring more effective fire to bear than a flat-trajectory gun. While it may be said that the trend in division artillery is toward the use of more 105mm howitzers, the new battlefield requirement for use of division guns as anti-tank weapons assures the gun of an important new role on the battlefield of today.

Science and modern engineering have thus made possible conversion of our large and valuable stock of 75mm guns into modern division guns. These new weapons will meet all service requirements as to power and mobility. Through re-design the gun has become an anti-tank weapon of first importance. These 75mm guns, augmented by powerful 105mm howitzers, will provide for the American Army artillery second to none.

●

Colonel Barnes' article is vastly important since it indicates that we have an ace in the hole to help scare off would-be aggressors. Other "aces" have been discussed by us previously; still others are yet to be explained to our readers. Soon to come, for example, is an article by Acting Secretary of the Navy Charles A. Edison on the power plants of the new destroyers. Another will be on tanks and Army mechanization in general. Look for them.—The Editor.



Trucks may be used, and frequently will be during wartime, to tow the gun on its split-trail carriage at high rates of speed to its position in the line

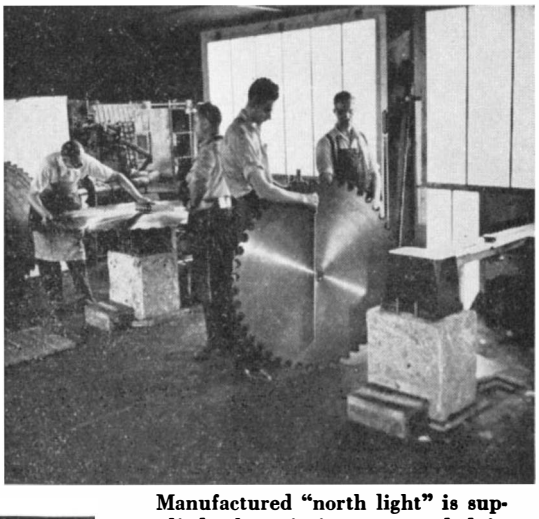
In this air conditioned, scientifically lighted plant are 700 workers, and offices and engineering departments

Controlled Comfort For Workers

THE world's first designed windowless factory, in which working conditions are constant and unchanging the year 'round, is in operation in Fitchburg, Massachusetts. Lighting was scientifically designed to give optimum visibility at all tasks; air conditioning provides the highest degree of physical comfort for workers; exhaust fans and ducts carry away dusts and heat of all operations; and color plays an important part in maintaining worker morale and promoting efficiency. The plant is that of the Simonds Saw and Steel Company, and was designed, built, and installed by The Austin Company. It was begun in 1931 but held up during intervening years because of the depression.

The Simonds company has concentrated in this five-acre room all the operations formerly carried on in three old plants totalling 17½ acres. These include everything from forging and heat-treating of steel to the sharpening and shipping of saws, machine knives, files, and other cutting tools.

The blanket of "cold" light, which is laid over everything by the more than 1400 100-watt fluorescent tubes, never varies, assures each employee absolute uniformity of light at his job at all times.



Manufactured "north light" is supplied where it is most needed in the great partitionless factory room

Eight self-contained production lines, each with a complete sequence of heat-treating to finishing facilities, function smoothly in the five-acre room

The atmosphere inside the plant is kept clean, cool, and comfortable despite the presence of some 70 heat-treating furnaces and more than a thousand individual motor-driven grinders, cutters, and other machines which are in almost constant operation and throwing off heat, dust, and smoke.

Five changes of air per hour are provided by large air-conditioning units which circulate 400,000 cubic feet of air per minute through 3000 feet of overhead ducts.

Special foundations and shock- and sound-absorbing insulation isolate the noise and vibration of four big drop hammers as well as dampening other factory noises and even the sound of voices in the offices. All machines are painted a bright yellow; all furnaces and benches are painted with aluminum; all steel columns, stairs, walkways, and the ceiling are a light cream.

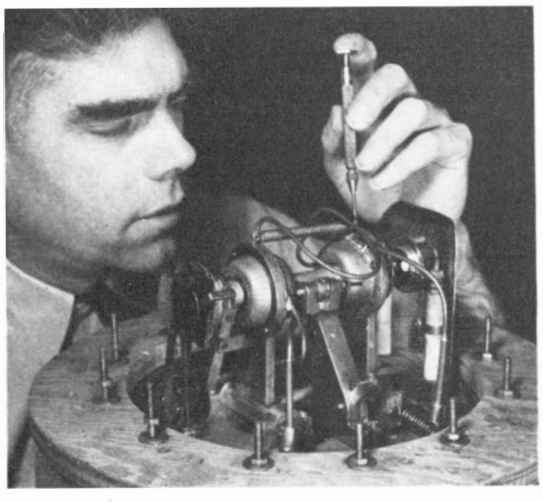
ELECTRONS DANCE THE RHUMBA

Klystron, Generator of Powerful Ultra High-Frequency Radio Waves . . . Useful in Blind Landing System for Planes . . . Other Possibilities

By ANDREW R. BOONE

DOWN the lower side of a cigar-shaped radio beam, an airplane flown by Capt. Milton M. Murphy and Jack Haynes, Civil Aeronautics Authority inspector, glided repeatedly to safe landings on East Boston airport in Massachusetts recently. These flights demonstrated for the first time a practical application of the klystron, an invention developed by scientists at Stanford University which generates ultra-short radio waves that can be directed as a searchlight directs a beam of light. The radio waves are sent out from a copper antenna which has only the thickness of a match and is but four inches long.

The klystron, which promises to revolutionize certain phases of, and to bring greater safety to, airplane operation, is an ultra short-wave, ultra high-frequency radio generator. Radio experts have called it "the most important advance in radio since Lee De Forest invented the audion tube in 1908."



Sigurd Varian, one of the inventors of the klystron, adjusting one of the two rhumbatrons that produce ultra high-frequency waves

Already, in the laboratory and on the airport, the klystron has demonstrated its ability to produce waves of a strength hitherto unattainable in high-frequency apparatus, waves which are only one tenth as long as any previously used. These waves may be focused and directed along an almost straight line, and pilots receiving them are not confused by a jumble of signals from several sources.

THE story of how the klystron was created, what it is, and how it operates at frequencies almost beyond comprehension, involves a Pan-American Airways pilot, a television engineer, and a professor of physics.

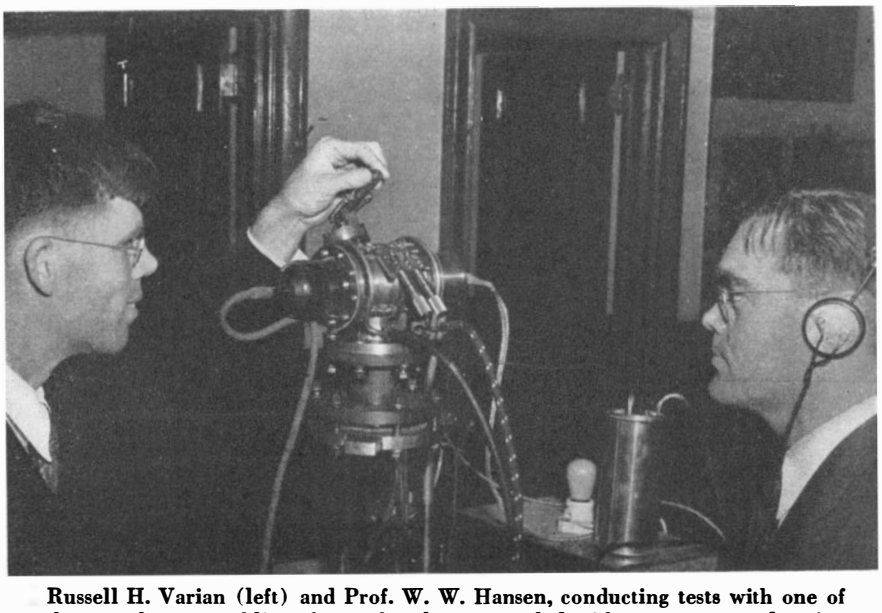
Some time ago, William W. Hansen, Stanford University physicist, was attempting to develop a new kind of atom smasher. Instead of the usual type of coil-and-condenser resonator he devised a method whereby radio waves could be made to surge back and forth within a copper tank. Because the rhythmic surging reminded a laboratory assistant of the rhumba, the little copper tank was dubbed the "rhumbatron."

Scarcely had the physicist announced this device when Flight Captain Sigurd Varian, who for eight years had been piloting fast land planes over Mexico and Central America, heard of it. While bucking storms over Panama and Guatemala, Varian realized aviation's greatest needs were for a successful blind landing system and for an absolute terrain clearance altimeter. Ultra-high electrical frequencies, he thought, held the secret. Perhaps the rhumbatron was the answer.

Shortly Varian and his brother, Russell, who had been doing research on television, became research associates at Stanford. Russell supplied ideas, Sigurd tried to work them out. One big problem was how to supply energy to the rhumbatrons at the very high frequencies needed. After many ideas that had to be abandoned, Russell finally thought of a simple way to excite the rhumbatron circuit and a working model was built. Professor David L. Webster, executive head of the physics department, became interested, and, among other things, worked out the mathematical theory of the process. Soon a design was evolved for the klystron—a high-power generator using two rhumbatrons—models were built, and the invention was ready to be shown to the world.

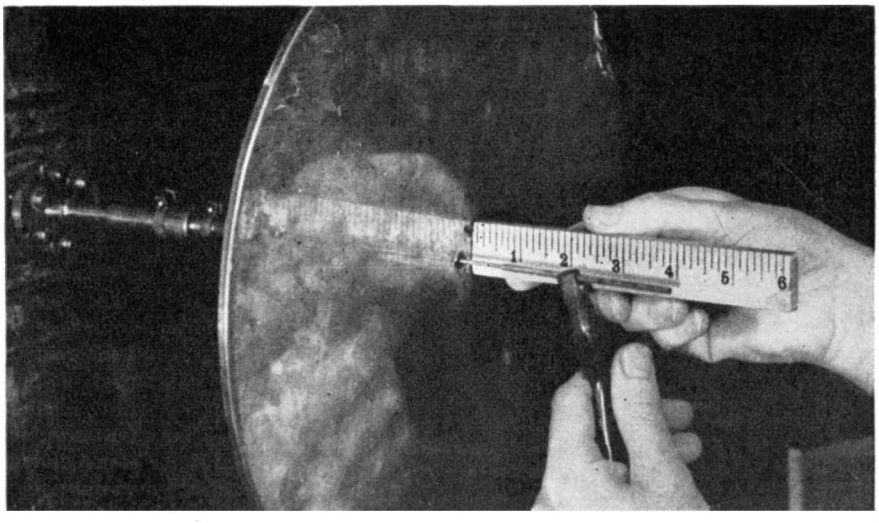
What had the inventors created?

The klystron ultra high-frequency generator utilizes the fact that an electric field inside a rhumbatron can be made to influence the speed of electrons. In operation, a cathode emits a continuous stream of electrons. Surging forward under the impetus of 3000 volts, these speed through the first rhumbatron



Russell H. Varian (left) and Prof. W. W. Hansen, conducting tests with one of the complete assemblies of two rhumbatrons sealed within an evacuated casing

at nearly 20,000 miles a second. This rhumbatron causes the speed of some electrons to increase slightly, forces others to slow down, while intermediate electrons race forward with unchanged speed. Leaving the first rhumbatron, known as the "buncher," the electrons speed down a short copper tube, and by the time they reach the second rhumbatron, called the "catcher," the faster electrons have caught up with the slower electrons preceding them, to form bunches. The bunches successively pass through the catcher at a frequency of three billion cycles per second, or even more. Through delicate synchronization of the buncher and catcher, the bunches are timed to go against an alternating current field within the catcher. This resistance causes the electrons to lose their energy of motion which instantly becomes converted into high-frequency electrical energy. Thence this energy flows to the tiny antenna.



Ultra high-frequencies are transmitted from the tiny antenna projecting through the disk. Antenna length is adjusted by sliding the copper tube on the rod

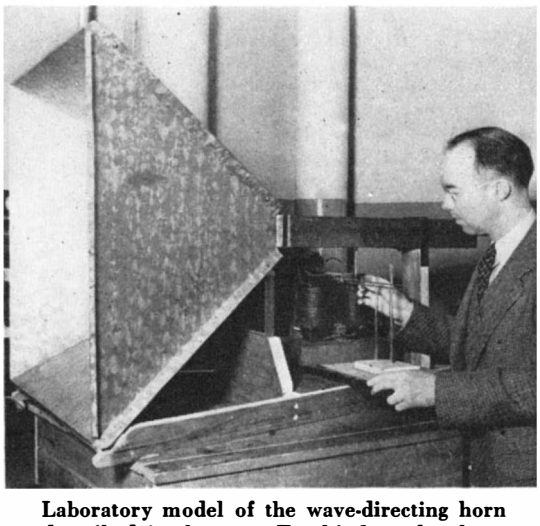
ONLY when the two rhumbatrons are synchronized will the pulsing electrons produce power. Tuning is accomplished by turning a micrometer screw which adjusts the distance between two grids through which the bunched electrons flow.

Recently I observed, while visiting the Stanford physics laboratories, a startling demonstration of this machine's power. One by one, Professor Hansen brought several types of lamps into the beam. Seven ordinary 60-watt globes, to which short receiving antennas had been soldered, glowed brilliantly when brought near the reed-like mast. "This," he pointed out, "will give you an idea of the amount of power produced." Two fluorescent lamps were held near the antenna, one parallel and the other at a sharp angle. The former remained unlighted, while the second gave out brilliant light, demonstrating graphically the wave's polarization. Again, Hansen held a filament light in position, and the filament glowed in alternate four inch sections. Here I saw the standing wave patterns, each light and dark space representing one quarter of a wavelength.

This was, of course, a laboratory display. The tests at East Boston served as proof of the pudding. During these flights, the same antenna flashed the signals that guided the airplane earthward. It was a sort of preview of more startling innovations to come.

Other scientists enter the picture here. Irving R. Metcalf, head of the Civil Aeronautics' Authority technical division, had evolved an idea for improving blind landings. He laid the problem before Professor Edward L. Bowles, Massachusetts Institute of Technology electrical engineer. As a result, a system was developed which involved transmission of two radio waves from the same spot.

The system, however, possessed too little power, so the eastern experimenters called upon the western inventors for help. A klystron, built at Stanford by J. R. Woodyard, a graduate student, was flown east to Boston. At the East Boston airport it was connected to an ingenious horn invented by Professor W. L. Barrow, another M. I. T. electrical engineer. This device made possible the transmission of a highly directional beam of radiation. The beam's characteristics can be explained this way: As the radio waves leave the horn, they lose intensity, in accordance with well known laws. At any particular distance from the source the greatest intensity will be found on the axis of the beam. Now the pilot's blind landing instruments are adjusted to indicate to him a path of equal wave intensity. Thus, if one thinks of the pilot as being on the beam axis at a point, say, 500 yards from the radio source, then in order to follow, by his instruments, the path along which the radio intensity will remain the same as at that point, he must drop below the axis and follow a slightly curved path, since obviously the equal-intensity path must depart from the axis. The shape of this path may be thought of as like that of the surface of a cigar. Advantage of the path created by ultra-short waves is that its curvature permits the pilot to glide fairly evenly to the ground.



Laboratory model of the wave-directing horn described in the text. To this horn has been adapted the klystron high-frequency generator

IN the future, Sigurd Varian believes, "sandwich" landings will be feasible, in which the pilot glides down a straight-line path along which the signals from two beams are equal. He thus will be "sandwiched" between the upper and lower beams emerging from two horns, one tilted higher than the other. So precise will be the path formed by the two beams that the pilot will need only to start down at a safe rate of descent and by consulting three lights on his instrument panel whose flashes signal his position (a device invented by Metcalf) keep to his gliding course.

Here, radio engineers believe, science has developed a radio searchlight, which opens the way to greater safety not only in the air, but also on the sea. By throwing the beam in any desired direction, many useful things can be done.

Other possibilities lie in new directions. The klystron's ability to produce short waves may make it possible for a million people to talk simultaneously through a single circuit. Operating on very high frequencies, hundreds of television channels can broadcast pictures and sound, where today one channel is available. Surging electrons, breaking like waves on a beach, have opened many fields which engineers will conquer as time goes on.

THE PITTSBURGH OF OLD PALESTINE

American Archeological Excavations at an Arm of the Red Sea Bring to Light a Buried City with a Smelter in which King Solomon Refined his Copper

By NELSON GLUECK
Director, American School of Oriental Research, Jerusalem

GREAT commercial enterprises were bound up in ancient times with the spices of Sheba and the gold of Ophir. Solomon was the first—and the last—king in Jerusalem, who not only benefited from the overland trade route to Arabia, but also took full advantage of the sea route from Ezion-geber to Ophir:

"King Solomon made a fleet of ships in Ezion-geber, which is beside Eloth on the shore of the Red Sea in the land of Edom. Once in three years the fleet came in, bringing gold, silver, ivory, apes, peacocks, a very great amount of sandalwood, and precious stones." (I Kings 9.26; *10*.22,11)

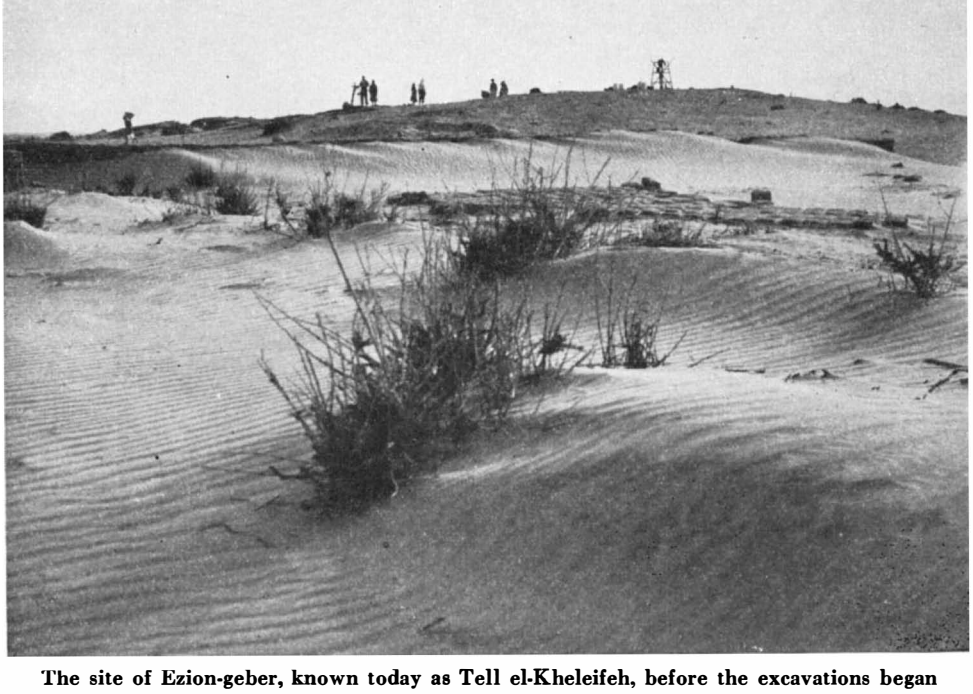
Enterprising entrepreneur that Solomon was, his shipping line evidently made such inroads in the lucrative caravan trade that had probably been largely in the hands of the Queen of Sheba, that she hastened to Jerusalem with all manner of presents, in order to conclude an amicable trade agreement with him.

"Now when the Queen of Sheba heard of the fame of Solomon . . . . she came to Jerusalem with a very great retinue, with camels bearing spices and very much gold and precious stones. As soon as she came to Solomon, she told him all that was on her mind, and Solomon answered all of her questions. . . . . Then she gave the king one hundred and twenty talents of gold, and a very great quantity of spices and precious stones. . . ." (I Kings *10*.1,2,10).

A satisfactory commercial treaty was evidently negotiated between the two sovereigns, because we are informed that "King Solomon gave to the Queen of Sheba all that it pleased her to ask, besides what he gave her according to his royal bounty." (I Kings *10*.13).

The pro-Arabian policy of Solomon was all the more natural in view of the fact that along the eastern border of his kingdom lay great deposits of copper and iron. They yielded the commodities he could exchange for the spices of Sheba and the gold of Ophir. A long part of the trade route between Arabia and Palestine traversed this border stretch of land known today by its ancient name, the Arabah. It is a great rift extending between the southern end of the Dead Sea and the Gulf of Aqabah, as the northeastern arm of the Red Sea is now called. It separates the territory of southern Transjordan from that of southern Palestine, and marked anciently the dividing line between Judah to the west and Edom to the east. The archeological survey expeditions of the American Schools of Oriental Research, Jerusalem and Baghdad, have mapped a long line of copper—and iron—mining and smelting sites in the Arabah, extending from near its north end all the way to the Gulf of Aqabah. The presence of most of these sites was previously unknown. They are marked by large slag heaps, the ruins of miners' huts and smelting furnaces, and great walled compounds in which the slave laborers were lodged and guarded. The pottery remains indicate indubitably that the period of main activity in these mining camps coincides with the reign of Solomon in the 10th Century B.C. These discoveries cast a new light on Deuteronomy 8.8-9, in which the Promised Land is described as: "a land of olive oil and honey; a land where you may eat bread without scarceness, lacking nothing; a land [in this instance the Arabah] whose stones are iron and out of whose hills you can dig copper."

EXCAVATIONS conducted in the spring of 1938 and again in the spring of 1939 by the American School of Oriental Research, Jerusalem, under the direction of the writer, at Tell el-Kheleifeh near Aqabah, have resulted in uncovering part of the buried city of Ezion-geber, which served as King Solomon's naval base. The location of Ezion-geber was conditioned by a number of factors. At first glance one wonders what induced the original builders to choose the particular site they did, because it is about the most uninviting one along the entire shore of the northern end of the Gulf of Aqabah. Situated in the bottom of a curve which is banked on the east side by the hills of Edom which continue into Arabia, and on the west side by the hills of Palestine which continue into Sinai, Ezion-geber is open to the full



The site of Ezion-geber, known today as Tell el-Kheleifeh, before the excavations began

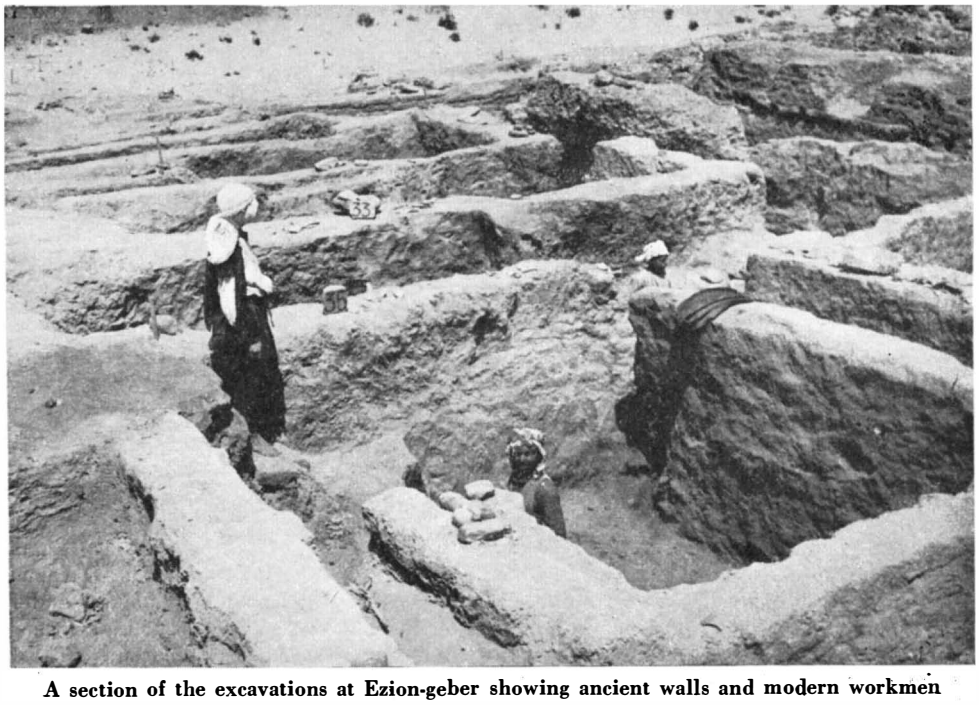
fury of the winds and sandstorms from the north that blow down the center of the Arabah as if driven by a draft forced through a wind tunnel.

The site of Ezion-geber is somewhat more than 500 yards removed from the gulf, and is about half way between Aqabah in Transjordan, and Mrashrash in Palestine. It is not difficult to understand why Ezion-geber could not have been built farther to the west. From Mrashrash to the site of Ezion-geber, there is no sweet water obtainable in a distance of some three miles for drinking purposes. The point where the sweet water wells begin is marked almost exactly by the location of the ruins of Ezion-geber. From there eastward, there is a continuous line of such wells, increasing in number the closer one gets to Aqabah, and marked by a correspondingly increasing number of date palm trees between the two points. While one realizes, then, why the early builders of Ezion-geber could not very well have built farther to the west, one wonders at first why they did not build

Showing the precise location of the site of ancient Ezion-geber

farther to the east, nearer to Aqabah, where there is more water and more protection from the winds and the sandstorms that blow fiercely and frequently, especially along the line of the location of Ezion-geber, in the center of the southern end of the Arabah. The actual excavations were to reveal that the founders of the city had considerable method in their madness, so to speak.

The excavations were for various reasons begun at the northwest end of the mound, not the least of them being consideration for the direction of the winds. It was found that all the houses were made of mud brick. A large mud brick building with ten rooms was opened up, which occupied the entire



A section of the excavations at Ezion-geber showing ancient walls and modern workmen

northwest corner of the mound. It soon became evident that this was not an ordinary large building or palace, but a completely novel type of structure, the like of which had not previously been discovered in the entire ancient Near East. The walls of the rooms were pierced with two rows of flues, and the main walls were interconnected by a system of air channels inside the walls, into which the upper rows of flues opened. The spaces between the two rows of flues had been turned green by reason of the sulfurous gases to which they had been exposed. The originally unfired yellowish mud bricks had been baked by the heat of the fires in the rooms to the consistency of kiln-fired bricks. Masses of hard baked clay debris, on which the pottery crucibles had been placed, completed the picture.

It became evident that the building was an elaborate refinery, where previously roasted ores were worked up into ingots of purer metal. It was obvious both from the sulfuric discoloration of the walls, the fragments of raw ore found, and the numerous finished articles discovered in the site, that the refinery at Ezion-geber was devoted largely to copper, of which great quantities abound in the immediate vicinity and along most of the length of the Arabah, and in adjacent Sinai. A long period of mining and smelting and refining must have preceded the construction of the elaborate refinery at Ezion-geber. The Kenites who were native to the country, and whose very name indicates that they were smiths, and the related Kenizzites who were also smiths by profession, were in all probability the ones who introduced the Israelites and the Edomites to the arts of mining and metallurgy. It will be recalled that Moses took a wife from the Kenites, and that the Israelites ever afterward maintained the closest relationship with them. The Edomites, too, were related to the Kenites through the Kenizzites. The Bible tells us that Tubal-Cain (a Kenite), was the first forger of copper and iron instruments, and that the Kenizzites lived in the Valley of the Smiths, which we take to be the Wadi Arabah, with its long line of copper mining and smelting sites.

EZION-GEBER was thus more than a seaport. It was primarily a great industrial center. The second season's excavations revealed the presence of additional similar smelting and refining plants. The reason, then, why the original builders of Ezion-geber chose the inclement site they did for the location of their city, was because they wanted the strong winds blowing from a known direction to furnish the draft for the furnace rooms in the refineries and to enable them to dispense with an expensive and burdensome bellows system. It was a matter of harnessing the elements for industrial purposes. More important to them than much water for fine palm groves, and protection from sandstorms in a location farther to the east, were strong winds which would enable them to operate, without a hand-bellows system, the refinery with its intricate system of flues and air channels. That Solomon built this great industrial and shipping center has been proved by the discovery of a very strong three-doored gateway, similar to the one he built at Megiddo, and almost exactly the same as the one built by him at Lachish.

Solomon's copper and shipping interests, coupled with his rôle as im-

porter of spices and other precious products from Arabia, do not by any means exhaust the list of his major activities of commercial importance. As a result of all his immensely successful undertakings, the comparatively little kingdom he ruled over became a first-rate power among the nations in the ancient Near East. Its importance was altogether out of proportion to its size. Hardly had Solomon established himself firmly on the throne than he embarked upon a great system of public works which extended throughout the length and breadth of the land.

THE resplendent temple in Jerusalem was built; also a new palace, and fortifications for the city. Key fortresses were erected or strengthened throughout the country, store cities set up to preserve great supplies for emergencies, huge barracks to house his large standing army, and great stables for his chariots and the horses of his cavalry regiments, the figure of whose personnel is given as twelve thousand. Excavations at Megiddo have revealed the stables which were constructed there for Solomon, complete with rows of stalls and stone mangers and stone hitching posts. To carry out his building program, Solomon did not even hesitate to draft thousands of his own subjects into compulsory labor battalions: "And this is the reason of the levy which King Solomon raised, in order to build the House of the Lord, and his own palace, and Millo, and the wall of Jerusalem, and Hazor, and Megiddo, and Gezer . . . And Solomon built . . . Beth-horon,

Sifting the debris to find the smallest objects it might contain

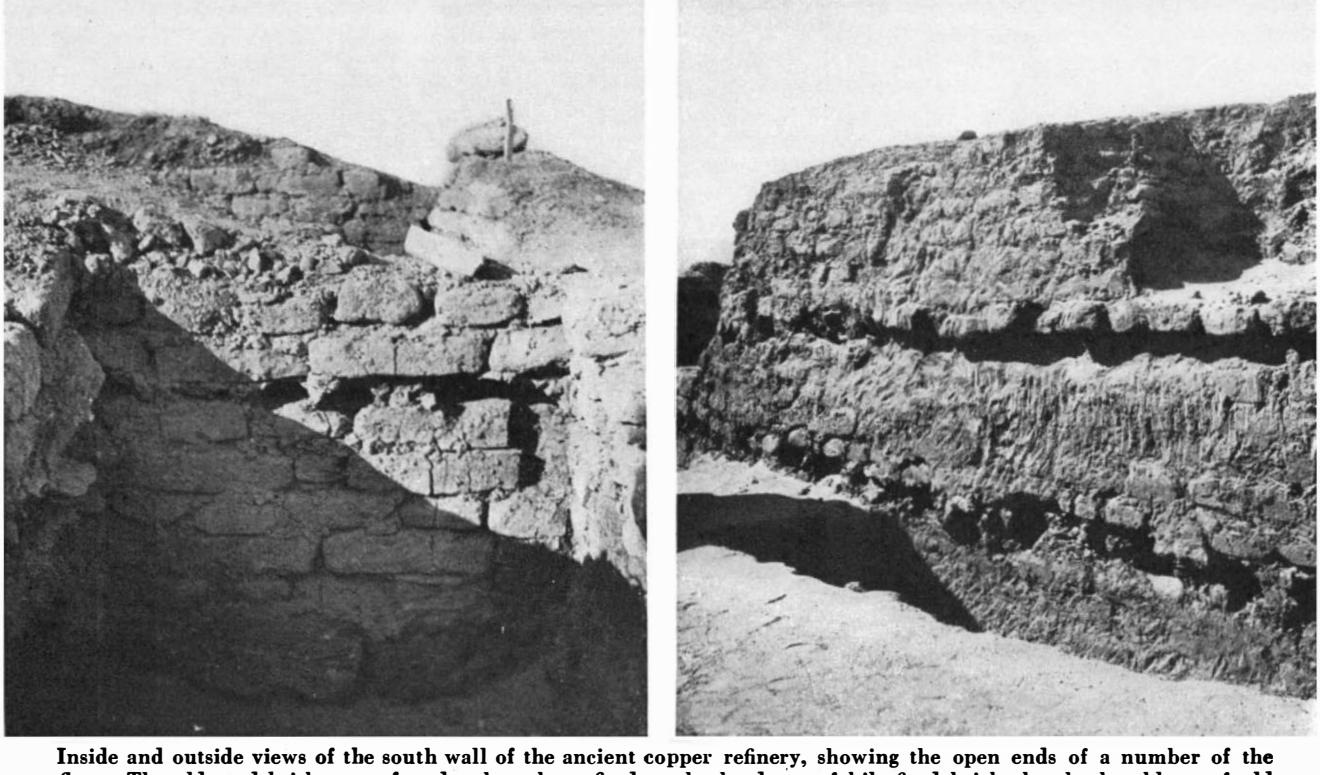
and Baalath, and Tadmor in the wilderness; and all the cities of store, and cities for his chariots, and cities for his horsemen. Solomon had forty thousand stalls of horses for his chariots, and twelve thousand horsemen." (I Kings *9*.15-19; *4*.26; *5*.27-28).

All the stables which Solomon had constructed were not, however, intended solely for his army's horses. Solomon was in the literal sense of the word a horse trader. He was also a dealer in chariots: "And Solomon had horses brought out of Egypt, the king's traders receiving them at a price. A chariot could be imported from Egypt for six hundred and fifty shekels of silver, and a horse for a hundred and fifty. Thus through their means trade was carried on with all of the kings of the Hittittes and the kings of the Aramaeans." (I Kings *10*.28-29).

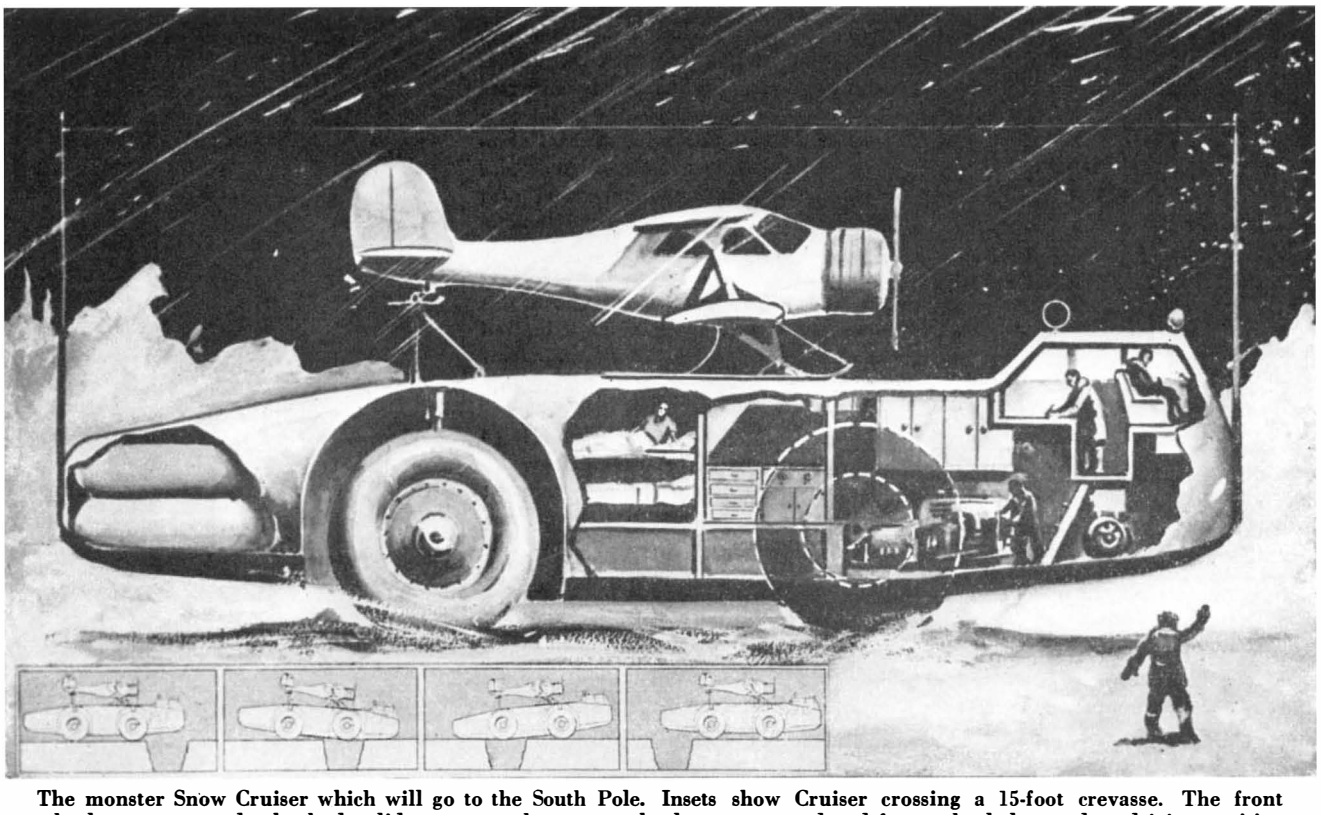
It is understandable, then, in view of all of Solomon's industrial and commercial activities, that there was a remarkable economic development in Israel during his reign. He established himself as the great middleman for the overland trade between Egypt and Arabia on the one hand, and the Hittitte and Aramaean kingdoms to the north of his territory on the other. For much of his imports he must have paid with the copper extracted from his mines in the Arabah and refined at Ezion-geber. There is indeed a basis in fact for the Biblical accounts about the fabulous wealth of Solomon: "The weight of gold that came to Solomon in a single year was six hundred and sixty-six talents of gold, besides that which came from the traffic of the merchants, and from all the kings of Arabia, and from the governors of the land . . . The king made silver in Jerusalem as common as stone, and he made cedars as plentiful as the sycamore trees that are in the foot-hills." (I Kings *10*.14-15.27).

●

Though war has already limited the field excavations of the archeologists—the "digs," as they call them among themselves—this magazine will endeavor to present articles about significant digs if the war leaves one man to dig and one more to read. Fortunately, when war cramps the archeologist's work he still can work up material he has dug up while the digging was good and stored away.—The Editor.



Inside and outside views of the south wall of the ancient copper refinery, showing the open ends of a number of the flues. The old mud bricks were found to have been fired to the hardness of kiln-fired bricks by the hot blasts of old



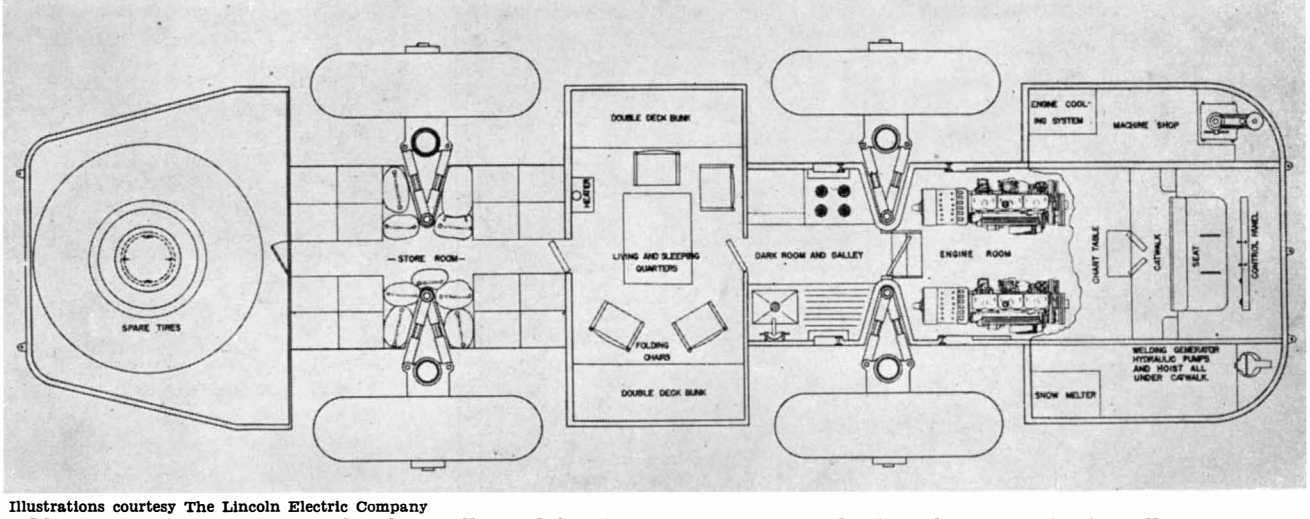
The monster Snow Cruiser which will go to the South Pole. Insets show Cruiser crossing a 15-foot crevasse. The front wheels are retracted; the body slides across; then rear wheels are retracted and front wheels lowered to driving position

The Snow Cruiser, A Mobile Base For Antarctica

WHEN the government-sponsored South Pole Expedition commanded by Admiral Byrd arrives in the Antarctic sometime this winter, it will have a unique vehicle which will be used as a mobile base. Designed by Dr. Thomas C. Poulter, it looks like a cross between a huge bus and a military tank. It is so constructed that it can negotiate rough ice fields, cross crevasses up to 15 feet wide, will make speeds up to 25 miles an hour, and have a cruising range of between 5000 and 6000 miles.

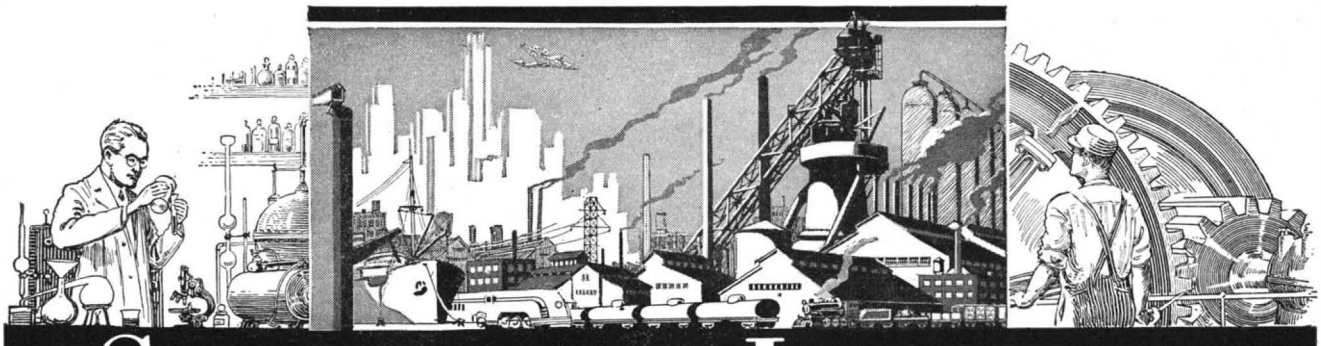
The craft will be 55 feet long and 15 feet wide, and will carry on its roof a five-passenger airplane. Its cost will be $150,000, its weight 75,000 pounds, and its body will be completely arc-welded and so insulated that the crew may keep warm when the temperature outside is 100 degrees below zero. Inside will be a control room, engine room, galley, living quarters for four men, a store room, and cargo space. The pneumatic tires will each weigh close to 1500 pounds. Hydraulic control of each axle permits the Snow Cruiser to "lift its own foot" so that a roof derrick may be used to change tires. A special device in each wheel keeps the air pressure constant by pumping in or releasing air as need be. The adjustable mounting of the wheels permits retraction of some wheels to allow the vehicle to slide over obstacles. Each wheel will be independently driven by a 75-horsepower motor, all being powered by two generators driven by two 150-horsepower Diesel engines.

The expedition will confirm the claim of the United States to a strip of land some 600 miles wide in the Antarctic, and it is expected that the Snow Cruiser will drive straight to the South Pole and remain there for a number of months.



Illustrations courtesy The Lincoln Electric Company

Plan view of the unique vehicle which rolls or slides. Here are shown control cabin, chart room, bunks, galley, engines, store room. Note independent mounting of separately controlled wheels. Fuel tanks are along center line under floor



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

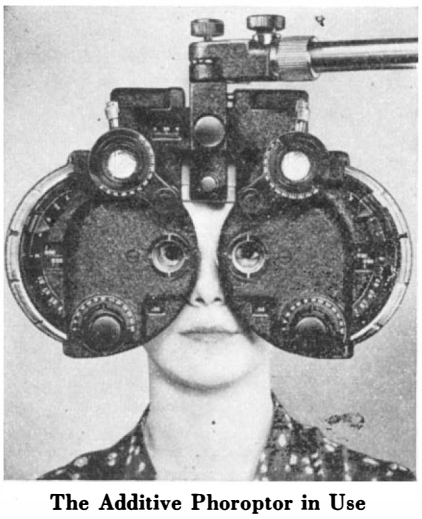
Versatile Eye-Testing Machine

MORE accurate and speedier eye examinations are made possible by the development of a remarkable eye-testing instrument capable of placing an infinite number of different lens combinations before the eyes. In actual figures, the batteries of lenses contained in the device permit the amazing total of 61,060,386,816 different prescriptions, according to Dr. J. F. Neumueller, director of American Optical Company's bureau of visual science, who announced recently a new model of the instrument, far superior to the original developed a few years ago.

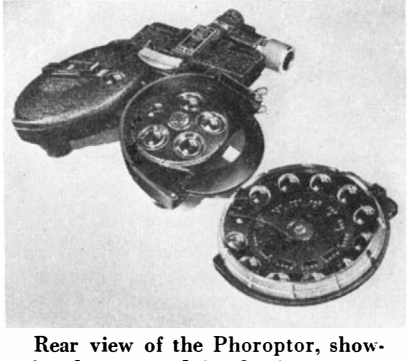
For many years prescriptions for glasses were arrived at by inserting different lens combinations into a spectacle frame held before the eyes. This was done by hand, and the procedure to obtain an accurate prescription was slow, awkward, and often inaccurate.

In an attempt to speed up the eye examination and make it accurate, the Additive Phoroptor was developed. The instrument contains batteries of test lenses; by manipulating dials and knobs, different lens combinations can be placed before the eyes with astonishing rapidity. An ingenious mechanism within the instrument automatically adds the individual lens powers and records the total correction on an indicator. From this reading, glasses are then made up.

The design of the instrument's lens system involved a mammoth task of mathematical computations, Dr. Neumueller stated, as not only the lens curvatures and thickness, and the distance between the lenses, but also the position of the lens system before the patient's eyes had to be controlled to assure the accuracy of prescriptions for glasses.



The Additive Phoroptor in Use



Rear view of the Phoroptor, showing lenses used in the instrument

Improved White Lead

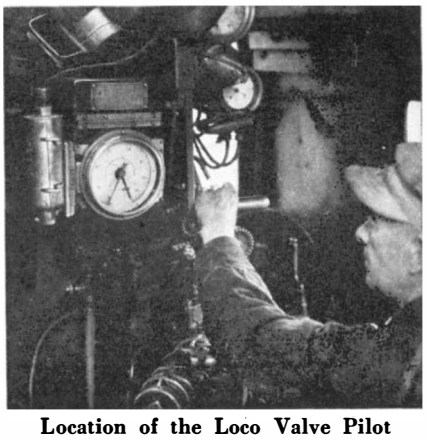
IMPROVED manufacturing technique in the production of white lead has resulted in three interesting developments which are important to the paint user. The light-reflective quality of white lead has been increased from approximately 81 percent to about 90 percent and this results in an economy in the amount of artificial lighting necessary in the average home or office. Pure magnesium oxide, the whitest substance known and therefore the one used as a basis of comparison in photometric tests, reflects only about 7 percent more white light than does white lead. Light-reflective qualities of paints which differ in their intensity by only a few degrees are not observable by the ordinary layman but, nevertheless, do bring about an appreciable economy.

Still another improvement due to the new manufacturing technique has been an increase of almost 23 percent in hiding, or covering, power which, while again not noticeable to any but the technician, does obviously create an advantage in making possible more economical painting; fewer gallons are required to cover a given area of surface.

A third development has been an increase in paint-thickening properties, or bodying power, of white lead which decreases the tendency of the paint to run and sag during application and hence allows for greater brushing quality.—*C. F. Greeves-Carpenter.*

Instrument Regulates Locomotive Cut-off

LOCO Valve Pilot, developed by the Valve Pilot Corporation, is putting the theory of locomotive cut-off regulation into scientific practice. As steam engine science has long known, a certain quantity of steam, allowed to expand in its natural way, will accomplish the same result for the job at hand as a greater quantity of steam. The engineer's trick is to use the minimum amount necessary. This is referred to as cut-off, or fixing the steam supply to the cylinders at a certain point for maximum economy and efficiency.



Location of the Loco Valve Pilot in the cab of a steam locomotive

To reach this goal, the Loco Valve Pilot is first a speedometer which functions in the usual way. On the same dial which shows speed, another pointer gives the correct cut-off for each variation in speed. Where, formerly, an engineer could only estimate his speed by counting mileposts or guessing, he now has an accurate speedometer. Then, instead of leaning out of his cab, listening to

the puffing sound from the smokestack and approximating the cut-off accordingly, he gets instantly and continuously all the necessary information from the instrument.

The device includes a recording instrument supplied with a roll of paper on which there is charted a record of the speed and cut-off during the entire trip. At the end of the run, the supervisor of operations has a written record showing how well the engineer handled his engine, so that economies in fuel and time may be calculated.

The motion of the locomotive is used as power for working the instrument. The speedometer mechanism consists of a speed unit drive fitted on the engine in frictional contact with the tread of a driver wheel. From this point, a flexible chain shaft leads to a centrifugal governor which actuates the speed-indicating needle and recording pencil. The power for moving the tape is taken also from the flexible chain drive.

The cut-off device is based on the principle of converting the motion of the reverse shaft into cut-off. This is done by connecting the reverse shaft to a cam mechanism by means of a cam-operating rod. This action is converted into cut-off in a cam box. Finally, a cable running from the box transmits the force to the cut-off hand and recording pencil in the cab.

Germicidal Energy Meter

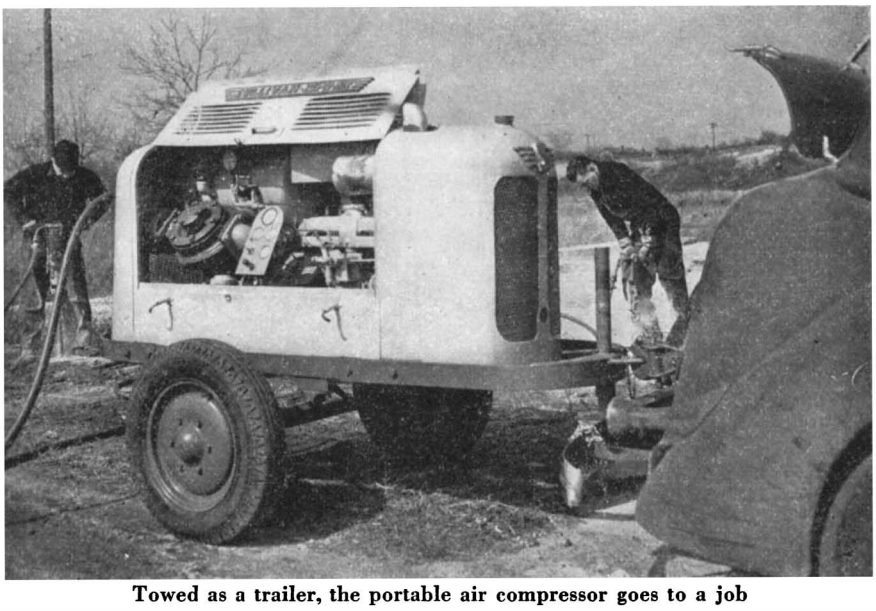
DEVELOPMENT of an easy and inexpensive way to measure the bacteria-killing effectiveness of ultra-violet from

Light meter attachment makes possible measurement of ultra-violet

germicidal lamps, has just been announced by Lighting Research Laboratory of General Electric's lamp department.

Conceived by Matthew Luckiesh, world-famous scientist and director of Lighting Research Laboratory and Contributing Editor to Scientific American, the method of measuring the germicidal ultra-violet makes use of the familiar G-E light meter.

Over the sensitive cell of the familiar light meter there is placed a contrivance consisting of an appropriate fluorescing material sandwiched between a plate of clear quartz and one of clear ordinary glass. When the quartz side of the device is toward the source of germicidal energy, the fluorescence is excited by both the germicidal energy and the energy of longer wavelengths. Light emitted by the fluorescing material is measured by the light meter. When the glass side is toward the source, the short-wave germicidal energy is absorbed and, therefore, does not excite fluorescence. The energy of longer wavelengths does excite fluorescence. Obviously, the difference between the light meter readings serves as an accurate measure of the germicidal energy.



Towed as a trailer, the portable air compressor goes to a job

Elastic "Glass"

WITH the appearance of glass, with flexibility and elasticity, with resistance to water, perspiration, alcohol, and many oils and solvents, a new material just announced may find many uses in everyday life and in industry. In its natural color it is clearly transparent, but may be made also in rich and sparkling colors such as garnet, sapphire, emerald, amber, as well as black and white. So far, no hint of the chemicals comprising this material nor of the process by which it is made have been released for publication.

At the present time this elastic "glass" is being used for making garters, belts, and braces but the manufacturers claim that it will soon go into the manufacture of luggage, handbags, women's belts, and many other similar items. Since it is quite tough, does not scuff or crack, is odorless, tasteless, and non-toxic, it probably will be adapted to the manufacture of many novelties, and one may even expect to find it as a bookbinding, for it may be stamped in gold or in silver and will take printing.

BATTLE WAGONS

THE United States has five battleships about the same age and the same general type as Britain's *Royal Oak*, which was sunk by torpedoes. They are the *Nevada, Oklahoma, New York, Texas*, and *Arkansas*.

Portable Air Compressor

CONTRACTORS often need compressed air for small jobs of breaking concrete or rock drilling, even though their work is not generally of a type that would permit them to maintain large and expensive compressors. On jobs requiring but little air it is often necessary to move large and cumbersome equipment to the site of the work. The Sullivan Machinery Company has, therefore, designed a portable compressor, called Zeph-Air, which is light in weight, unusually compact, and may be towed behind any passenger automobile or mounted on a light truck. It is rugged and powerful, and, the manufacturers claim, is more efficient in several respects than larger machines of older types. It is furnished in two models: one of which delivers air at the rate of 60 cubic feet per minute, and the other at the rate of 85.

Lintless Surgical Sponge

SURGEONS find it necessary to use some sort of sponge frequently during all kinds of operations. Sea sponges cannot be used because sterilizing and boiling breaks them apart. Hence, gauze pads and cotton pledgets are generally used. Gauze and cotton are easily sterilized but loose fibers from the cotton are a constant source of danger. Lint left in the wound may retard healing or serve as a place for bacteria to lodge.

A new type of sponge, just announced by duPont, is made from cotton fibers converted chemically into a regenerated form of cellulose. It will absorb 20 times its weight in water, is free of lint, and can be sterilized by boiling or in an autoclave. One set has been used, sterilized, and re-used, over 80 times. They have been used for eye, tonsil, and mastoid surgery—all operations in which the use of ordinary cotton in any form is dangerous.

Protecting Windows in Bombing Raids

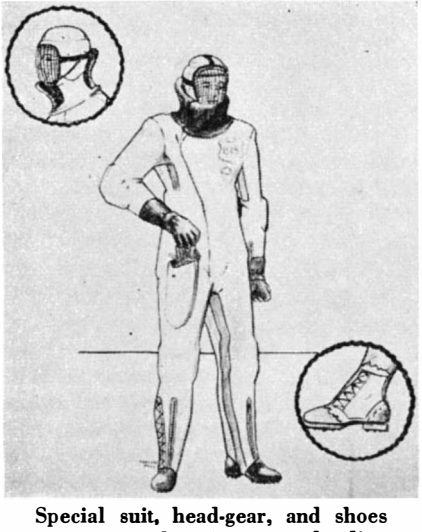
SAFETY glass, such as is used in motor cars today, depends upon the adherence of the glass to the glass's center layer of transparent plastic. This same principle (with variations) is being made use of, in European cities where bombing raids are imminent, to prevent flying splinters of glass when windows are broken by the concussion of exploding bombs.

Wire screen, cellulose sheets, and criss-cross gummed paper strips are being used

for this purpose. In addition, latex is either sprayed or painted on the glass. According to *India Rubber World*, "single sprayed coats of latex averaging 0.004 to 0.005 of an inch in thickness on ⅛-inch glass windows were found to prevent splintering when a two-pound spherical weight was dropped on the protected glass from a distance of six feet; whereas unprotected glass shattered in all directions under the same force."

Fighting Forest Fires by Parachute

THERE were enough forest fires during the year 1938 to damage 33,815,000 acres (an area almost as large as that of the state of Arkansas) with damage estimated at about $37,000,000. Anything that can be done to reduce the number of forest fires or their effects is of national importance and the United States Forest Service is to



Special suit, head-gear, and shoes protect parachute jumper on landing

be complimented on its vision in utilizing the parachute as another protective method. Experimental use of the parachute is being made in the Chelan National Forest and, while definite conclusions have not yet been drawn, the experiments are highly promising.

One way of using the parachute consists of dropping fire-fighting tools, equipment and supplies needed by the fire fighter on the ground. One carefully planned kit comprises shovel, axe, flashlight, water, rations, compass, map, first-aid equipment, and perhaps a light radio set. A simple 10 by 10-foot burlap 'chute is used.

Another method of utilizing the parachute is to drop the fire fighters themselves, after the equipment kit has been released. These men will be intensively trained and will be dropped on the "softest" spot as near the location of the fire as possible. Upon landing, the man crawls out of his protective suit, frees himself of the parachute, retrieves his equipment pack, and strikes out for the nearby fire. Two or three men may be dropped on the same spot, but one good "smoke-chaser" can do wonders. The protective suit is shown in one of our illustrations. It is worn over the clothing, is padded with sponge rubber, and has a head gear fitted with a steel face mask and neck protector. There are ankle supports, tough gloves, reinforcing straps, and other devices

Fire-fighters' supplies ready to be dropped by parachute to ground

to protect vital spots of the body from injury. In a streamlined pocket, a rope is provided for climbing or descending from a tree.

Another item of interest lies in the parachute itself. The special 'chute meets Army and Navy requirements and descends at the relatively low rate of 14 feet a second. The new type of "lobe" 'chute is said to be safer than the more conventional type because it is built with an outside convex canopy resembling a collar 'round the rim, and is provided with flaps. By pulling down the shroud lines on either side and thus actuating the flap, the 'chute pilot can do a great deal to guide himself. Of course, it is quite possible to pull down on the shroud lines of the ordinary parachute not provided with flaps, but experienced jumpers consider such practice hazardous as it may cause collapse of the entire supporting surface. Another feature of the new design is the reduction of swinging to and fro of the jumper which lessens the chance of injury by striking trees or rocks.—*A. K.*

Tethering the Airplane

THE rapidly increasing number of private airplanes has resulted in a shortage of hangar space, and airplanes left outdoors can suffer real damage in strong winter winds. Walter C. Clayton, writing in *Aviation*, points out a number of methods of "tethering down" the airplane, whereby possibilities of damage may be reduced. The main principle is to reduce the lift of the wing.

One plan is to tether the plane in a substantially horizontal position, with the tail a little higher than in normal flight, and to head the plane into the wind. Another proposal is to tether the airplane with the tail into the wind, so that the lift forces will actually press the airplane onto the ground. A third method is that illustrated in the diagram. Here spoiler boards are placed over the wing. At the same time, the wheels should be carefully blocked, and various parts of the airplane fastened by cables to ground anchors.—*A. K.*

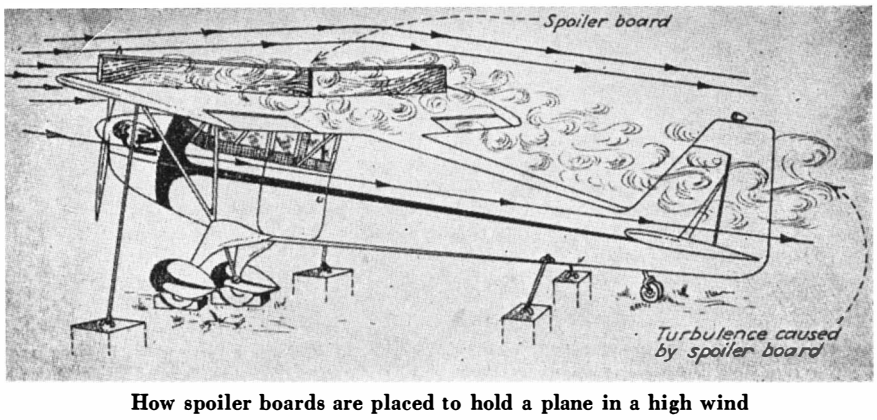
New Ideas for Aerial Warfare

JUST as in every war, a crop of new ideas have appeared to improve the gentle art of legalized murder. Since modern wars are likely to be fought mainly in the air, inventors and engineers have turned their attention mainly to devices which are concerned with aerial warfare. It is interesting to note a few such devices.

U. A. Sanabria, of the American Television Institute, has developed plans for a flying torpedo, often suggested yet never practically realized. The torpedo is to be a small, streamlined airplane controlled by a larger airplane a hundred miles away. The torpedo plane is to carry a load of explosives which would explode on hitting the target. In the nose of the torpedo plane is a television transmitter which televises the scene in front of the torpedo plane to the distant control airplane. The personnel of the control ship is then able to steer the torpedo directly onto the target by radio control. Instead of subjecting costly bombers and well-trained personnel to anti-aircraft fire, enemy centers could be attacked by a cheap craft, with no risk to personnel. The question is: Can the multiplicity of complicated devices involved be made to work under actual and practical, rather than laboratory, conditions.

On the other hand, the Sperry Gyroscope Company is reported to be working on improvements to the more conventional bombing methods. In bombing operations today, the officer operating the bomb sight has to inform the pilot how to change the course so as to give him the best shot at the target. In a new electrical coördinating device, the bomber adjusts his sights, and an automatic pilot does the rest.

Incidentally, the accuracy of our present bomb sights is the envy of all foreign nations, and their construction is one of this

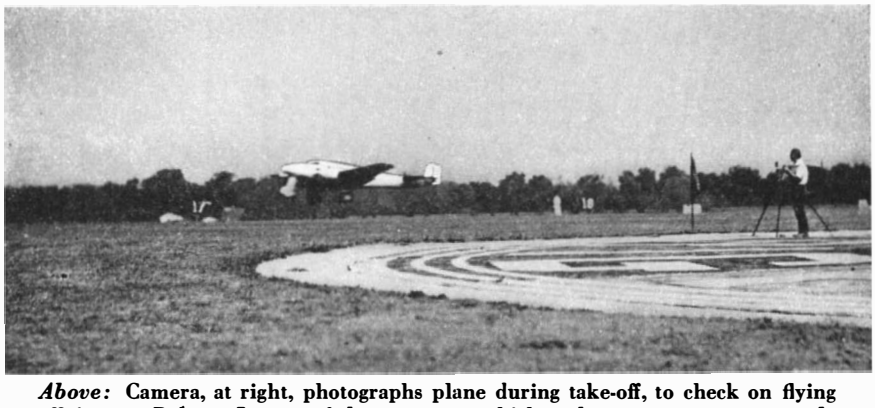


How spoiler boards are placed to hold a plane in a high wind

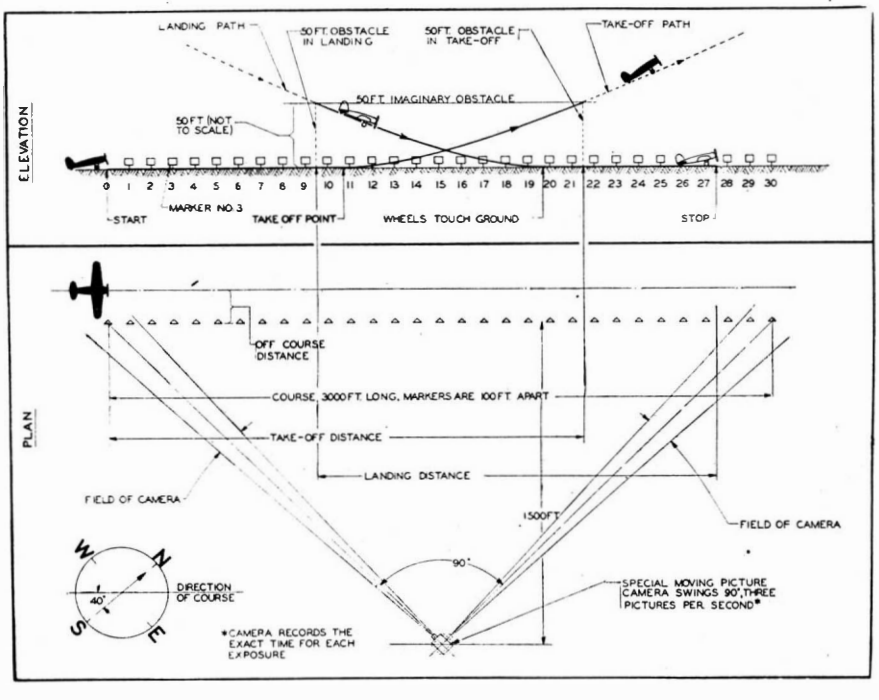
nation's most jealously guarded secrets. After practice bombings by the Air Corps, the sights are always removed and placed in safe-deposit vaults. During recent months, reports have been current of direct hits on targets made with almost perfect regularity from altitudes of 25,000 feet.—*A. K.*

Photographic Method of Measuring Take-off

IT is most desirable to know how an airplane makes a take-off or comes in over an obstacle, particularly when the wing loading is high. The old theodolite system



Above: Camera, at right, photographs plane during take-off, to check on flying efficiency. *Below:* Layout of the course on which such measurements are made



of obtaining such information depends on the skill of the observer and leads to tedious calculations. Photographic records with measurements made on films are more accurate, but cumbersome. The Materiel Division of the Army Air Corps has therefore developed a new method which is accurate yet remarkably simple.

The general scheme is illustrated in one of our diagrams. The main piece of equipment is a "gun" camera, capable of taking three photographs per second, and provided with a built-in stop watch. The only other equipment is an anemometer for measuring wind velocity, and large stand-flags numbered from one to thirty. Reports are made separately by the camera man, anemometer operator, course observer, and airplane pilot.

It takes about an hour to get ready for the test. As shown in the diagram, marker flags are placed at intervals of one-hundred feet on a 3000-foot course. A portable camera shack is placed mid-way on the course but 1500 feet away from it. At a signal from the camera man, the test starts. Continuous shots are taken from a point ahead of actual take-off to the point where the airplane has reached an altitude of over 50 feet. In landings, the camera picks up the airplane at an altitude of nearly 65 feet and follows it until the wheels stop rolling. From start to finish of each test the stop watch automatically makes a time-record on each exposure.

After the strip-film has been developed, it is wound on a spool and projected vertically on chart cards. For this projection, the 3000-foot course is reduced to a scale drawing. The chart shows directly, without calculations, the actual horizontal and vertical position of the airplane at any instant.

A great advantage of this simple method is that the records can be studied at leisure by pilots and technicians, and the true ground performance of the airplane really evaluated. Particularly when accepting expensive new airplanes, the Materiel Division will have a powerful weapon for checking the predicted and contracted performance. Of course, similar information is highly desirable also for private planes. Certainly the buyer of a private airplane likes to know how long a run is required to clear such an obstacle as a hangar or a clump of trees situated near a landing field.—*A. K.*

Rotary Aircraft Notes

A SMALL helicopter, being built by Dr. De Bothezat, is to weigh something in the neighborhood of 600 pounds, with a 90 horsepower air-cooled engine. The aircraft is to be provided with two superimposed airscrews, each of the controllable-pitch type. The blades are to be of duralumin; besides vertical ascent and descent, a high rate of forward speed is expected. Technical details are scarce and forthcoming flights will be awaited with great interest.

An interesting thought from a correspondent: While experimentation in very advanced 'giro and helicopter types is entirely in order, should not other manufacturers besides the Kellett Autogiro Corporation give a little attention to getting rotary aircraft into actual production, contenting themselves with evolutionary rather than revolutionary improvement?—*A. K.*

Why the Curtiss Hawk is Beating the Messerschmidt

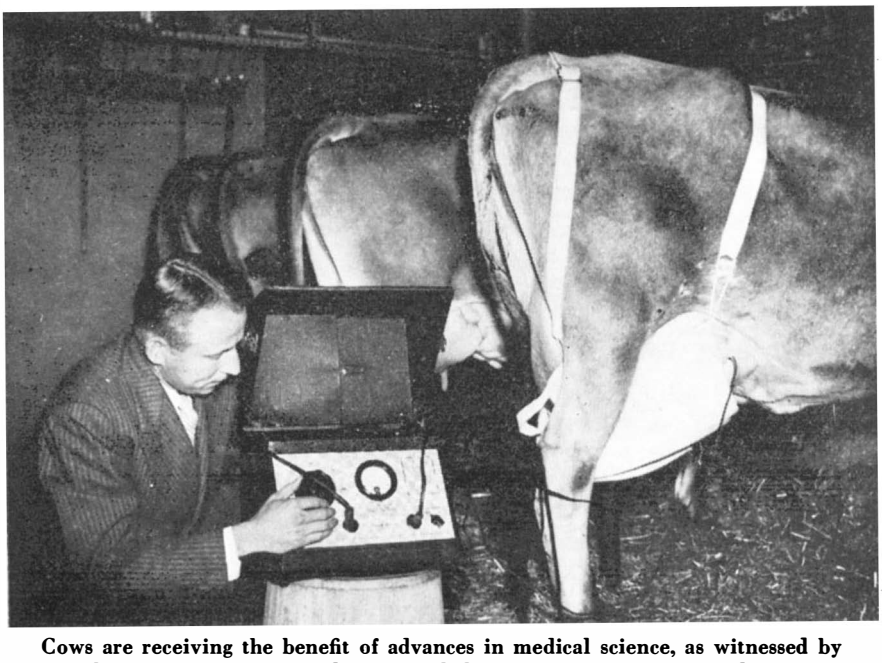
OF COURSE we are all neutral, but how pleasant it is to hear that the Curtiss Hawks are out-maneuvering and out-fighting the German Messerschmidt pursuits on the Western Front! So many friends have asked us the reason that, after verification in well informed quarters, we can risk the following: Maneuverability is to some extent a question of wing loading. When the wing loading is too heavy, the ship can no longer be rapidly maneuvered, and in a sharp turn the plane may stall. In the Messerschmidt, in the frantic attempt to secure high speed, the wings were given too high a loading, clipped too short. It is, of course, too much to hope that German designers will not profit by the lesson!—*A. K.*

RADIUM

AVIATION is creating an increased demand for radium salts for use on luminous instrument dials. During the World War planes had a maximum of eight dials whereas today the average small plane has 12 to 15 luminous dials, and larger craft may have 60 to 75.

Molded Non-Metallic Bearings

TO make molded non-metallic bearings to meet various service requirements, more than 30 formulas have been developed by the Gatke Corporation. These bearings are now used in many industries as they have enormous resistance to wear, a lower



Cows are receiving the benefit of advances in medical science, as witnessed by this demonstration of a newly invented diathermy machine for applying heat treatment for adhesions and other ills of the udders of cattle. Demonstration was given by Dr. E. D. Hildreth, professor of bacteriology at Ohio University, at Randleigh Farm, Lockport, New York

coefficient of friction than metal, and are not damaged by salt water, oil, grease, or most organic solvents. They have a high impact strength and will withstand repeated shocks and blows without being permanently deformed. They are made in three general types: water lubricated, oil or grease lubricated, and self-lubricating.

Depending upon the formula, these bearings may be used in many industries, including the chemical, where they must be run continually submerged in various kinds of liquids.

Drug Combats Serious Dog Disease

A NEW drug to combat the rapidly spreading heartworm infestation of dogs will shortly be made available to veterinarians. The drug, antimonial-III catechol thiosalicylic acid sodium, is the result of three years of intensive research by James A. Austin and Dr. Harold P. Brown of Kansas City, Missouri.

Heartworm infestation of the dog is a unique disease because living adult worms, *Dirofilaria immitis*, 8 to 12 inches long, situate themselves in the right heart. Under treatment, the adult worms are slowly killed by gradually building up a concentration of trivalent antimony in the blood stream of the dog.

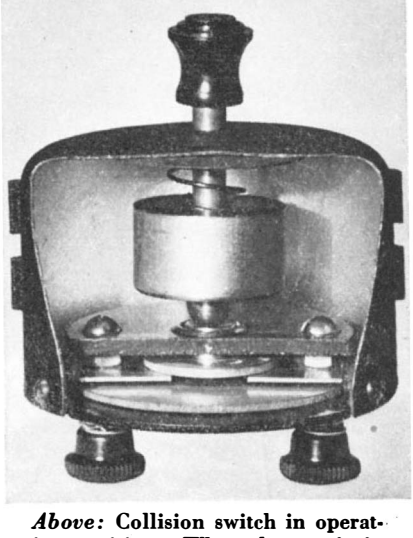
The ill effect of heartworm infestation upon the host is not entirely due to the presence of the adult worms in the heart. Larvae liberated into the blood stream also damage the dog. These larvae, or microfilariae, 0.2 to 0.3 millimeters in length, are worm-like in appearance, and move through the blood with a whipping motion.

Heartworm infestation cannot be transmitted directly from dog to dog, but must pass through an intermediate host. The mosquito has been indicted, and the tick, flea, and other biting and sucking arthropods and insects are suspected.

Treatment of the condition involves a series of graduated daily doses of the drug administered intravenously.—*Science Service.*

Collision Switch

THOUGH fires seldom follow automobile collisions, the danger is an ever-present one and a menace not only to the lives of passengers but to the cargoes of large trucks. When fires do happen they are usually



***Above:* Collision switch in operating position. When the car is in collision, switch opens the ignition circuit, as shown at the right**

caused by the automobile's ignition which cannot be turned off as can that of an airplane when a pilot foresees a crash. Thus the Grigsby Collision Switch has been designed to give a positive cut off of the ignition of cars and trucks as soon as a collision occurs.

As shown in the two accompanying illustrations, this device is relatively simple. A vertical weight rests upon a button which presses a disk in contact with two plates to complete the electrical circuit. This weight is held in place by a spring so that ordinary jars and jolts have no effect upon the setting. As soon as a crash occurs, however, the excessive jar throws the weight off the button so that the disk is sprung away from the plates, thus breaking the circuit completely. By means of a protruding knob, the device may be reset instantly by the driver.

Antiseptic Rubber

ANTISEPTIC rubber goods — dress shields, toys, baby pants—may soon be extended to include antiseptic rubber sheetings, surgeons' gloves, rubber cases for instruments and similar items, by the introduction of three new chemical compounds designed to render rubber fully antiseptic, according to a manufacturer.

The new materials are reported to be three, three, and six times as powerful as thymol in antiseptic qualities. They are white, odorless crystals, said to be effective in concentrations of 0.5 to 1.5 percent (depending on the rubber stock), and to contain no metallic salts.

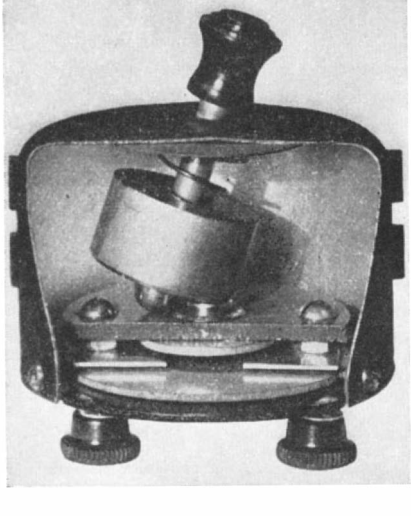
Rubber products so treated are said to meet with the standard tests for antiseptics as set forth by the Food and Drug Administration.

Self-Registering Rainfall Measurer

AN instrument for measuring rainfall, invented by an employee of the Stockholm Observatory, Fabian Nilsson, has found widespread use in Sweden. Readily portable, it works according to a new principle and is said to be ten times more sensitive than older apparatus of this kind. In addition, it is capable of registering unlimited quantities of rainfall.

The rain is collected in a moveable measuring vessel, which is automatically emptied in 1/50 of a second, whereupon it immediately functions again. The instrument is self-registering and works for a week at a time, and thus requires very little attention. By means of an ingenious system, the rainfall is registered on a diagram paper from which can be read exactly the amount of rain which has fallen during any day, hour, minute, and even second during the week.

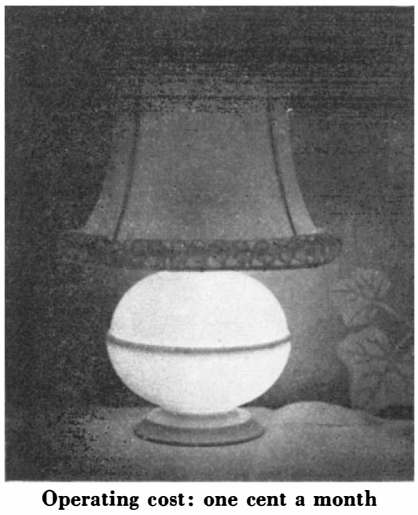
The instrument measures snow with the same accuracy. This is allowed to fall into a calcium chloride solution, which keeps the snow liquid even in very cold weather. The



snowfall increases the volume of the calcium chloride, and the excess runs through a siphon device to a gage where it is registered.—*Holger Lundbergh.*

Table Lamp Glows at Night

A UNIQUE table lamp, which becomes a glowing sphere when room lights are out, has been developed for use in bedrooms to eliminate groping for the lamp, and in nurseries to reassure children who are afraid of the dark. The warm orange-red



Operating cost: one cent a month

glow is not bright enough to keep light sleepers awake, yet it may easily be seen from any point in an unlighted room. A tiny neon glow tube is concealed in the base of the lamp. As soon as the room becomes dark, the soft, warm light characteristic of the neon glow tube emanates from the spherical body of the lamp, which is composed of translucent plastic. The glow tube consumes only ¼ watt of electricity, operating cost of the tube being, therefore, less than 1 cent a month, in spite of the fact that it burns continuously, day and night.

Astronomical Light Finders

DIE-CUT figures of luminous-paint-coated crescent moons, stars, comets, and some of the planets comprise a novel package recently put out under the name of Twinkle-Twinx. Many people interested in astronomy are using these to locate light switches. The backs are gummed so that they may be stuck to ceilings or walls where they may absorb the most light for activation. The manufacturer claims that they glow for an hour after each activation.

Spot-Welding the Retina

ELECTRICAL spot-welding in the eye for restoring sight to patients threatened with blindness due to a detached retina is helping more than one out of three patients, Dr. Samuel J. Meyer, of Chicago, recently reported to the American College of Surgeons.

The retina is the light-sensitive part of the eye which transmits images to the brain through the optic nerve. It may be compared with the photographic film or plate in a camera. It depends for its nourishment on tissue called the choroid. When, because of injury or disease, it becomes detached from the choroid, it cannot function properly and the patient feels as if a curtain were falling over part of his eyes. If not treated, the retina as a rule will eventually all peel away from the choroid, like wallpaper off a wall, and total blindness results.

Modern eye surgeons treat this condition by a kind of electrical spot-welding. Tiny needles carrying an electric current are applied to the choroid without puncturing it. The electric cauterization produces an adhesive inflammation between the choroid and the retina, causing the retina to become re-attached.

This method is only 11 years old, but eye surgeons are getting increasingly good results with it, Dr. Meyer's report shows. More than one out of three patients operated on at the Illinois Eye and Ear Infirmary since 1934 had re-attached retinas with vision ranging from normal to one tenth normal.—*Science Service.*

Heat Treating Cylinders

A NEW method of heat-treating metals by electrical induction, which makes possible hardening of inside diameters of cylinders and other bores, has been developed by Budd Induction Heating, Inc.

The process, which already is being utilized in production work at the Budd Detroit plant, makes possible the heat treatment of inside diameters of metal cylinders from two inches in diameter up, and up to 50 feet in length.

The area treated, depth of treatment, and

An automobile hub in the induction heat treatment machine described

the degree of hardness developed are controlled within exceedingly close limits, while timing of the operation is a matter of seconds.

In hardening inside diameters in which the treated area is of considerable length, such as engine cylinders, a retracting type head, which heats the material by electrical induction, is used. This is drawn evenly through the cylinder, followed by a water quench.

It is anticipated that the process will find wide use in the metal industry. Other practical applications where it can be used to advantage, according to metallurgists who have observed the process, are the cylinder bores of Diesel, gasoline, and steam engines; oil-well casings; and the inside diameters of the sleeves which are the vital parts of all types of sleeve-valve internal-combustion engines.

Courtesy Max Factor, Jr.

Grotesque? Yes, but even the glamor girls of Broadway and Hollywood have to don make-up such as this before they face the television camera. Otherwise, they will not appear natural on the screen of the television receiver. Basic foundation is light tan, with solid white high-lights below eyes, on neck and throat hollows, laugh lines, and inside both nostrils. Soft blue powder on the cheeks and dark red lipstick, with a definite undertone of blue, completes the working make-up for television

Germany's "Fat Gap"

ONE of the most conspicuous deficiencies in the German economy when Hitler came into power was the so-called "fat gap"—the lack of sufficient supplies of fats of all kinds—according to Karl Brandt, distinguished German economist now on the staff of the Food Research Institute of Stanford University. To close this gap, the Germans expanded their dairy industry and improved the stock and all equipment. Production of oil seeds was subsidized, while consumption of margarine, made from imported vegetable and whale oils, was discouraged. Between 1931 and 1936, a 10 percent increase in pork production was achieved by encouraging the German farmer to fatten his hogs.

In addition to these steps, many substitutes for fats have been suggested. Sugar, jam, and marmalade have replaced to some extent butter and margarine. Largely for this reason the German orchard acreage doubled between 1931 and 1936. Sugar has also been substituted for fats in baking. The soap industry, which is the principal industrial consumer of fats, to a certain extent now uses coal and lignite derivatives as substitutes for fat in soap manufacture.

Fatless washing powders and synthetic cleansers are now commonplaces. In paint manufacture, cellulose products now replace oils for some kinds of paint, and the use of stainless steel has been encouraged to cut down paint consumption.

25-Million-Candlepower Searchlight

USING three of the small capillary water-cooled mercury lamps described in these pages some months ago, instead of the customary carbon arc, General Electric has developed a new 25-million-candlepower

The small object held in the hand is the complete light-source unit of the 25-million-candlepower searchlight shown in the background

searchlight. As there are no carbons to be replaced or adjusted, the new searchlight will function automatically. The three high-pressure mercury lamps, each rated at 1000 watts and no larger than a cigarette in size, are mounted close together. Despite the enormous candlepower produced, little heat is generated, and 70 percent of this is removed by pumping 90 gallons of water an hour through the cooling jackets of the lamps.

Fire-Trench Digger Does Work of Many Men

THE United States Forest Service has made important advances in scientific fire fighting this year. They center mainly about such modern devices as airplanes and high-powered chemicals. But the average man on the fire line is likely to name as the most outstanding recent development a contrivance called, after its inventor, a Bosworth trencher.

In fighting forest fires the machine is used to dig a flat trench or ditch in advance of a fire or to turn the flank of the flames. This trench is at least a foot wide and deep enough to remove all leaf mold or other inflammable material. Along this line the fire fighters form to start a backfire or to put out small fires that may jump the trench.

The new trencher, devised by Jim Bosworth, assistant supervisor on the Kaniksu National Forest in Idaho, and perfected after much experiment and suggestion, will dig 50 or more feet of trench a minute, depending upon the terrain and the strength and skill of the operators, and may do the work of as many as 300 men. It has a wheelbarrow type of frame with a heavy bicycle wheel to carry the load. A small two-cylinder engine with a power shaft reaching groundward is suspended between the handles and drives a series of iron bars or "hammers" that swing from a central hub and throw the soil to one side.

The trencher weighs 96 pounds. A harness of web straps enables the man who pushes it to carry part of the weight on his shoulders. In favorable country one man can push the trencher with good effect, but a towing bracket is provided so that one or more can aid by pulling where the terrain is tough.

Generally one man goes ahead to clear a path, tossing aside fallen logs and loose rock and other encumbrances. The machine can be disassembled and carried in a pick-up truck or on a man's back in emergencies.

Car Dumper Empties A Car A Minute

A NEW car dumper recently built for the Pennsylvania Railroad by Heyl & Patterson, Inc., is capable of emptying 60 cars an hour. The dumper is located at Sandusky, Ohio, where it is an example of the most modern methods of coal handling. A lift-and-turn-over type, the car dumper is built to handle 120-ton cars at a rate of 45 per hour or 90-ton cars at a rate of a car a minute. The electrical equipment, supplied by the General Electric Company, is conservatively designed to handle the full capacity of the dumper on a continuous basis and is so flexibly arranged that the dumper can still handle the maximum load even though a major piece of electrical equipment should fail.

"Leaded" Steel

"LEADED" steel is the newest trick of industry to increase the machinability of its product and thus bring lower production costs. But not to be overlooked in the gathering wartime tempo of the nation's industry is the thought that "leaded" steel can increase the production of machine parts that are used in a thousand ways in everything from automobiles and airplanes to tanks and tractors. Metallurgists F. J. Robbins and G. R. Caskey of Bliss and Laughlin, Inc., reported these facts recently.

The addition of small amounts of the soft, malleable metal to batches of steel makes "leaded" steel. The result is a metal that can be cut faster on the lathes, gearing, and cutting and milling machines of industry. There is less wear in cutting tools and dies, faster production, and fewer breakdowns in streamlined mass-production operations. All these factors in peacetime mean lower costs that can be translated into a cheaper product, or into increased dividends as the manufacturer chooses. In war it means more machine parts for a war-geared industry. And metallurgists Robbins and Caskey showed that the strength remains unchanged while the machining properties are increased.—*Science Service.*

SOY BEANS

THE 1939 acreage planted to soy beans totaled 8,119,000 as compared with the 1938 area of 6,058,000 and the 1928-37 average of 4,246,000. Illinois is the largest soy-bean producing state, with 2,452,000 acres under cultivation.

Dam-Sealing Clay

LEAKS in ponds, dams, ditches, canals, and the like, may be effectively stopped by the use of Akwaseal, a product of the Wyodak Chemical Company. This material is claimed to be the highest type of colloidal clay known—Wyoming Bentonite. Mixed in varying proportions with soil and packed around the point of leakage, it swells when wet so that it closes the spaces between the particles of soil.

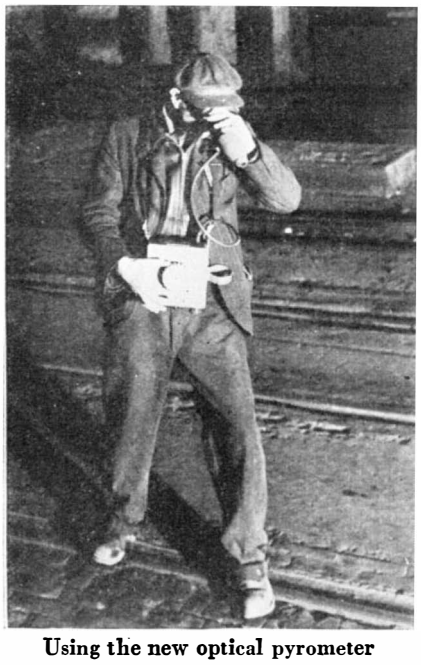
At a fish hatchery in Marianna, Florida, Akwaseal was applied in the following manner: The pond was drained, bottom disked, and Akwaseal applied to the bottom and sides of the rearing pond in the ratio of 100

Demonstrating the fire-trench digger described above

pounds to 500 square feet and worked into the top soil to a depth of 2½ inches and then rolled with a heavy roller. The soil formation consisted of sand and clay; the result was a reduction of better than 60 percent of the former seepage.

New Optical Pyrometer

AN entirely new temperature measuring instrument—not a re-design of a previous model—the Leeds & Northrup optical pyrometer is now a potentiometer. Calibrated, not in milliamperes, but directly in temperature degrees, it measures tempera-



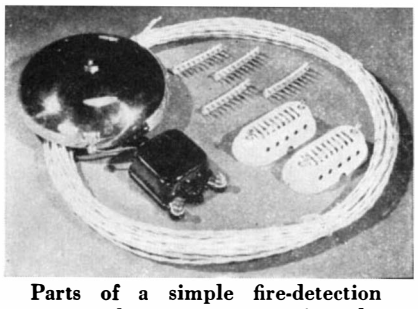
Using the new optical pyrometer

ture more conveniently, and with greater accuracy. It is the first industrial optical pyrometer to use the potentiometer method. Light in weight, easily and rapidly operated, rugged in construction, it meets those requirements important to an industrial pyrometer, and is also amply accurate for laboratory use. This instrument is used in the production of metals, ceramics, glass, and the like, as well as in the laboratory.

Inexpensive Fire-Detection System

INVALUABLE in the protection it affords both life and property, while simple and inexpensive, the Fyre-Scout fire-detection system will appeal to the average household, shop, farm, or factory. Manufactured by Technical Appliance Corp., it gives warning of a fire at its inception.

The heart of the system is the detector head or super-sensitive thermostatic switch enclosed in a neat enameled housing, of compact dimensions. This unit closes the circuit and keeps it closed when a dangerous temperature is reached in its vicinity. All detector heads are wired in parallel and connected between a large fire gong and a power source—a six-volt dry battery or a bell-ringing transformer. The basic kit comprises gong, two detector heads, and 75 feet of heavy-duty twisted-pair wire. Additional heads are available separately, for as extensive a system as may be required.



Parts of a simple fire-detection system that operates on six volts

The installation is as simple as wiring a door bell.

The detector heads are located high up on wall or ceiling of potential danger spots in home or other building, such as near the furnace, in the basement, kitchen, barn, attic, and so on. The gong is placed where it will be heard best.

WOOD

THERE are at present well over 4500 uses for forest products such as fuel, shelter, posts, implement handles, and others which, like Cellophane and rayon, bear no apparent trace of wood or forest origin. These are discussed in a new bulletin published by the Forest Service, U. S. Department of Agriculture.

Grandma Was Right, at That!

GRANDMA'S favorite tonic of sulfur and molasses turns out to have had more scientific basis than she probably suspected. Experiments just concluded at the Massachusetts Institute of Technology show that old-fashioned molasses is just about the best food known for treating nutritional anemia, the kind of anemia due to improper diet.

Spinach as a source of iron was thoroughly debunked by the research conducted by Dr. Robert A. Harris, Dr. John W. M. Bunker, and L. Malcolm Mosher. Whereas molasses has 6.1 parts of usable iron per 100,000 parts by weight, spinach has only 0.5. Beef liver has 5.6; oatmeal, 4.6; with apricots, eggs, and raisins following in that order. The scientists computed usable iron, not total content, for only that iron which the body can use to manufacture hemoglobin is valuable.

The trio also reported that recent medical studies indicate that nutritional anemia is far more prevalent than had been suspected. More than 40 percent of infants have it and the figure for adult women is as high as 70 percent. It is also fairly widespread among growing children.—*Science Service.*

A Finer Porcelain Clay

PORCELAIN enamelers have depended largely on Vallendar Clay, which is a German product, because of the fineness of that material. Recently, however, the Porcelain Enamel & Manufacturing Company developed a new clay for porcelain which has been tested in plants throughout the country with highly satisfactory results. Ordinarily, Vallendar Clay passes through a 250-mesh screen whereas the new "Pemco Micronized Clay" is so fine that it could pass through a 2500-mesh screen.

This new clay is mined in North America and then prepared by the Micronizer process. In this process the unrefined clay enters a cylindrical chamber at a speed in excess of 700 miles per hour, causing the clay to bombard itself. This bombardment results in the explosion of the clay particles and their reduction to an average grain size of three microns. (Three microns equals 0.00011811 of an inch.) The terrific speed of this process causes the impurities—iron pyrites, wood, and the like—to be thrown out so that the result is a perfectly pure clay.

Paint Combinations

THE Glidden Company has taken advantage of the fact that an animated sales display will attract more attention than one that is still, and in doing so have evolved a unique display for their paints. More important, they have provided the prospective user of paints with the best possible manner of finding proper color combinations for both interiors and exteriors of homes.

This display consists of a columnar collection of attractive, painted miniature home models which rotates upon a stationary base.

Color schemes on display

Vertically the device is broken into a number of sections, each of which is divided into small angular spaces. As these sections of the column revolve, the paint buyer will note a large number of color combinations presented in an attractive exhibit.

Protection With Charcoal

CHARRING, probably the oldest method of preserving wood that is known to man, led to the development of a formula by Carbon Chemical Products, Inc., with which it is possible to "char" almost any kind of material including metal, concrete,

and asbestos without the use of fire. The process does a double job of preserving and waterproofing materials.

This new product is applied easily with a brush or spray, is non-poisonous and non-explosive, and will not burn the hands. It is resistant to fire and most common acids, as well as to the depredations of termites. After the product, which is named Kar-Bon-Seal, has been applied it forms a hard, permanently-bonded, non-porous, flat black coating. A gloss can be produced, and paints can be used over this chemical treatment.

The base of the product is charcoal obtained by burning hard wood at 800 degrees, Fahrenheit. The finished product has about the same consistency and coverage as paint.

The same company also makes another product named Kar-Bon-Sealuminum, which has all the properties of the former but dries to a silvery finish and also serves as a heat reflector for roof work.

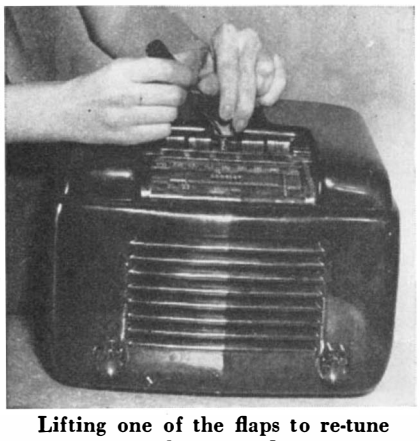
Germs Tell When Glasses Are Dirty

WOMEN have a different kind of germs on their rouged lips than men do, Drs. L. A. Dick and G. J. Hucker, of the New York State Agricultural Experiment Station, recently reported to the American Public Health Association. The germs are two varieties of *Streptococcus salivarius* and they were found on the rims of glasses in taverns, restaurants, cocktail lounges, and soda fountains.

These germs, harmless in themselves, can be used as an index of how well such glasses are washed between drinks and of how many more dangerous germs may be left on the glasses by careless washing. Nearly every presumably clean glass in a taproom will show these harmless germs as evidence of contamination and improper washing. But of all the glasses examined, those in soda fountains were least germy.—*Science Service.*

Simplified Push-Button Tuning

THE latest advance in push-button radio receivers makes them as easy to adjust as roller skates. It enables any radio set owner to change over the tuned circuits of his receiver with a minimum of effort and in a single operation. This development is incorporated in the new Crosley push-button sets in which there are hinged flaps which flip back to expose the adjusting screw or key for each button. To reset a button for a new station, the flap is lifted, a screw driver is inserted in the adjusting screw, and the key is pushed down as far as possible. The key is then turned until the dial reading is that desired, the hinged flap is flipped back over the key, and the button is set for reception.



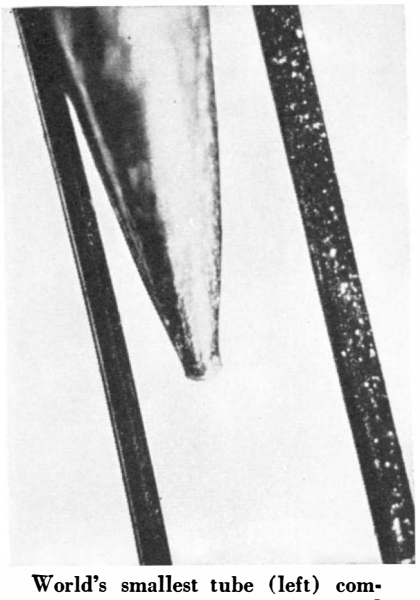
Lifting one of the flaps to re-tune a new push-button radio receiver

Athletes Have "Fever" Temperatures

ATHLETES in severe muscular exercise can show body temperatures that normally would mean high fevers, according to Dr. Eugene F. DuBois of the Russell Sage Institute of Pathology, Cornell University Medical School. Dr. DuBois, reviewing studies of the body's temperature, showed that the familiar 98.6 degrees, Fahrenheit, which the clinical thermometer registers normally, is only one single spot between internal temperature and skin temperatures of 93.2 and lower.—*Science Service.*

Smallest Metal Tube Ever Produced

A PURE nickel tube with a hole so small that a strand of human hair could not pass through it is believed to be the smallest metal tube ever produced; it measures 26/10,000 of an inch in diameter. The hole is about 1/3 this size and the thickness of the metal wall is about 7/10,000 of an inch.



World's smallest tube (left) compared with pin point (center) and hair (right); all 180 magnification

Pure nickel was used in preference to ordinary steel or other metal subject to rusting because even a slight speck of rust might clog the tiny hole.

Gunk

A UNIQUE solvent that combines soap and water detergency with the high solvent performance of benzenes is announced by A. F. Curran, Research and Development Chemist for The Curran Corporation. The new solvent, called Gunk, is, according to the development laboratory, sparkling clear in appearance, highly penetrating, and non-flammable.

Small metal parts, stampings, extruded shapes, or die castings dipped in the solvent assume a scoured appearance without etching, marking, or loss of weight. Such parts may be rinsed by sluicing with water to obtain chemically-clean surfaces where painting or lacquering is to follow. It is said that where prevention of storage corrosion or rusting is desired, the parts need not be water rinsed, but are simply drained or centrifuged to remove excess solvent. The light phenolic-type film remaining will act as a rust preventive, making an extra treatment with oil unnecessary.

The best protection the coffee bean has against loss of flavor due to evaporation of its aromatic oils is its own skin. Hence the Kitchenaid container and electric coffee grinder. The roasted beans are kept in the upper container and, at a flip of the switch, a measured amount is ground as needed

Paint brushes no longer need be soaked in water or messy oil after using, but may, instead, be dipped in Gunk. This solvent not only dissolves the soft paint but emulsifies it as well so that the pigments and oil vehicle may be instantly and completely rinsed away under a water faucet as easily as you would wash soap from your hands.

Advertising Goes Night Flying

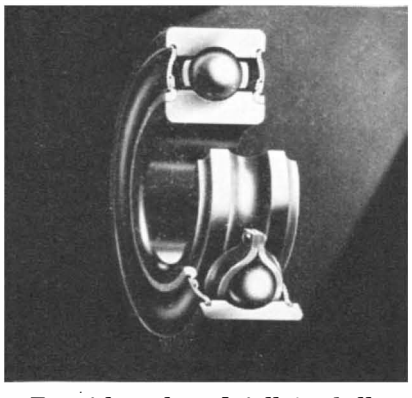
DURING favorable weather, the Goodyear Tire & Rubber Company maintains three dirigibles at their hangar at Bendix, New Jersey. During daylight hours they provide an unique means of seeing the sights of New York City from the sky, but at night they carry over the city an ingenious neon advertising sign by means of which all sorts of messages may be flashed to observers on the ground.

These neon signs are made up of 10 32-pound units, each four feet by six feet, on each side of the ship. Interchangeable copy can be flashed on these frames from the control board in the gondola, which is connected by means of 330 circuits. The signs are completely universal and the operator has a standard typewriter keyboard which, in turn, perforates a small paper tape. This is then run through a "translator." If the message is to be repeated at regular

intervals, a complete loop is made of the tape so that it automatically repeats itself. Besides advertising copy, weather reports, correct time, air temperature, and news items of civic importance are flashed on the signs. While the ships are aloft they are in continuous two-way radio communication with the airport.

Double Felt Seal Bearings

SEALED ball bearings along entirely new and simple principles have been developed by SKF Industries, Inc. The seal used in these bearings is one that can be applied to bearings having a standard single row S. A. E. dimension of bore, inner and outer



Two felt seals and full-size balls feature this dirt-proof bearing

race width, which up to the present time has not been possible except through the use of small balls and, consequently, loss of bearing capacity.

This development has been made possible by departing from the conventional stuffing-box type of seal in favor of modern air-cleaner principles, sealing against dirt by the felt fiber contact on the polished surfaces of the inner race, and by the utilization of the natural tendency of deflected felt to resume its original flat shape.

Extensive tests have proved that the new seal retains the bearing lubricant and excludes any dust or dirt entry into the bearing itself, yet the sealing action is so light that the friction drag has been greatly reduced. The bearing is, therefore, suitable over a great range of speed.

Surgical Instrument Fishes Bullets From Abdomen

A NEW life-saving instrument that is attracting attention among surgeons is called a peritoneoscope, because in effect it gives the surgeon an eye at the end of his knife. It is a long, slender instrument, carrying a telescope and tiny electric light at its end and is equipped with a forceps for grasping a piece of bullet or clamping shut a bleeding artery. The instrument can be passed through the bullet wound or a stab wound made by a knife, saving the need of cutting open the abdomen, an operation which might prove fatal to a desperately sick man. Once the bleeding is stopped, the patient's condition may improve so that he can withstand an operation if necessary.

If there is no bullet wound, a needle is

used to make a hole through skin and muscles for the peritoneoscope to go through. Air is first blown into the hole, to make a space between the tissues and internal organs, so that the instrument will not pierce these when inserted.

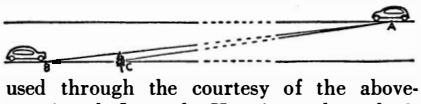
In the war on cancer, the instrument does its part by enabling surgeons to remove a bit of tissue for diagnosis. With a needle instead of a forceps at its end, it may be used to drain a liver abscess. The hole made by the instrument in such cases is so small it usually does not need even a stitch to hold it together while healing. For this and diagnostic purposes, the patient is not only spared shock of an abdominal operation but need be in the hospital only 24 hours.—*Science Service.*

Odd Optical Effect in Motoring

RECENTLY a physician asked *The Journal of the American Medical Association* the following question: "If you park by the roadside and watch the automobiles approach you on the opposite side of the road by means of a powerful field glass, you will find that any car approaching at 45 miles an hour appears, through the glasses, to be crawling along at about 10 miles an hour. There seems to be some relation between time and space and our perceptive sense, and I am unable to get to the bottom of it."

That magazine answered with mathematics, which we simplify as follows:

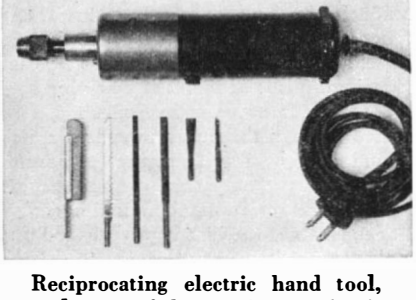
Assume that the observer is in car A in the accompanying diagram, which is



used through the courtesy of the above-mentioned *Journal*. He views through 8-power binoculars car B, which, as the questioner said, is approaching at high speed. Through the glasses the distance AB and, for that matter, any intermediate increment of that distant, will appear just exactly ⅛th the actual distance. Thus when the car travels from B to C (or between any other two points) its rate of travel will appear to be considerably slower than is actually the case, simply because, in the same length of time it travels over a certain distance, it appears to be covering only ⅛th the actual distance. Naturally, this explanation would apply only to cars coming head on.

Electric Hand Chipper and Filer

RECENTLY placed on the market is a new electric tool similar to the small "hand-size" electric grinders but with the



Reciprocating electric hand tool, and some of the attachments for it

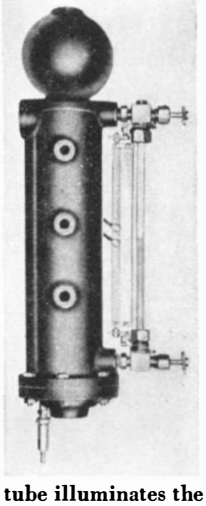
difference that the movement of the tool is reciprocating instead of rotating. The handle containing the motor fits the hand nicely. Into the chuck may be inserted small chisels for chipping, small files, honing stones, and even small hack saws. Two models are made: one with a 7/16-inch stroke, and the other with a 1/8-inch stroke. The motor is 110 volt, for use on alternating or direct current.

Neon Water Gage Illuminator

ALL who have squinted up at water gages on boilers will appreciate the neon illuminator for gage glasses being offered by the Wright-Austin Company.

This new neon illuminator is a surprisingly simple and efficient device, and consists of a neon light tube and a magnifying lens placed behind the gage glass.

The liquid filled portion of the gage glass stands out as a broad, red neon band, and the empty space above fades into a hairline



Neon tube illuminates the gage

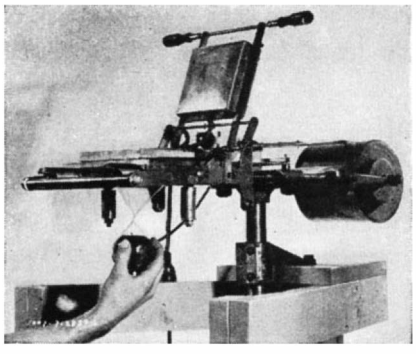
red stripe. The water level can be read distinctly, day or night. Neon rays penetrate not only darkness, but haze, steam, dust. and fog almost as readily.

The neon illuminator is furnished complete with a small transformer and an extension cord ready to plug into 110 to 120-volt, 60-cycle circuit. It can also be supplied for a 25-cycle circuit, and also for 220 volts. It is easily attached to almost any standard water gage by two U-clamps, which grip around the top and bottom water gage fittings, and can be attached in a few minutes time.

Machine Wraps and Seals

DEVELOPMENT of a Stretch-Wrap machine for packaging various articles of miscellaneous shapes in Pliofilm, is announced by The Goodyear Tire & Rubber Company. Known as the Pfeiffer Pliofilm Stretch-Wrap machine, it takes advantage of the following Pliofilm characteristics: stretchability when heated; strength increase in all directions when so stretched; extreme resistance to puncture when stretched, making application to irregular shapes easy; self-sealing when heated. Thus with the new machine any article can be wrapped and sealed in one operation.

The Stretch-Wrap machine should prove



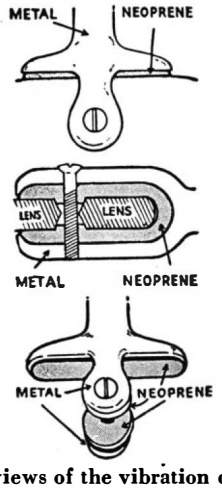
Irregularly shaped objects are rapidly sealed in this machine

advantageous to many industries now handicapped with a difficult or laborious wrapping or packaging operation. Savings in material consumption is another decided advantage of the Stretch-Wrap method. Up to 300 percent savings in wrapping material can be effected. For soap wrapping for example, a six by six-inch sheet of Pliofilm will wrap the same size cake of soap that now requires a 13 by 13-inch sheet with the wet-wrap hand method.

For many diverse small wrapping operations not sufficiently large in volume to afford an automatic machine operation, the Stretch-Wrap machine should prove to be the ideal answer.

Vibration Dampener for Spectacles

HAVE you ever considered the installation of a vibration dampener on your spectacles? Probably not, but such a device might solve a problem for you; that is, if you are wearing rimless glasses and find that the



Three views of the vibration dampener that holds spectacle lenses

lenses break frequently, a cushion mounting between the straps and the lenses will aid in reducing breakage.

In one design of this type a pad of neoprene completely surrounds the lenses, holding them in a firm yet flexible grip and protecting them from shock and strain. The elimination of shock and strain also eliminates breakage caused by these conditions.

At the top of our illustration is a side view of the strap and lens showing how the neoprene pad fits against the side of the lens. In the center is shown the way the neoprene is carried over between the hole in the lens and the screw that presses the straps to-

gether. The bottom drawing illustrates the way the neoprene cushion mountings are arranged so that no metal will touch the lens.

The advantages of this design are readily apparent and include the possibility of using stronger, more rigid straps around the lenses. Neoprene is used for the pads because it provides a long-lived mounting that will resist the effects of body acids and cleaning solutions. But its ability to resist deterioration is not the only reason for its use.

For example, if the strap contacts any material containing sulfur, the sulfur will cause discoloration of the gold surfaces and this discoloration might create the idea in the mind of the user that the straps were corroded. Or, to clean up the discoloration, the user might employ a solvent which actually would cause corrosion. So it is impractical to use any such materials for the mounting pad. Fortunately, sulfur can be eliminated from the neoprene compound without adversely affecting the properties of the compound. Such a compound will not discolor the straps, so the manufacturer is able to secure an efficient cushion mounting which will last for many years without endangering the life of the straps.

Greasy Thumbs Have No Effect

TO any machinist who has had to thumb his way through a greasy data book looking for tapers or thread settings, the DataTule, a handy little vest-pocket aluminum-cased file of information on things a

mechanic needs to know will be just what he needs. A twist of the fingers brings a wealth of data and information into view. Lard oil and grease have no effect on the legibility of the enclosed tables.

A product of The DataTule Company, this two-ounce device can be readily fitted with any one of several printed strips of data. It can also be threaded with a strip on which special data have been typed.

Permanent Traffic Lane Markers

REPORTING in *The American City*, C. W. Paige, City Engineer of Alhambra, California, describes the construction of a double white centerline marker. The marker is of reinforced concrete placed to exact grade before the fine grading is done on the street. This "curb" is 16 inches wide at the base, sloping uniformly to 12 inches at the surface, which is 10 inches above the base. The top two inches of the marker is constructed with white cement. A two-inch deep groove is left in the center of this top section, three inches wide at the bottom and

four inches at the top. When the asphaltic surfacing is placed on the street, this groove is filled with the asphaltic material, leaving a smooth surface which is marked with a double centerline.

In *Public Safety*, Lieut. R. O. Bennett, of the Lincoln Police Department, describes a method being used to install permanent lane markings in asphaltic streets already placed. First, the pavement is softened with a burner, the width of the desired stripe. After this heating, a templet is placed on the surface and a coat of asphaltic emulsion is applied. To this is added a half-inch layer of white "Joplin Chats,"—flint-like stones. The templet is then removed and a hand roller which develops over 300 pounds per square inch pressure is used to force the stone into the pavement.

Lieutenant Bennett reports that these lines, some of which are more than five years old, seem to have gotten whiter with age. He also states that it is better than a painted line at night or when the streets are wet.

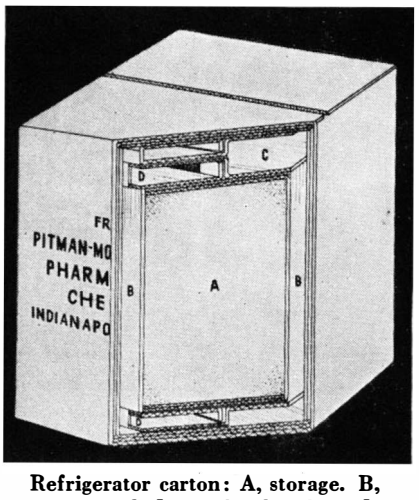
Refrigerator Carton

A NEW type of refrigerator carton to facilitate safe as well as speedy handling of serums, vaccines, and other perishable biological products has been developed by Container Corporation of America.

The new carton, which allows the product to be packed with dry ice, was developed to meet the needs of Pitman-Moore Company of Indianapolis and already has been placed in use in the shipping of animal vaccines.

In this carton, biologicals can be shipped by express to any part of the United States at a constant temperature of from 32 to 42 degrees, Fahrenheit. It carries a maximum of three pounds of dry ice, sufficient to maintain low temperature to destinations several thousand miles away.

The dry ice is first wrapped in heavy Kraft paper and then placed in a bunker at the top of the carton shown in our illustration. The product itself is carried in an

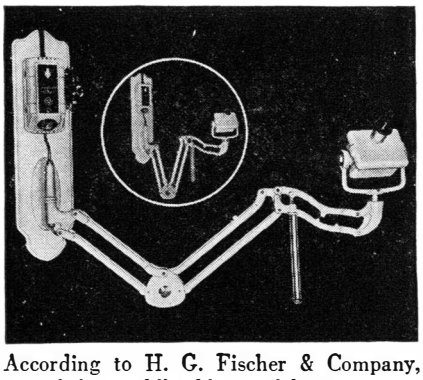


Refrigerator carton: A, storage. B, air space. C, dry ice bunker. D, pads

inner shell, with air space on all sides to allow circulation of the fumes from the dry ice. The inner carton is suspended by pads at the top, bottom, and corners.

Wall-Mounted Dental X-ray Machine

INDUSTRY'S lightest structural metal finds a unique use in a new wall-mounted, shock-proof dental X-ray machine. Weight has been reduced from one third to one half through the use of Dowmetal.



According to H. G. Fischer & Company, one of the world's oldest and largest manufacturers of X-ray equipment, unprecedented standards in light weight and compactness characterize this new instrument. The extension arms and mounting mechanism are designed to give exceptional compactness against the wall, at the same time assuring full extension and flexibility for easy manipulation while the patient remains seated in the dental chair—with unusual freedom from tubehead vibration.

Document Protection

A SPECIAL light filtering yet transparent glass that retards aging of valuable documents and other articles protected by it, known as Hi-Test Laminated Document Glass, has been developed by the Pittsburgh Plate Glass Company. This special glass essentially is a "double deck" sandwich in which three pieces of glass, each ¼ of an inch thick, form the "toast" and two thin sheets of vinyl plastic the "meat."

The two outer layers of glass are of clear plate glass, while the inner "toast" of the sandwich is a high-lead-content plate glass that filters out the harmful rays. The three pieces are held together with the vinyl plastic "meat" which makes them resistant to blows.

Sandbags to Destroy Dunes

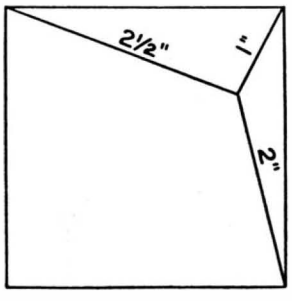
SANDBAGS are being used, says the United States Soil Conservation Service, to do a strange job. Laid across the crests of sand dunes, they are causing the dunes to disperse.

As long as a sand dune has a sharp upper crest, a prevailing wind will continue to build it up. Break that upper crest into a sawtooth form and the wind begins to tear it down. Some farmers in the west cut the crest lines of dunes by means of a disking machine or by pulling a pole drag along the crest. This process has to be repeated as the dune gets lower and gradually cuts a new, clean, crest line. Sandbags, however, follow

The Problem of the Square

CONTINUING our series of mathematical amusements, this month we have something a little different. If you have found some of the preceding problems a bit too difficult because calculus was required for their solutions, perhaps this will be more interesting:

Construct by graphical means—that is, using a compass and ruler—a square having



three corners at distances of 1, 2, and 2½ inches from a point within the square. Also, compute the length of a side of the square.

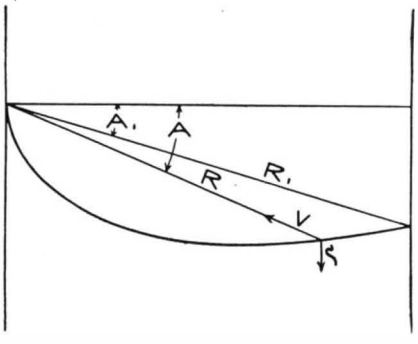
As usual, this problem comes from Lieutenant-Commander Leonard Kaplan. All correspondence concerning it should be addressed to him in care of Scientific American, 24 West 40 Street, New York, N. Y. We forward all letters unopened.

Solution to Our Problem of the Dog in the River

IN our December number was proposed a problem concerning a man and his dog. And here is the solution which was promised for this month. It was required, if you don't remember or if this is your first sight of the problem, to find out how long it takes the dog to swim the river which separates him from his master. The dog swims at a rate of two miles per hour, always headed toward the man, and starts from a spot 0.14 miles below a point directly opposite its master. The river is 0.48 miles wide and flows at one mile per hour.

The following symbols are used in our solution and sketch:

V, velocity of the dog, (2 m. p. h.).
v, velocity of river, (1 m. p. h.).
t, time after starting, hours.
R, distance in miles between man and dog at any time, t.
A. The angle made by R with a line normal to the bank of the river.
A_1 and R_1, values of A and R when t is zero.



Now, resolving the velocities V and v along R and at right angles to R, we have:

$$\frac{dR}{dt} = v\sin A - V \text{ and } \frac{dA}{dt} = \frac{v\cos A}{R}$$

Consider next the identity:

$$v^2 - V^2 = (v\sin A - V)\ (v\sin A + V) + v^2\cos^2 A$$

and substitute in it the values obtained above for

$$v \sin A - V$$

and

$$v \cos A$$

Then,

$$v^2 - V^2 = (v\sin A + V)\frac{dR}{dt} + (v\cos A)\ R\frac{dA}{dt}$$

Integrating,

$$(v^2 - V^2)\ t = vR\sin A + VR + C$$

Setting $t = 0$ and solving for the constant,

$$0 = v\ R_1 \sin A_1 + VR_1 + C$$

Hence,

$$(v^2 - V^2)\ t = R\ (v\sin A + V) - R_1\ (v\sin A_1 + V)$$

Substitution in this equation of the values given in the problem, ($v = 1$, $V = 2$, $R_1 = ½$, $\sin A_1 = 0.14/0.5 = 7/25$) gives the time required to cross the river. That is, when $R = 0$,

$$t = \frac{-½\left(\frac{7}{25} + 2\right)}{1 - 4}$$

giving a time of 0.38 hours or 22.8 minutes.

the crest line down and presumably stick to their job until the entire dune has been leveled.

This method is being used where lands were denuded of sod and where dust storms were numerous in recent years.

No More "Burned Out" Cows?

"BURNED out" cows will no longer plague the American farmer. Chemists have found that a diet of corn sugar or molasses prevents ketosis, a disease which cuts milk production and inflicts economic loss, it was announced recently by C. F. Huffman and C. W. Duncan of the Michigan Agricultural Experiment Station.

Ketosis, it was explained, is characterized by the inability of animals to burn fat completely. "The incompletely burned fatty fragments are called ketone bodies. The term ketosis implies the abnormal accumulation of the ketone bodies in the blood and their excessive excretion in the urine.

"Their accumulation in the body of dairy cattle is of economic importance because they result in a drop in milk production, in a loss of appetite, and a decrease in body weight in the more pronounced cases. Ketosis is the modern name for the disturbance which was formerly referred to when the farmer said that his cow was 'burned out'."

Over-Inflation in Truck Tires

DURING the past several years there has been a gradual swing from high-pressure truck tires to balloons. Many truck owners, however, are not receiving full benefit from their balloon equipment because

they are continuing to use air pressures more in keeping with high-pressure inflation recommendations and not the pressures recommended for balloon tires.

Over-inflation reduces deflection and contact area, causing the tire to ride on the crown. This results in the following: (1) tread wear more rapid than normal; (2) increased tendency toward bruise or crown breaks; (3) excessive strain on beads and rim; (4) abnormal growth and possible tread cracking; (5) more cuts and snags than would be experienced with proper inflation; (6) abnormal stresses and strains in the tread area which increase the tendency toward tread separation; (7) harder riding and increased up-keep on equipment; (8) reduced non-skid qualities by reason of smaller area of road contact.

Among the recommendations for proper inflation are: inflate to proper pressure when tires are cool; if tires are continually *under-loaded*, use air pressure to correspond with actual load carried (refer to a load and inflation table); if both load and speed are factors, either load or speed must be reduced to obtain normal service; never "bleed" tires to relieve "build up" of pressure caused by heat. The ratio of temperature to pressure "build up" in service is approximately 8½ degrees of temperature for every pound of "build up."—*India Rubber World*, from Bulletin No. 13, Rubber Manufacturer's Association, Inc.

Identifying 'Shakespeare'

(Continued from page 8)

one Joseph Hall who in 1748 was employed to repair and otherwise "beautify" the statuary. The Oxfordian color scheme is also found in practically every one of the ancient paintings of Shakespeare that show him dressed as a nobleman.

Exigencies of space prevent reproduction at this time of anything approaching a complete layout of the pictorial evidence gathered during our investigation of the three portraits. The triple set of infra-red and X-ray studies alone total more than 20 plates. I shall, however, try to give a general idea of results achieved by outlining briefly our dissective study of the "Ashbourne" painting (page 4).

First brought to public attention in 1847 by the Rev. Clement U. Kingston, one of the masters of Queen Elizabeth's Free Grammar School at Ashbourne, Derbyshire, this impressive work of art had long been in possession of one of the old British county families who treasured it as a genuine and contemporary portrait of Shakespeare. Mr. Kingston knew there could be no question of the picture's antiquity, for the canvas was in rags and had to be immediately re-backed to preserve the painted image. Abraham Wivell, a portrait painter of talent and one of the few recognized authorities on Shakespearean art, vouched for the "Ashbourne" as a composition of the late Renaissance and for its technical relationship to other ancient representations of the Bard. Wivell's findings were corroborated by Samuel Timmins of the British Society of Antiquarians and also by M. H. Spielmann, Shakespearean art authority of the "Encyclopaedia Brittanica." About 11 years ago the portrait was brought to this country by the late Eustace Conway, who finally sold it to the Folger Shakespeare Library. It is generally considered the most beautiful, as well as the largest, of all the many famous old portraits of the poet now owned by this $22,000,000 foundation. It is life-size, three-quarter length, covering a canvas 47½ inches long by 37½ inches wide.

Facing three quarters to the observer's right, precisely as Lord Oxford does in both his Portland and St. Albans pictures (Figures 1 and 2), Shakespeare appears as a courtly gentleman of middle life, dressed in a black doublet and black bombasted trunk-hose with inserts of gray satin in the puffed pleats.

His waist is encircled by a rapier belt of French design, consisting of black leather and gold filigree work, while about his neck is a flimsy and skimpy ruff—entirely out of key with the rest of the attire.

He stands by a square-edged table, covered with a wine-red cloth. On the table, just beneath his right arm, appears a human skull, or *memento mori*, the same emblem of mortality that Falstaff mentions in "I Henry IV." It is interesting to note that the top of the wall-memorial to Shakespeare in the Stratford Church is crowned by an identical example (page 4) of the "Ashbourne" skull—both being minus the lower jaw.

In his right hand Shakespeare holds a small, elegantly bound volume, tooled in gold and displaying open tie-strings of sheer crimson silk. Eustace Conway and other students of the portrait have opined that this is the poet's private copy of his "Sonnets." A masque of tragedy and crossed spears appears in the center of the cover. They are raised above the surrounding surface and painted in a tone of orange gold quite different from the lemon gold of the rapier belt. This indicates that the masque and spears, like the skimpy neck ruff, are later additions to the original composition.

The inscription, AETATIS SVAE. 47 A° 1611, in the upper corner of the canvas, to the observer's left, corresponds with the chronology of the Stratford man's life, but has been painted in the same tone as the ruff and the masque and spears, obviously at the same time. M. H. Spielmann gave it as his opinion 35 years ago that all these additions are of ancient application. We shall learn more about them in a moment or two, when we come to examine the dissective photographs.

A gauntlet of the type that Elizabethan courtiers wore on dress occasions dangles from Shakespeare's left hand. It is of rich maroon material, tasselled, and appliquéd with cloth-of-gold tape. A somewhat similar gauntlet will be observed on Lord Oxford's right hand in his portrait which bears the date 1575.

Many have remarked on the length of Shakespeare's fingers, especially the left thumb, which bears a signet ring of the swivel pattern, the unmistakable mark of a dignitary. Turning to the St. Albans portrait of Lord Oxford (Figure 2), which was evidently painted by Marcus Gheeraedts the Younger when the Earl was about 36

years old, we find the same unusually long fingers and thumb. Here they draw attention to the device of the wild boar, hanging around the nobleman's neck. (See Figure 6). This boar served as the crest of the famous Vere family to which Oxford belonged. It is one of the best-known devices in British armory.

The matrix of the thumb seal that Shakespeare wears in his "Ashbourne" portrait (page 4 and Figure 7) is about the size of a present-day sixpence. The original design is not apparent to the naked eye because the matrix has been treated to a daubing of the thick orange gold already mentioned.

When we examine our semi-microscopic close-up of the seal, however, its hidden design takes form (Figure 11). Underlying shadows, plus broken surface brush strokes, give us the eye, the ears, the long snout, jaws, lolling tongue, and tusk socket of a wild boar—the same armorial device that Lord Oxford wears in his St. Albans portrait!

We know quite definitely that Willm Shakspere did not have a signet of any pattern. For at the conclusion of his will, which was signed at Stratford in February, 1616, when we come to the paragraph reading "whereof I have hereunto put my seale" the word "seale" has been struck out and the word "hand" (meaning handwritten name) substituted.

In order to find out whether Lord Oxford might have possessed a signet ring, I wrote to the Librarian of Hatfield House in Hertfordshire, the ancient seat of the Cecil family with which Oxford was allied through his first marriage. Two dozen or more personal letters from the Earl are still preserved here. In due course, I received the following reply, dated February 17, 1939.

> I have examined the correspondence of Edw. de Vere, 17th Earl of Oxford, in our collection, and find that with one exception all the seals extant are wafer seals of the de Vere arms and show no distinguishable detail. The remaining example—a small signet seal, the size of a sixpence—appears to represent the de Vere crest of a Wild Boar on a coronet, shown in its entirety. This seal is a very poor specimen and not worth photographing . . . I enclose a rubbing.
>
> Yours faithfully,
> J. V. LYLE.

From the rubbing of the wax impression which Mr. Lyle was kind enough to enclose, it is immediately apparent that we have an example of the same swivel type of thumb signet that Shakespeare wears in the "Ashbourne" painting. The artist merely confined his design of the matrix to the wild boar's head instead of meticulously reproducing the whole Vere crest.

Our photographic dissections (Figures 4 and 9) of the "Ashbourne" head not only bring it into unquestionable conformity with the two inscribed Oxford portraits but show how this literary nobleman was long ago converted into a bald-headed counterpart of the synthetic commoner who appears in the stone memorial effigy at Stratford and in Martin Droeshout's clumsy engraving on the title-page of Shakespeare's First Folio.

Reference to our infra-red plate (Figure 9) discloses that the original forehead has been raised an inch or more. The crude strokes of the renovator's brush show the same slap-dash haste and the same technical deficiencies that are apparent in similar operations on the other two Shakespearean portraits that we have found to be disguised likenesses of the poet Earl.

The hair in the "Ashbourne" has been re-done to match the synthetic forehead. That the head was originally topped by a normal growth seems evident. Oxford has a good red-brown thatch in both the Portland and St. Albans paintings.

The infra-red dissection of the neck-ruff is also revealing. Undersurface outlines make it plain that this was once a huge circular affair, covering almost twice the area of the flimsy thing now on view, and that it was of the fluted pattern affected by many of the elder Elizabethan statesmen. Of course a neck-piece of this aristocratic design would be so strikingly inconsistent with Willm Shakspere's known position in life that it would be one of the first articles of personal adornment to be sacrificed by any one interested in converting a portrait of Lord Oxford into an alleged representation of the Stratford native.

The present surface inscription on the "Ashbourne" canvas (page 4), although conforming to Shakspere's personal chronology, struck Spielmann as questionable when he first examined the portrait, which he describes as that of "a gentleman, perhaps a noble, born and bred." The Shakespearean art authority of the "Encyclopaedia Brittanica" made much of the hurried crudeness of the lettering, with cross-bars missing from the *A*'s and *E*'s, the poor spacing and lack of alinement. It is also worth reiterating that the gold paint used for this lettering is of the same orange tone that appears in the raised daubs on the book cover and the disguised thumb ring.

Our X-ray photographs of the inscription area (Figure 13) reveal a whole series of clues which, taken together, seem to leave no loop-hole for doubt regarding the true identity of the man in the painting.

The first of these exposures—the upper half of the figure—makes it plain that the original inscription was something far different from the one which appears on the surface today. And although this pristine lettering was long ago scraped out—so vigorously that perforations were made in the canvas—it is still possible to distinguish the ghostly remnants of both alphabetic characters and numerals.

More exciting still, a phantom crest appears just below the inscription. And beneath the crest, our second X-ray exposure has brought to light a full shield of arms, surrounded by decorative mantling and a scroll that evidently once bore a family motto. As a sort of appendage to the whole layout, the artist has added his monogram, identifiable as a conventionalized C K. The entire section, containing this feast of evidence for scholars, genealogists, and art historians alike, was painted from view at some remote period, undoubtedly at the time the original inscription was destroyed. It is even possible that these changes were made in the painting early in the 17th Century so that Lord Oxford in Shakespearean disguise could be used as "copy" by Garret Johnson, the London sculptor who made the memorial effigy of the Bard that was set up in the Church at Stratford.

Let us see, meanwhile, what this evidence of the hidden arms and the artist's monogram has to tell us in summing up the case.

The recovered device on the upper part of Figure 13 is really a double crest. To the

left, the faint black penciling of a leopard or lion appears, while to the right is the white outline of a griffin.

Months of research have proved that two Elizabethan families of Staffordshire had crests that corresponded to the above combination. They were the Sneyds of Keel Hall and the Trenthams of Rocester Abbey. About 1592, Edward de Vere Earl of Oxford, then known as the most gifted poet and brilliant writer of unpublished comedy at Elizabeth's Court, married Elizabeth Trentham, one of the Queen's Maids of Honor, for his second wife. Elizabeth Trentham's father was Thomas Trentham, of Rocester Abbey, High Sheriff of Staffordshire. Her mother was Joan Sneyd Trentham, daughter of Sir William Sneyd of Keel Hall. So the combination crest could designate the Countess of Oxford.

The shield of arms, shown in the lower part of Figure 13, would seem to make this armorial identification positive, for the Trentham arms are described in contemporary records as *Three griffins' heads, erased, sable; beaked, gules.* And the photographic reproduction (Figure 15) of the Trentham shield in stone, which was placed in St. Peter's Church, Wolverhampton, some time during the 1580's, corresponds so closely to the phantom shield in our X-ray picture that there seems no room for argument. The dispositions of the three heads on both shields are identical, the only differences in detail being such as would be inevitable in comparing a finished work in stone with the shadow of a design in paint that has been long subjected to chemical amalgamation with concealing coats.

But—it may be asked—how comes it that the literary Earl of Oxford would have his wife's arms, instead of his own, emblazoned on his portrait?

Genealogists tell us that it was a common custom in medieval days for knights to honor their ladies in this manner. Richard Neville Earl of Warwick—the famous "Kingmaker" —is an outstanding example. His great seal bears the crest of his wife, Anne Beauchamp, and his mother, Alice Montague, with no sign whatever of the Neville family arms.

Moreover, we find this statement in Franklin's "The Bearing of Coat Armour By Ladies": "When armoury was in the making, no arrangements were made for women to bear arms. If the lady were an heiress, or owned lands, *her husband bore her arms for her.*"

Upon her father's death in 1587, Elizabeth Trentham had inherited considerable property under the terms of his will.

So it appears that, in having the double crest and shield of his heiress-wife painted on his own portrait, Lord Oxford was merely following approved etiquette. It is also probable that the painting was originally designed as a personal gift to the wife who brought the harassed nobleman respite from known financial straits, as well as a son and heir. In this connection, it is significant that the painting takes its name from Ashbourne, Derbyshire, where Mr. Kingston first drew it to public attention early in the last century. The "Ashbourne Addition" in this same locality was one of the properties owned by Elizabeth Trentham Cockayne, great-grand-niece of the Countess of Oxford, who became sole heiress of both the Vere and Trentham estates about the middle of the 17th Century.

Our final piece of corroborative evidence in this classic example of mistaken identity is the artist's monogram distinguishable in our X-ray picture (Figure 13). The conventionalized initials, C K, when studied in close-up comparison (Figure 14, at left) with other authenticated monograms (same figure) of Cornelius Ketel, the great Dutch portrait painter who was born in 1548 and died in 1616, show conclusively that Ketel must have been the artist who signed the "Ashbourne" canvas in its original, undisguised state. All other considerations aside, the discovery of Ketel as the creator of this portrait should enhance its value far beyond the sum which the Folger Shakespeare paid for it. For the Dutch master is now recognized as one of the really great portrait painters of the late Renaissance, perhaps the most gifted forerunner of Rembrandt. He made his home in England from 1573 to 1581, and during this period and later is known to have done the likenesses of many of the most distinguished members of the English and Scottish aristocracy, including Queen Elizabeth and King James.

Moreover, when we turn to the contemporary account of Ketel's career, published in 1604 by his friend and fellow artist, Karel Van Mander, we find the following significant statement: *"Ketel also made a portrait of the Duke of Oxford (Edward de Vere)*, the High Chancellor (Sir Christopher Hatton), and of many other important members of nobility, with their wives and children. Some of these portraits were life size and full length."

George Vertue, the English art commentator of the 18th Century, also speaks of a large portrait of the 17th Earl of Oxford that had been painted by Cornelius Ketel. Vertue was not able to trace the work at first hand, as it had quite evidently become completely confused with the Shakespearean arcana by the time he wrote. But he remarks that it was once in possession of a Countess of Strafford.

Henrietta Maria Stanley, great-granddaughter of Edward de Vere Earl of Oxford, married William Wentworth Earl of Strafford in 1655. She may have been the Countess of Strafford that Vertue mentions.

In any event, we are able clearly to connect this remarkable "portrait of William Shakespeare" with the poetical Earl of Oxford and his heirs and descendants in so many ways that there should be no lingering doubt of the identity of the real man of letters beneath the over-painted surface.

My investigation to date convinces me that a whole series of portraits of this eccentric peer who had lost caste, political reputation, and wealth for reasons that historians associate with literary and dramatic extravagances, were long since converted into representations of "Shakespeare." The two likenesses known as the Portland and the St. Albans pictures, which show Lord Oxford wearing head-coverings, could not be so easily disguised. These bear his name and titles on their surfaces. Such a situation should explain logically why eight or more antique paintings are listed by the "Encyclopaedia Brittanica" as traditional portraits of the hazel-blue-eyed, auburn-haired "Bard of Avon" which depict him in the apparel of a nobleman.

And, as the penetrative eye of modern photographic science is focused more sharply upon this extraordinary picture-puzzle, more and more evidence accumulates to argue that we have at last found a visual key to the age-old mystery of "William Shakespeare's" real personality.

YOUR FIREARMS

Conducted by A. D. RATHBONE, IV

INTEREST IN FIREARMS *is traditional with American men; science has so developed them that millions yearly find sport and recreation in their use. Hence this monthly department presenting a wide variety of discussion regarding firearms, their handling, and their accessories. Suggestions from readers will be heartily welcomed.*—The Editor.

Shotgun Heresy?

WHEN, in 1807, Rev. Alexander Forsyth, Scotch Minister, received an English patent for a firing lock which proved to be the basic principle underlying evolution of the metallic cartridge, breech loading, and other modern firearms improvements, British sportsmen readily accepted the Forsyth detonating theory, but 30 years passed before the English army officially adopted the percussion method in favor of their old "Brown Bess" flintlock muskets. The army said the Forsyth idea was "objectionable and dangerous."

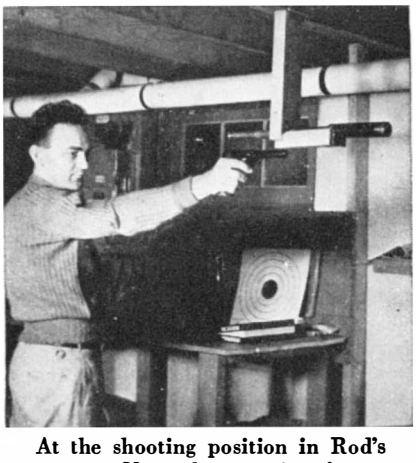
When, recently, the W. R. Weaver Company announced a new one-power (no magnification) 'scope for shotgun use in skeet, trap, and wing shooting, the ensuing howl was comparable to that which rewarded efforts of the Reverend Forsyth 132 years ago. We have before us at this moment a letter from "Bill" Weaver which sets forth some strong arguments in favor of his 'scope, which is 9½ inches long, weighs ½ pound, and has a field of view of 75 feet at 100 yards. It has normal eye relief of 4½ inches, but will function satisfactorily at from 3¼ to 7 inches, and illumination is approximately 120. Reticule consists of a round black dot at intersection of crossed hair lines.

Weaver claims: regardless of speed, target may be instantly caught in 'scope; shooter knows exactly where center of pattern will be and how he is swinging; 'scope simplifies problem many have of shooting with both eyes open, for while aiming is done with one eye, target is seen with both, thereby making it easier to pick up target and judge its position and speed; target is seen more clearly than without 'scope due to light-gathering qualities of the instrument; eye does not have to be accurately centered—it can vary ½ inch or more sideways and four inches fore and aft.

Revolutionary as it sounds, we won't start condemnation proceedings on shotgun 'scopes without a trial, for we'd awfully hate to think that by damning something new we'd make the same mistake as an army which said the detonating principle of firing was "dangerous" and preferred to defend its "Tight Little Isle" with flintlock muskets.

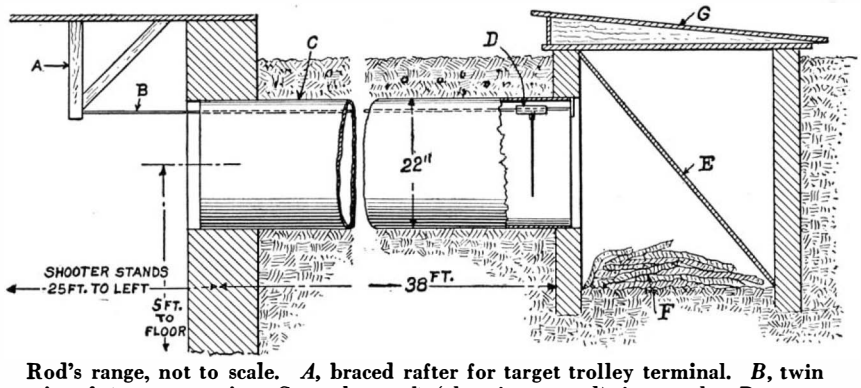
This Is The Range That Rod Built

WHEN Mr. and Mrs. Rod Risley decided to build their attractive and modest little residence in the hills of Westchester County, some 32 miles north of New York



At the shooting position in Rod's range. Note the spotting 'scope

City, Rod, being something of a revolver and pistol shot, tried to figure a way to install a small-caliber range in his own basement. To be completely satisfactory, Rod decided, the proposed range had to give him 60 feet of shooting distance; offer some satisfactory method of muffling the sound; be kept at a minimum cash outlay, even if some personal



Rod's range, not to scale. *A*, braced rafter for target trolley terminal. *B*, twin wires for target carrier. *C*, smoke stack (shooting tunnel) in trench. *D*, target carrier. *E*, steel plate bullet deflector. *F*, bullet cushion. *G*, cover of "cubicle."

Target and trolley. Opening of the shooting tunnel is in background

labor and puttering were involved. As the plans for the new home specified a 25 by 30 foot basement, the first problem was how to fit a 60-foot range into a 30-foot room.

Scouting around the country side, the amateur range builder found an old laundry smoke-stack of 1/8-inch cold-rolled steel, 22 inches in diameter. Fortunately, there were two sections, each 19 feet long, so Rod consulted his slide rule and ended by buying the stack. Still keeping in mind cost of operations, Rod helped his contractor dig a shallow, 38-foot long trench, which extended into the back yard, with a box-like hole about 30 inches in width, length and depth at the far end. When the sections of stack were delivered, they were rolled into the trench, the end nearest the house was fitted into a hole previously left in the foundation, the joints were well tarred to keep out moisture, and dirt was shoveled in on the steel "tunnel." The cubicle-like hole at the far end had meanwhile been lined with a four-inch wall of concrete on all four sides and had been topped with a wooden cover, weatherproofed with asbestos shingles.

By this time Rod's new neighbors were in stitches, trying to emulate Sherlock Holmes. To them, the contraption was an air-conditioning plant, a new-fangled fruit or vegetable cellar, or part of the sanitary system, but Rod said nothing and departed for another country scouting trip. This time he returned with a rusty steel plate—⅝ of an inch thick, 25 inches wide, 32 inches long—and an armful of old inner tubes from heavy-duty truck tires. The steel plate went into the cubicle in a diagonal position and the inner tubes were slashed into sizeable pieces and piled on the sand under the plate; although the neighbors still didn't understand, Rod had completed his bullet-deflecting apparatus.

Rod now found he had a distance of 63 feet from the far side of his basement, through the circular hole in the foundation and on down the "tunnel" to the place where the target would eventually be placed. Waterproofed electrical cable was strung through the "tunnel" and connected to a light socket equipped with a reflector to throw the light down onto the target. A target carrier of strap iron was constructed in the shape of an "H", with holes drilled in the cross bars of the "H" so that the carrier would ride freely on twin tracks of wire which had been stretched from a basement rafter to the concrete cubicle.

The range was finished, the neighbors were finally satisfied, but Rod wasn't. He still wanted to muffle the sound, so he built a wooden box 13 inches wide, 16 inches tall and 4½ feet long. He lined it with Johns-Manville sound-proofing material and succeeded in so muffling the firing reports that Mrs. Risley, upstairs in the living room, never dropped a stitch in her assiduous rug-hooking avocation. She actually thought her industrious husband was trifling at something with a small hammer instead of firing a round of some 30 shots. To complete the comfort of his indoor range, Rod rigged a bracket from the rafters in which he could insert his telescope at eye level and thus peer into the "tunnel" to count the score after shooting, thereby avoiding hauling the target carrier back into the cellar.

Having accomplished the dual feat of fitting a 60-foot range into a 30-foot basement and of adequately muffling the sound, Risley sat down and computed his costs as follows: second-hand steel smoke-stack, $15; cement, $1.50; electric cable, socket, and switch, $4.50; extra labor, $5; wire, pulleys, rope and strap iron for target carrier, $2.50; sound-proofing material, $2; (No charge for wood in either muffler box or 'scope bracket—it came from crates and left-over pieces around the house). Total cost, $30.50. Equipped for a standard 50 foot target, the range has proved an "all-fired" success.

Pot-Shots

AT THINGS NEW

RKO-PATHE's new Sportscope, "Gun Play," shows dramatically in slow and normal motion the interesting possibilities of trap and skeet shooting, particularly so because it was filmed on the 2000-acre preserve of New York's Trout and Skeet Club where special ranges are designed as nearly as possible to simulate true conditions of grouse, woodcock, dove, and quail shooting. Active participants throughout the picture are Eltinge Warner and Bob Nichols, respectively Publisher and Skeet Editor of *Field & Stream*, Frank Kelley, captain of 1937 All-American Skeet Team, Steele Roberts, and A. G. Boesel.

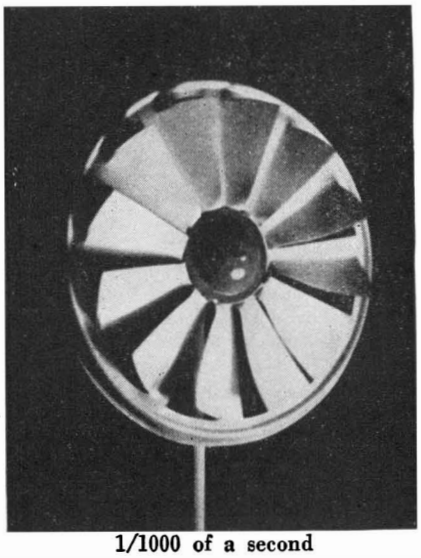
HIGH STANDARD MFG. CO. adds to their .22 automatic pistol line Models A, D, and E which are equipped with new, long handle, free from magazine projection. These guns have automatic slide locks, heavy barrels, and shoot all makes of .22 rim fire cartridges, high speed and low pressure. All have Patridge wide blade front and adjustable rear sights, positive safety, walnut grips, blued finish, 10-shot capacity and choice of 4½ or 6¾-inch barrel. Standard equipment with Model E is choice of right or left thumb-rest grip, and, together with Model D, this gun has a heavier barrel than Model A. Thumb-rests on Models A and D are extra.

ABERCROMBIE & FITCH, in their 1939 fall gun catalog, devote 136 pages to a full range of imported shotguns and rifles, domestic models of all types and prices, and feature their 50th Anniversary as exclusive United States representative of Auguste Francotte et Cie., famous Belgian gunsmiths, by presentation of the Francotte Jubilee double-barrel, hammerless, ejector shotgun in 12 to .410 gage.

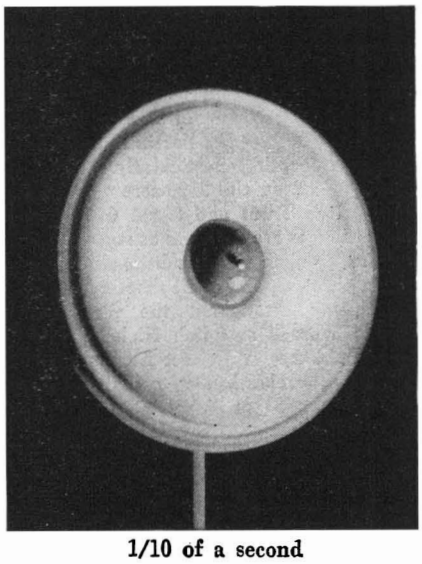
Conducted by JACOB DESCHIN, A.R.P.S.

How Fast?

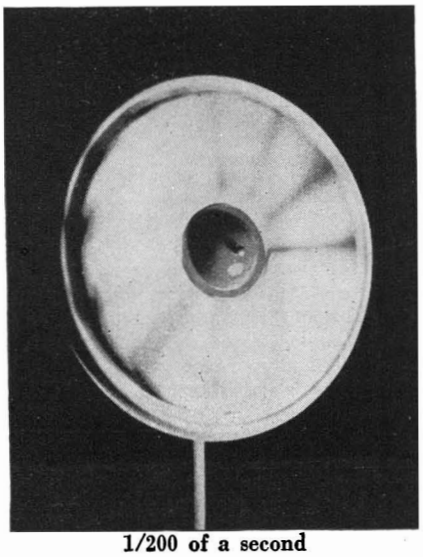
WITH so much stress being placed of late on the matter of high-shutter speeds, we thought it might be in order to provide a comparison of results obtained at relatively slow and high shutter speeds. We set up a toy pinwheel and kept it revolving, with the aid of an electric fan, at a steady pace while we made a number of exposures at different shutter speeds. The effect of partial and complete stoppage is partly illustrated in the pinwheel demonstration reproduced in the three examples shown here. The first example, taken at 1/10 of a second, shows no sign of stoppage at all, giving the effect of a disk. The last, at 1/1000, stopped the wheel practically so "dead" that, paradoxically, it looks as if it had been photographed when at a standstill for all the evidence of movement that it shows.



1/1000 of a second



1/10 of a second



1/200 of a second

Between these two extremes a variety of effects were produced, respectively, at 1/50, 1/200, 1/300, and 1/600, that furnish some idea of motion evidences achieved at different shutter speeds. It is interesting to note that no really strong difference could be observed between the exposures made at 1/25, 1/50, and 1/100, and that the first truly visible difference occurred at 1/200 second.

Camera On The Air

THE first nationwide radio program devoted exclusively to photography for the amateur was inaugurated in the New York studios of WJZ recently under the guidance and leadership of Herbert C. McKay, F. R. P. S., well-known photographic writer and technical consultant. The half-hour program is given every Wednesday evening at 10:30 o'clock over the Blue Network's more than 50 stations throughout the country and is known as "Adventures in Photography," or The Radio Camera Club, membership in which is open to every amateur photographer, who has merely to drop a card or letter to the club, care of Station WJZ, New York City, to become a member.

Mr. McKay, who created the program and is its technical director, advises that a national picture contest is under way under the sponsorship of the club. The goal of the program, according to Mr. McKay, is "to make the Radio Camera Club a common bond among all individuals and groups interested in photography."

Two of the interesting highlights of the

program are the features, "What's Wrong With My Picture, Please?" and a dramatized photographic problem. The former is a sort of question-and-answer box which comprises a round-table discussion including, among others, a professional photographer, an advanced amateur, and Mr. McKay himself. Questions are proposed by listeners and the round table discusses the reply over the air. Kip Ross and Guy Lombardo were the guests on the first program which, incidentally, drew a studio audience of more than 300 persons. The dramatized problem, which winds up the program, presents a question in story fashion; listeners are invited to write in their solutions.

Binding Color Slides

NEXT to dust and lint, curling transparencies are one of the worst bugaboos of the color slide maker. This is particularly true of the short Bantam Kodachrome strips. An effective way to overcome this and to keep the slides as flat as possible under the circumstances is to cut and bind the slides the day they arrive. As soon as you open the package, unroll the strip and hold it unrolled for a few minutes. If you will cut and bind the slides then and there, you will find comparatively little trouble with regard to curling. Also, you will thus avoid too frequent handling of the strip before it is bound and, as a consequence, prevent to some degree the accumulation of lint on the transparency surfaces.

Contrast In Lighting

THE accompanying illustrations provide a graphic example of the negative results obtained with flat lighting and the effectiveness of lighting so arranged that a more faithful reproduction of the subject is achieved. Figure 1, as can be seen, shows the subject illuminated from the front by a single light placed near the camera. This type of lighting, though useful in color photography, where the colors in the subject themselves provide the needed contrast, is lacking in interest when photographing in "black and white." Perhaps this is not a happy example, because the subject is all white, or, rather, light-toned. However, except where one is trying for a high-key effect or some other special result, a flat lighting in black and white will seldom prove attractive.

Figure 1

Figure 2

On the other hand, Figure 2 provides almost a startling difference when compared with Figure 1. The light in this case, also a single unit, was positioned behind the camera and above it, the beam being directed down towards the subject at an angle of about 45 degrees. In both Figure 1 and Figure 2, the light was in front, but a variation in the height and angle of the light made all the difference in the world. Figure 2, as a result, shows depth and roundness, solidity, strength, and character, whereas Figure 1 is practically lifeless.

Ray-Del Contest Extended

PROMPTED by letters received from amateurs asking for extension of closing date of the Ray-Del Picture Contest after learning that all prints were to be developed in Ray-Del, the manufacturers have pushed the date ahead. Prints for entry in the contest will be accepted until December 31, 1939. The contest calls for pictures depicting the idea of "Balance."

It's The Man Behind The Camera

BELIEVE it or not, a $2.50 box camera can take good pictures—and win prizes too. Witness the example of Carl Bakule, of Minneapolis, who paid 50 cents down and 10 cents a week in order to acquire a camera which he otherwise could not afford. Carl has built his own darkroom, flood lights, and other equipment out of tin cans, bits of metal and boards, and other odds and ends. In a "write-up" in the Minneapolis Star-Journal, it is reported that "his film is bought a roll at a time. He can afford only a few sheets of paper at once . . . and he has rarely, if ever, spoiled a picture or a print." Carl says "he can't afford" to miss exposures "because every bit counts."

Among the numerous occasions on which he has won prizes is the selection of his

photograph "Student of Science," as part of the 58-foot mural, "Youth Around the World," in the International Y. M. C. A. building at the New York World's Fair. Carl's picture was one of 63 chosen from more than 1000 entries from amateur photographers in various countries.

Carl writes us that recognition for one of his pictures in last year's Scientific American photographic contest was his "first great inspiration." His letter follows:

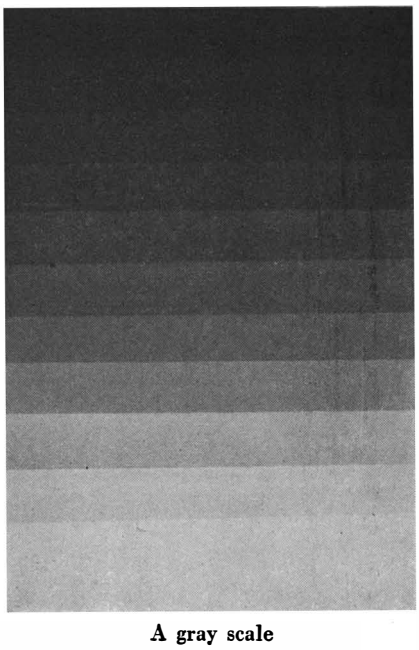
"I am one of your last year's photography winners (Honorable Mention). I would like to say that your contest was my first great inspiration and I look upon your magazine as helping me find my forte. (If you could have seen me when I received your letter!)

"Soon after your contest, I won a one-year subscription to the *Camera Magazine* in the Minneapolis Public Library Salon. Since my first victory with you I have had a good deal of success which is helping me attain my destination. I haven't at present a very good position and through doing photographic exhibiting I hope to attain a good name in order to get a good position in the photographic line."

More power to you, Carl!

See What Your Paper Can Do

SOMETIME ago we described in this department the method employed in making a test strip in order to determine the exposure time required for a given set of conditions as to negative density, paper contrast, distance of negative from the easel, and so on. This called for the use of a strip of paper, narrow bands of which were successively exposed for a given length of time. This same method can be used in making a so-called gray scale of each of the various papers you use, exposing them in the same manner as the printing test strip. If the test is carried through for all your papers, you need never wonder again as to the range of tones your paper is able to produce. Also, it will help you considerably in matching the paper to the particular negative. A gray scale of this type (reduced in size) is illustrated here.



A gray scale

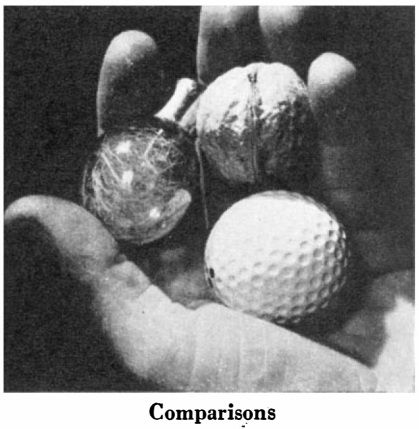
All you need is a sheet of photographic paper and a piece of cardboard or other opaque material to limit the area you are exposing. Recently there came on the market a handy device for performing this routine in a convenient, simple, and accurate manner. It is called the Haynes Gray Scaler and automatically covers up successive steps of the test strip.

Lighting by the Clock

SEVERAL persons appear to have discovered simultaneously that the placement of light sources may be conveniently identified by following the hour numbers of the clock. Thus, with the light at 12, its position is directly over the subject, with the light at 6, its position is from below. Similarly, when at 9 and 3 it is at left or right of the subject. And so on, with the other hour numbers used either in a vertical or horizontal circle around the subject.

Midget Bulb Brings New Phase in Flash Photography

BY the time you read this, the "mighty midget" flashbulb, hardly bigger than a walnut, will have become available as a regularly marketed product. The bulb is being introduced, according to General Electric Company, the manufacturers, "on the occasion of the tenth anniversary of the Photoflash lamp's debut in America, for it was in 1929 that the Mazda lamp



Comparisons

manufacturers introduced the first flash bulbs in this country."

Known as the Mazda Photoflash Lamp No. 5, the bulb is so small that more than two dozen may be carried in the pocket of a suit coat and more than three dozen in an overcoat pocket or a lady's handbag. Featuring a bayonet-type base, similar to the bases of lamps used in automobiles, the bulb is wire-filled, is coated with a lacquer safety jacket, and has a total light output of 13,000 to 15,000 lumen-seconds. The bulb may be fired only with dry cells (two or more), not house current, and is designed for use with all cameras except those of the focal-plane shutter type. The advent of the "mightly midget" presages the introduction of smaller and less cumbersome reflectors.

In this connection, it is interesting to recall a prediction along these lines in the August, 1938, issue of the *Gevaert Sensitizer*, in which C. W. Gibbs, A. R. P. S., wrote as follows:

"Speaking of flash bulbs it is our opinion that, now that the bulbs are being made so small, the next advance in their manufacture should come in the reduction of the size of the base so that these small bulbs and the smaller bulbs of the future would fit the socket in an ordinary flashlight. Photographers seldom use 110 volts for igniting the bulbs and such an advance could result in a saving of equipment if it were only necessary to carry around a fountain pen flashlight for ignition instead of the present apparatus."

Depth of Focus and Depth of Field

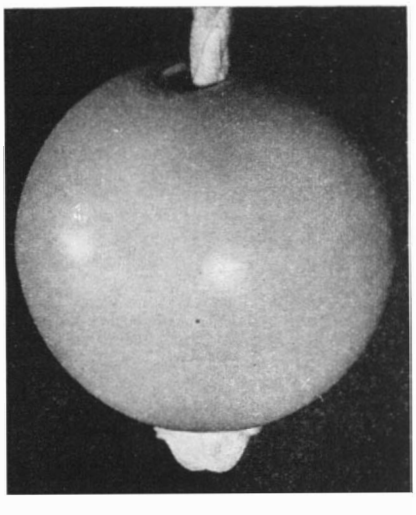
THESE two terms are popularly used interchangeably, but one hears the term depth of focus more often than the other. Actually, so long as a term is generally interpreted in the same way, it really does not matter a great deal, except to philologists, whether the term is used correctly or not. One might point to quite a number of words in the English language that, in the strictest sense, denote something altogether different from the meaning popularly attributed to them. The same with the terms depth of focus and depth of field.

Depth of focus is generally understood to mean the extent or depth of field from the plane nearest the camera to that farthest away in which objects are sharply recorded by the lens at a given aperture and distance from the principal point of focus. Correctly, this phenomenon is termed depth

of field. Depth of focus, on the other hand, refers to what might be called a latitude of sharp focus, a narrow field, with the lens at a fixed point, within which any one of several points may be used as the point of "sharp focus." This will be readily understood by those who have focused on a ground glass. You will remember that on occasion, after you had focused on one point and found it sharp, you were able to move the focusing screen a little, or accidentally jarred it forward, and found that, despite this, the focus remained visually undisturbed. We know, of course, that there can be but one point of sharpest focus, but this is only theoretically so, because the eyes, and it is with these, after all, that we attempt to focus an image, can actually focus on several different points and obtain visual sharp focus at any one of them. Since we have no other means of focusing except with the eyes we must, therefore, take their evidence for it.

How To Light A Sphere

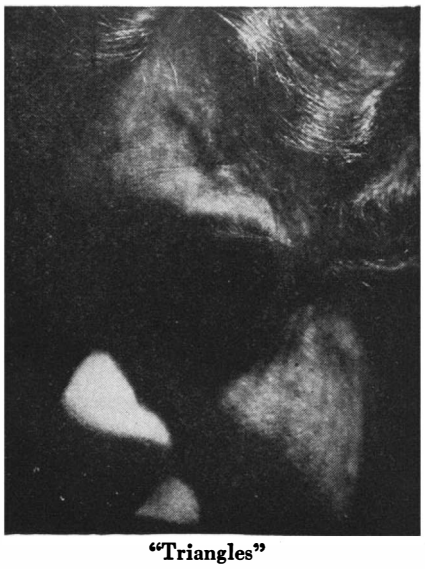
TO still all curiosity from the start, let us explain that the picture shows a bath soap ball—nothing more—which is the only thing, curiously enough, that we could find that would answer the description of a white sphere. The two tell-tale highlights at side and front tell the light-



ing story in a moment. One light was placed at the side, the other in front. In this manner the tonal range is permitted to progress evenly from brightest to darkest area and thus describe the shape of the sphere. Unless care is exercised in placing the lights, particularly the front one, which must be moved back and forth until the desired effect of even progression of tone is achieved, a shadow band will show in the center, caused by the greater intensity of the side light.

Study In Triangles

OF course we do not recommend our "Triangles" as a method of portraiture. We all know that the lighting has still to be completed by a soft light in front to fill in the shadows and illuminate the eye. One of the reasons for making it was to provide a subject for an exercise in pattern-making. Here we have a succession of light triangles, in the forehead, the cheek, the



"Triangles"

nose, and shadow triangles in the area around the eye and the area between lip and cheek. The answer might be, So what? And maybe you are right. However, it does seem to offer some possibilities in the way of trick photography, puzzle picture-making (Guess who?), and so on. The lighting was from a single source directly over the subject and slightly adjusted to light the areas shown.

Camera Books For Rent

A LARGE photographic supply store in New York City has hit on the idea of inaugurating a circulating library of photographic books on the plan of the fiction rental libraries that have been in vogue for years. From the worn appearance of the books on the rental shelf and the report of the management, it appears that the scheme is going over in a big way. Fulfilling the store's expectations also is the fact that borrowers, after reading the book, have, in a number of instances, been inspired to purchase a copy.

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 send a stamped envelope with your request.

B2 Shur-Flash ($3.95) and A8 Cadet-Flash (price not yet announced): Box cameras featuring built-in synchronization and separate flash units. May be used for "straight" photography by day or by night, or for synchronization of flash and shutter for flash exposures. Flash unit is light and compact, providing polished metal reflector on light-weight plastic base. Uses two penlight-size batteries and can be fitted with any one of several types and sizes of standard photographic flash lamps. B2 takes eight 2¼ by 3¼-inch pictures on B2 rollfilm. High-quality meniscus lens; two diaphragm openings; optical direct-view finder; easy loading with hinged back having secure latch; compact, rigid; attractive waterproof covering trimmed with black enamel and satin finish chromium. A8 takes eight 1⅝ by 2½-inch pictures on A8 rollfilm.

Victor Flash Synchronizer ($8.75): Synchronizes shutters equipped with cable release socket, at speeds up to and including 1/500 of a second. Features: Easy attachment to any camera; uses no battery current except for igniting lamp; shutter tripping drive will trip either automatic or pre-set shutters with uniformly accurate timing; protects shutter mechanism by stopping cable plunger at exact tripping point; release button operated simply as cable release; difference in pressure on release cannot upset timing; quickly adjusted or set for any shutter; synchronizes all speeds of shutter when adjusted to any one of them; has adjustable height reflector to center any flash bulb; polished aluminum, 6-inch reflector.

Agfa Speedex Camera ($27.50): Lens *f*/4.5 anastigmat, 85mm focal length. Shutter speeds ½ second to 1/250, time and bulb. Measures 5¾ by 3⅝ by 1½ inches closed. Takes twelve 2¼ by 2¼-inch pictures on B2 rollfilm. Focuses 3½ feet to infinity by adjustment of focusing ring on lens mount. Shutter of pre-set type released by button mounted on camera body. Molded top contains eye-level view finder, built-in shutter release, opening release button and winding knobs. New type, self-erecting platform and front, brings lens and shutter assembly quickly into rigid picture-taking position. Recessed tripod socket centrally located on base of camera; single film window peephole positioned in center of camera back. Special eveready leather carrying case available at $4.75.

Saymon-Brown Exposure Meter ($1.85): Gives direct readings. Entirely self-contained. Measures ½ inch by ¾ inch by 1¾ inches overall. Chart based on films having 24 Weston rating; instructions provide for adjustments from 8 to 128. Simple adjustment of meter to individual eyesight at start sets system for all future readings. Finished in chrome, equipped with leather case. Can be used held in hand or fitted into camera shoe. Shoe can be supplied for 25 cents.

Master Leicameter: Has all Weston features, but gives readings in direct shutter speeds. "High Illumination" scale gives direct shutter speed readings from ½ second to 1/1000th second. Reading is based on 24 Weston and diaphragm opening *f*/6.3. For "Low Illumination" scale, film speed is 50 Weston, and scales based on use of *f*/2 diaphragm opening. Calculator dial indicates diaphragm stop to use when film speeds are used other than those on which scales are based. Calculator dial can also be employed to determine shutter speeds to be used at various diaphragm openings, for any particular opening.

Lafayette "Anodized" Tripod (2-section, $8.49; 3-section, $9.95): Made entirely of aluminum. All parts "anodized", process finish which resembles stainless steel both in appearance and resistance to wear and scratches. Friction joints "Stica" lined to provide firmer locking with less pressure and to avoid slipping likely to occur in metal-to-metal friction contacts; also per-

mits adjustment of tripod at any height. Reversible tips provide choice of rubber pads or metal spearheads to insure firm grip on any floor or ground surface. Large diameter machined aluminum head provides firm seat for large and small cameras, preventing vibration caused by flexing of camera case itself when supported on small surface.

HOLLYWOOD VIEWER PROJECTOR ($39.50): Combination viewer and projector for 35mm slides. Built of aluminum; baked dull enamel finish. Viewing screen mounted in deep-set viewing box, permitting slides to be shown in daylight, or, with turn of knob, viewer is changed into projector. Cooling system efficient; 100-watt projection lamp used. Accommodates slides of any thickness. Available are black carrying case with compartment for slide file ($4.50) and slide file for 100 slides that fits into carrying case ($2.50).

TALBOTT 35mm STRIP PRINTER ($1.50): Consists of die-cut mat board printing frame and lamp housing complete with cord, switch, 7½-watt opal bulb. In operation, merely frame negative and paper, place lamp housing over aperture, and expose.

CARGILLE TRANS-SHARP (Model K for Kodachrome), 25¢; (Model D for Dufaycolor, 40¢): Designed for viewing negatives and transparencies.

F-R DARKROOM PAPER CABINET ($3.95): Accommodates one full gross 5 by 7-inch paper; one full gross 8 by 10 and one-half gross 11 by 14 paper. Made of wood. Interior divided into several sections to accommodate various paper dimensions. Shelves finished smooth. Cabinet permits quick access to all sizes of papers. Light trap makes cabinet light-tight. Metal clasp keeps cabinet shut when not in use and prevents door from accidentally opening. Rubber domes on bottom prevent table scratches. Light in weight; guaranteed light-tight.

WILLO SPOTLIGHT No. 88 ($1.50): Completely enclosed unit with condensing lens which concentrates small, bright spot. Uses No. 1 Photoflood or other high-intensity bulbs. Complete with cord, plug, and heavy clamp.

VICTOR SUNFLECTOR: Designed for balancing lighting when making exposures in direct sunlight. Compact and portable. Sunflector is nine inch, convex mirror formed to curvature of 40-inch diameter sphere. Mounted in aluminum casing. Chromium finished support, through friction joints, may be variously positioned to direct reflected rays as desired. Front feet rubber-tipped. Chromium finished loop forms base or provides means of hanging Sunflector on wall hooks, pegs, etc. May be used as spotlight for highlighting when subjects are in shade, for concealed lighting, and specially effective in relieving shadows in color photography outdoors. Most useful in movie and still photography when subject is single figure or close-up.

SOLAR, JR. MINIATURE ENLARGER ($39.50): Optical system employs three-inch condensing lenses: Standard equipment includes 2-inch Wollensak *f*/4.5 enlarging lens. Negative carriers available for double frame 35mm and half-vestpocket negatives.

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. I have six rolls of film exposed three years ago, not developed. They were given normal full exposure. What special precautions should I take to obtain the best possible result?—L. V. P.

A. Develop the films for 20 percent longer than the normal developing time. For example, if development for a given temperature is 15 minutes, prolong development to 18 minutes. This should result in satisfactory negatives if nothing has happened to affect the emulsion since the negatives were exposed.

Q. Will you kindly give me information as to the best method, as well as the most economical, to obtain positives for projection purposes from 35mm black and white film?—P. A. S.

A. This procedure is exactly the same as that employed in making contact prints from negatives. The 35mm negative is placed in close contact with 35mm positive film, emulsion to emulsion, with the "glass" or celluloid side facing the light. Regular printing devices are available for this purpose, but a less expensive method is the use of the 35mm wooden printing frames designed for printing either one or six at a time. Process the 35mm positive film in accordance with the formula recommended by the manufacturer.

Q. Will you please explain the differences between a focal plane shutter, a front shutter, a Compur shutter, and a Robot shutter in their actual operation?—H. S.

A. The focal plane shutter consists of an opaque rubberized fabric or metal curtain which moves under spring action close to the plane of the film. The speed is varied by adjusting the spring tension or varying the size of the opening or slit which extends the whole width of the picture area. A front shutter is a so-called "silent" portrait shutter consisting of a set of moving blades and which is used in front of the lens and is operated by a cable release, adjustments being made for time, bulb, or an instantaneous exposure, the latter usually being about 1/25 or 1/50 of a second, the actual speed depending on the pressure exerted on the release. The Compur shutter is of the so-called between-the-lens type and consists of several blades of very thin metal which rapidly open and close. The speeds are regulated by a spring-operated escapement consisting of a train of gear wheels. The shutter of the Robot camera is a special disk type design which is operated by a spring motor. When the latter is fully wound up, as many as 24 exposures may be made in rapid succession without the necessity of rewinding.

Q. Can you give me an effective formula for a print cleaning solution?—L. K.

A. Make up a little solution containing equal parts of ammonia, wood alcohol, and plain water. Apply with a soft rag, rubbing gently over the print surface.

Q. Recently I saw a reference to the fact that a "buffered borax" formula can be made merely by adding boric acid to D-76. Can this be done and if so, how much per 32 ounces of D-76? How does the buffered borax formula compare with D-76 as to grain and the effect on film speed? The camera directories list the Leica as Model II, III, IIIa and IIIb, while the camera shop ads call them Model D, F, G, etc. What is the relation between these two methods of reference?
—J. A. H.

A. By adding 14 grams (203 grains) of boric acid crystals, the D-76 formula is converted to the "buffered borax" formula, which, therefore, is as follows:

Water (about 125° F)	24 ounces
Metol	29 grains
Sodium sulfite, desiccated	3-1/3 ounces
Hydroquinone	73 grains
Borax (20-Mule Team)	29 grains
Boric acid, crystals	203 grains
Cold water to make	32 ounces

At 65 degrees, development for fast emulsions is 20 to 22 minutes; for emulsions of medium speed, 16 to 18 minutes. The grain of the developed image is finer, without any apparent loss in emulsion speed.

The numeral designation of the various Leica models, formerly employed only abroad, has recently been adopted in this country to replace the alphabetical system. Becoming accustomed to a change from one system of model designation to another naturally takes a little time, especially since the alphabetical system has been in use here for such a long while.

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.

AMERICAN MEDICINE MOBILIZES

By James Rorty

RORTY, the author, here presents one side of an at present extremely controversial subject; that is, group medicine, compulsory health insurance, governmentally subsidized medical care and "bringing adequate medical care to all the people"—subjects on which there is much, very much, to be said on both sides. Readers who prefer a calm, objective, unemotional, and scientifically weighed discussion of such issues probably will be irritated by this book which is at times scornful of opinion not fully in agreement with the author's. Those who enjoy a fight will like it, if they also like its point of view. It is an excellent compendium of arguments favoring socialized medicine, flavored with a bountiful background of gossip about prominent personalities. (358 pages, 5½ by 8½ inches.) —$3.10 postpaid.—*A. G. I.*

SYNCHROFLASH PHOTOGRAPHY

By Willard D. Morgan

FLASHLIGHT bulbs, used over a wide variety of natural lighting conditions, have done much to change and enhance photographic technique. Here is told the whole story as it applies particularly to the advanced amateur—equipment and how to use it under all conditions. (200 pages, 6 by 8½ inches, 200 photographs and drawings.) —$2.10 postpaid.—*A. P. P.*

PATENT FUNDAMENTALS

By Adelbert Schapp

A TREATISE on patent, trade-mark, and copyright procedure including information about assignments, licenses, and so on, written in non-technical language. The book is particularly valuable to the layman in furnishing information which will guide him in obtaining proper protection for his developments. (176 pages, 5½ by 8½ inches, illustrated.) —$2.10 postpaid.—*J. P. D.*

BETTER BUSINESS LETTERS

By L. E. Frailey, B. A.

EVERY business firm in the country should purchase copies of this book and pass them to all employees and demand careful reading. The results would be finer, more human, and decidedly more modern letters than are now ground out by the millions daily. One important result would be the elimination of such rubber-stamp phrases as: "In reply we would wish to state," "We are pleased to attach hereto," "Beg to acknowledge," "Thanking in anticipation," "Hoping . . . we remain," and numerous other hold-overs from the dull 90's. This book covers various types of business letters, correspondence problems, promotion letters, and has a large section devoted to lectures and quiz questions. Numerous examples of letters, good and bad, are given. (198 pages, 5¾ by 8½ inches.) —$2.10 postpaid.—*F. D. M.*

FIELD BOOK OF ANIMALS IN WINTER

By Ann Haven Morgan, Prof. Zoology, Mt. Holyoke College

AMATEUR (also professional) naturalists will find here a mine of detailed, collected data on the ways in which animals meet the crises of winter by hundreds of stratagems, endurances, and fine adjustments with their surroundings: hydras, rotifers, bryozoans, leeches, insects, spiders, snails, fishes, frogs, snakes, turtles, birds, mammals, and numerous others. Many odd surprises for the uninitiated. (527 pages, 4 by 6½ inches, pocket size, 282 illustrations.) —$3.60 postpaid.—*A. G. I.*

MACHINE DESIGN

By Stanton E. Winston

HEAVY in mathematics, this volume presents those fundamentals of theory and analysis which are basic to the field of machine design. It is intended as a reference for the designer as well as a textbook for the student in this field. Its range is indicated by some chapter headings: Fundamental principles—simple and compound stresses; bolts and screws; shafting and keys; friction drives; spur and bevel gears; and others. (333 pages, 5¾ by 8½ inches, numerous illustrations.) —$3.10 postpaid.—*F. D. M.*

GUN COLLECTING

By Charles Edward Chapel (1st Lt. U. S. Marine Corps, Retired)

ANY gun fancier who has never ridden the hobby of firearms collecting will, in all probability, reach the last page of this book with the firm resolve immediately to inaugurate his hitherto neglected gun gathering activities. A pleasing, narrative style smoothly and rapidly motivates the presentation of historical and informative data on antique arms and the pleasure and profit to be had from their ownership. Although written for the novice, and therefore equipped with an excellent glossary, index, bibliography, and source lists of collectors, museums, and periodicals dealing with the hobby, the veteran also will find this volume well worth adding to his library. (232 pages, 5 by 7½ inches, 15 illustrations.) —$2.60 postpaid.—*A. D. R., IV.*

MODEL RAILROADS IN THE HOME

By Earl Chapin May

MODEL railroad fever may be compared with a disease; one is either susceptible or immune. In this book the author exposes the reader to the hobby. For the immune he explains some of the fascination, and how it all started. For the susceptible he tells how to start, build, and operate a system. Many interesting sidelights and pointers are offered for those infected with the fever. The latter will particularly like the vocabulary section, in which many terms of the special jargon of railroading have been listed, with definitions. (248 pages, 5 by 7¼ inches, illustrated.) —$2.10 postpaid—*L. B. P.*

DIESEL ENGINES, THEORY AND DESIGN

By Howard E. Degler, M. E., M. S.

STUDENTS and designers in the automotive field will find this book to be a practical text on Diesel engines, dealing as it does with such phases as efficiency, thermodynamics, fuels and combustion chambers, testing and performance, and principles of design. It is not in any sense of the word a book for the beginner but is written rather with the assumption that the reader is equipped with a knowledge of the principles of mechanics and has a general acquaintance with internal combustion engines. Thorough understanding of the text requires a certain amount of mathematics. (270 pages, 6 by 8½ inches, well illustrated with drawings and half tones, graphs and tables.) —$2.60 postpaid.—*A. P. P.*

CHEMICALS OF COMMERCE

By Foster Dee Snell and Cornelia T. Snell

INTENDED as a source of information on the composition of actual commercial products, this volume is written in language which any user of chemicals can understand. The authors have departed from the usual dictionary style of presentation in that all material has been classified according to type of compound. Each type—there are 36—is covered in a chapter which starts with a discussion giving the general back-

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ground and chemical nature of the particular group. The chapter method of presentation will permit rapid and easy comparison of related products. Completely indexed. (542 pages, 5½ by 8½ inches.)—$5.10 postpaid.—*L. B. P.*

MATTER AND LIGHT

By Louis de Broglie, Professor of the Faculty of Sciences of Paris

SERIOUS readers of the new physics, either professional or well-informed lay, will find here the noted Nobel Prize winner's approach to the whole of modern physics: a general survey, matter and electricity, light and radiation, wave mechanics, philosophical studies on quantum physics, and various other subjects. It contains a small amount of calculus and is intermediate in difficulty. (300 pages, 5½ by 8½ inches, unillustrated.)—$3.60 postpaid. —*A. G. I.*

TOOL MAKING

By C. B. Cole

THE tools that a workman uses or that a designer makes are discussed in detail in this volume which gives complete instructions for making and using them. The range is all the way from personal tools to such large machine tools as arbor presses, drilling machines, lathes, shapers and planers, and so on. Heat-treating methods for use on most tool materials, including steels, alloys, brass, bronze, and aluminum, are clearly outlined. Equipment necessary for such treatment is described in detail. There are many pages of working drawings and tabulations of bills of material. (413 pages, 5¾ by 8½ inches, numerous illustrations.)—$3.60 postpaid—*F. D. M.*

LIGHTPLANE FLYING

By Wolfgang Langewiesche

FLYING for sport or business is a possibility that frequently occurs to a large number of people. But is it safe? Is it too expensive? Is it difficult? Does it really have sufficient advantages to offset any of its disadvantages? A noteworthy attempt to answer these and other questions has been made in the present book which is written, not from a technical angle, but from the point of view of the average person who really would like to know what lightplane flying is all about. If the reader is at all susceptible to suggestion, a careful perusal of this book will make the way much easier for lightplane salesmen. (214 pages, 6 by 9½ inches, a number of illustrations.)—$2.60 postpaid.—*A. P. P.*

PATTERNS OF SURVIVAL, AN ANATOMY OF LIFE

By John Hodgdon Bradley

ONE place that philosophy touches science is in the realms of biology. "If there is any meaning for mice or men in the restless drive of life," the author writes, "a billion years of living should contain it. To search those years for that meaning will be the object of this book." It deals largely with the old questions of vitalism and mechanism, and leans to the vitalistic side with the various outlooks that usually go with that side. (223 pages, 5½ by 8¼ inches.)—$2.35 postpaid.—*A. G. I.*

TELESCOPTICS

A Monthly Department for the Amateur Telescope Maker

Conducted by ALBERT G. INGALLS

FROM the day when the book "Amateur Telescope Making—Advanced" was first published, with its detailed chapter on Walkden's Richest-Field Telescope, this compact type of instrument, nicknamed the "RFT," became popular. The Richest-Field Telescope is designed on the basis of scientific data to show at one Milky Way view the greatest possible number of stars in one field, and the viewing in the Milky

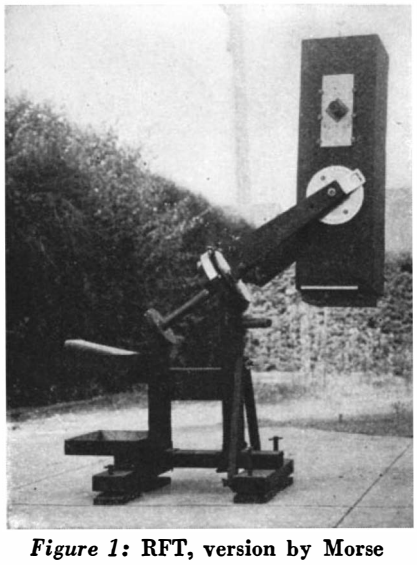


Figure 1: **RFT, version by Morse**

Way is very milky indeed—myriads of stars. Such a telescope is quite small and stubby—it is demonstrable both in theory and fact that a large telescope would show fewer, not more, stars. It has a rather deeply curved mirror and therefore is not suited to the tyro's maiden job, since deep mirrors are harder to make, but could be the amateur's second or third job. Foreign commentators say we Yankees "go" for anything biggest or smallest, longest or shortest, heaviest or lightest, or anything, so long as it ends in "est," and so there must now be hundreds of these Richest-Field telecopes in use, judging from reports we receive. Here are pictures of three of them. The first (Figure 1) is by E. H. Morse, 2401 Mar Vista Avenue, Altadena, California (see photo of his 15″ reflector in "ATM," p. 355). It has a 5½″ mirror of 22″ focal length. "It has exceeded my expectations in performance," Morse writes. "In fact," he continues, "I have had more fun with it in two hours than I have in many nights with my large telescope."

The "RFT" in Figure 2 was made by Howard P. Smith, Jr., 405 North Park Avenue, Tifton, Georgia, and has a 6″ mirror of 20″ *f. l.* Smith states that "the definition is superb." He puts in a claim to being the youngest to make an "RFT"—age 14. As very few youths under 18 ever make telescopes—for telescope making is essentially an adult hobby—we suspect he will retain this record easily enough.

The third "RFT" (Figure 3) is by B. L. Harrell, 114 South Street, Gadsden, Alabama. It has a 4¼″ Pyrex mirror of 20½″ *f. l.*, in a cedar tube, and is equatorially mounted on an old transit tripod.

"HERE'S something that, until a few days ago, was quite new to me, and I feel that the amateurs should know about it," Russell W. Porter says in sending the note which follows:

"I think I am safe in saying that the average mirror maker, when testing with the knife-edge at the mirror's *focus* (note, *not* at the center of curvature), takes it for granted that an even and uniform cut-off indicates a perfect paraboloid. However, this seems to be not precisely true, when the pinhole and image are sufficiently separated for convenient observation. The following note, made by Dr. John A. Anderson, executive officer in charge of the 200″ telescope, will show clearly why the cut-off should *not* be uniform when testing a paraboloid at the focus."

'The other day,' Dr. Anderson states, 'one of our opticians called me in to see the test of an *f*/4.6 paraboloid of 26″ aperture. The set-up was the regular one with a full-

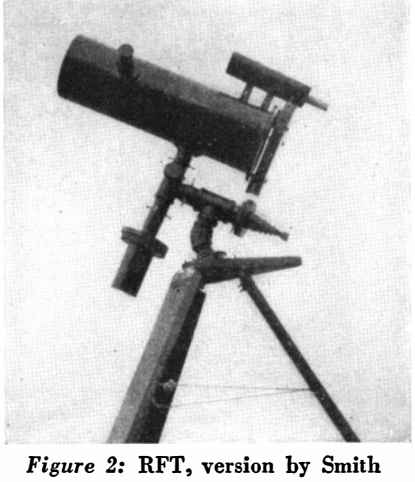


Figure 2: **RFT, version by Smith**

sized flat, and the conventional Foucault knife-edge. Pinhole and image were separated by a small distance—about ¼″ or less. The optician had found that the cut-off was not changed by rotation of the paraboloid—or the flat. The small diagonal also was found to be free from suspicion.

'In the horizontal cut-off,' Dr. Anderson continues, 'the shadows came in from the left and right equally [see Porter's drawing, Figure 4.—*Ed.*] and in the vertical they came in from both ends of a diameter inclined about 45° to the vertical.

'A reference to pages 100 and 101 of Dr. Gardner's "Optical Design", or any other description of the formation of pure third order coma, will account for the above observations exactly. The interesting thing to remember is that the effect is so easy to observe even when the off-axis angle is only 3½ minutes of arc.' "

Supplementing this compact statement by Dr. Anderson, Porter writes, "It should be noted that the shadows referred to are somewhat fainter than the familiar shadows seen at the center of curvature. The diagrams may help to show what actually takes place. Figure 4 is the appearance of the shadow when the knife-edge moves in from the left. Figure 5 represents three zones, *a, b, c,* arbitrarily selected on the mirror, and the numbers 1 to 8 refer to octants discussed below. Figure 6 is a schematic diagram showing the three images formed by the zones *a, b, c* of the mirror. Now, if the knife-edge cuts in from the left in Figure 6, it collides with light rays coming from 1 and 5 on the mirror. Hence the shadow shown in Figure 4. If the knife-edge makes a vertical cut-off (say, from below) it extinguishes light reflected from 2 and 6 on the mirror, and hence the resultant shadows creep in at 45°.

"The images," Porter continues, "produced by an off-axis pinhole and knife-edge are included in a 60° angle (regardless of the separation). This off-axis condition can be overcome by interposing a half-silvered diagonal on the mirror's axis, as in Figure 7. The diagonal must have a minimum thickness to avoid double reflections. One method, described in Strong's new work, "Procedures in Experimental Physics," page 75, is to half-silver a film of lacquer stretched over a frame."

"The full title of the book referred to by Dr. Anderson is 'Application of the Algebraic Equations to Optical Design,' by I. C. Gardner, May 1927, Superintendent of Documents, Government Printing Office, Washington, D. C."

FLATS are sometimes as temperamental as prima donnas. H. E. Dall, 166 Stockingstone Road, Luton, Bedfordshire, Eng-

Figure 3: **RFT, version by Harrell**

land, relates in a private communication, how one misbehaved. "I had an experience with a flat which I made for A. P. Norton (of star atlas renown) which has rubbed home its lesson. The flat was for a Newtonian and was a properly shaped oval of 2¼" minor axis, 11/32" thick. I started by making a circular flat large enough to cut out two ovals, using polished plate completely free from strain, one side to be

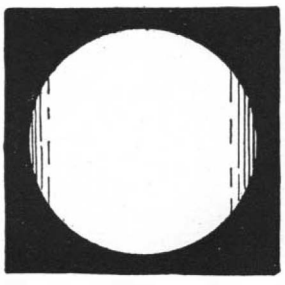


Figure 4: Horizontal cut-off

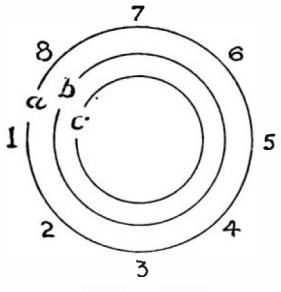


Figure 5: Three arbitrary zones

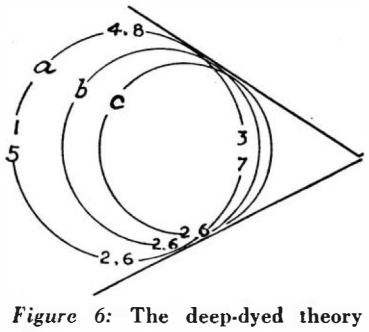


Figure 6: The deep-dyed theory

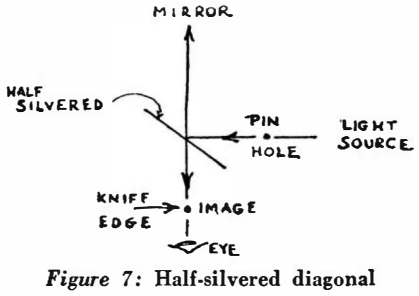


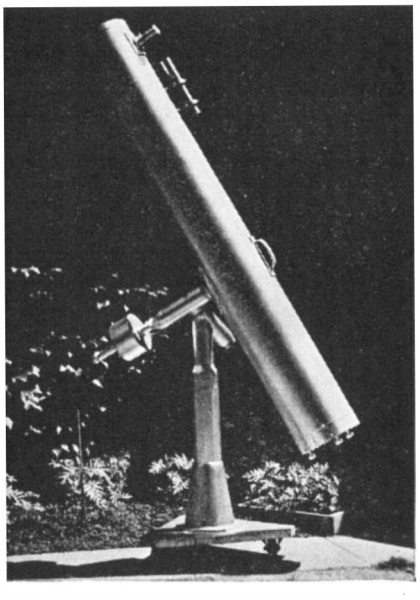
Figure 7: Half-silvered diagonal

ground and worked to a flat. I succeeded in getting flatness within 1/20 wave in four or five hours' total work. Now comes the rub! I cut it in half, lathe-ground an oval from one half, ground the back and, on testing it before silvering, found it was no longer flat. The error was a regular bend of a few millionths of an inch—far more than I could tolerate for a first-class flat, although even then it would take a trained eye to detect its effect in the telescope. No alternative but to cut another flat, using the remaining half. This time I didn't grind the polished back and on test, when finished, it still was flat! The apparent

THE BEGINNER'S CORNER

SEMI-PORTABILITY, permitting a telescope weighing 100 or 200 pounds to be trundled out of doors and, within the limits of one's dooryard, shifted from place to place, is often forced on the beginner by circumstances. Later, when the long-eared telescope bug has bitten him till he is far gone and past hope, he may throw up his job, sell his home, and drag his wife into the country to live where there is a wide horizon and better seeing, and there he may have a telescope on a fixed base under a permanent housing.

Two semi-portable telescopes mounted on caster trucks are shown here, the first an 8" made by H. R. Fertig, Chief of Yard and Terminal Operation, Rock Island and Pacific Railway Co., Chicago, Ill. He calls it "From Junk to Jupiter," as the mounting is made of old motor car parts. For the pedestal, a rear housing was bolted at its bell end to a truck, or "dolly," on rubber-tired swivel



casters. As this would be far too light and top-heavy, a half barrel was set around it and filled with concrete. Guy wires add to the stability. Total weight, 250 pounds. "I know of nothing I have ever undertaken before," Fertig states, "which gave me the satisfaction of seeing my rub-rub-rub, night after night, slowly develop into a telescope. It is also a beautiful thing to see Saturn come into the edge of the field of view and pass across the mirror without even a blur."

Another semi-portable is the one at the right, made by Robert E. Smith, D. D. S., Medico-Dental Bldg., Sacremento, Calif. Starting at the bottom it has: three castors; a 3/16" steel plate reinforced with angle iron; a welded iron taper; 3½" standard pipe; a 3½" to 2½" welded reducer; 2½" double-heavy pipe welded to a piece of the same diameter, machined for inside bearing; 2" double-heavy pipe also machined internally. Welding was done in local shops. The whole is both neat and mechanically well proportioned. Such a mounting should be inexpensive.

TELESCOPTICS

(Continued from preceding page)

explanation is in line with some earlier experiences of the surface tension effects of polished glass, and the moral is: 'don't grind the polished back of a flat mirror after finishing the front.'"

JUST as we go to press, the November number of the *Journal of the Optical Society of America* comes out, containing an article entitled "A New Method for Testing Cassegrain Mirrors," by Dr. E. Gaviola, of the Observatorio Nacional at Córdoba, Argentina. Too long (4 pp.) to reprint here at present, the gist of it may be gathered from the following:

Dr. Gaviola (whose photograph, by the way, appears in "ATMA" at p. 474 and who has done much research at Pasadena — see also p. 76, "ATMA," — and who is especially keen on mirror refinement) was confronted with the problem of testing and correcting the Cassegrain secondary of the 32" telescope at the La Plata Observatory, but had no flat of that size and no Hindle sphere. So he thought up the new test. Directly in front of the convex he put a mask — typical kind. Close to that he put a convergent lens — a bad lens serves as well as a good one — a trifle larger than the secondary and with *f. l.* shorter than the *r. c.* of the convex. Using monochromatic light and a test rig in which k-e and slit were virtually coincident, he determined the position of the image of the various zones. Next, he removed the convex from the set-up and put a small flat at proper distance beyond the lens, so that the new image would return to the k-e end, and once more measured each zone. Amateurs who want to try it may obtain the November number of the "J.O.S.A." from the offices of the Optical Society of America (American Institute of Physics), 175 Fifth Avenue, New York, for 60 cents.

In the same number of the same journal there is a 15-page paper by Ricardo Platzeck and Dr. Gaviola, entitled "On The Errors of Testing and a New Method for Surveying Optical Surfaces and Systems." Fortunately, it involves precision in workmanship not ordinarily reached by the beginner. The paper shows that the regular method of testing is not accurate enough to

work to a close degree of precision. The new method consists of determining the *caustic* or line of the centers of curvature of the surface elements. The method may be used in the Cassegrain secondary test described above, also to determine astigmatism, to study Schmidt correcting plates, single lenses and lens systems. A wire is used for k-e, to give higher precision. Note from Porter, Pasadena: "Gaviola has

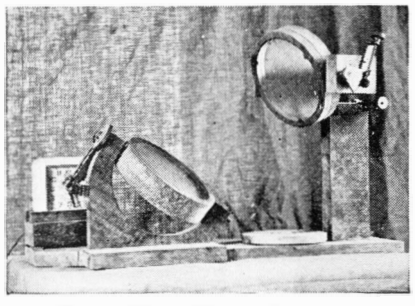


Figure 8: Coelostat by Morse

just been here and told us of a new way of making k-e test at c. of c. Dr. Anderson says it's O.K. If so, then all mirrors thus figured are over-parabolized." Evidently the same test. And how Ellison, if he were alive, would chuckle! Vindication for his under-correction argument.

As stated above, these two papers came out on the day when the present notes had to be sent to press, so there was time to read only the first one better than sketchily. The second is illustrated with interesting focograms of secondary zones too subtle to be seen in ordinary testing—also, unlike the first, is plagued with several acres of higher mathemetics. An effort will be made to have the low-down on it for later publication. In the meantime, let none but advanced workers worry about their mirrors now being all wrong.

SUN telescopes, described in Porter's part of "ATM," seemingly seldom are made. Just why amateurs pass up the only star whose details any telescope can reveal at all, and whose details are varied and ever-changing as well as conspicuous, is something of a puzzle. Anyway, E. H. Morse, 2401 Mar Vista Ave., Altadena, Calif., has made a 6″ sun telescope whose coelostat is shown in Figure 8. "It has 15′ f. l." he writes, "and is mounted in my workshop on a plan very similar to that of the Snow telescope on Mt. Wilson. All three mirrors are unsilvered, which brings the light down almost sufficiently for the eye, although I have a selenium glass wedge to reduce glare when necessary. Observations of the ever-changing features of the Sun are even more interesting," Morse states, "than the sameness of double stars, clusters and so on."

In your copy of "ATM," unless you have the recent and corrected *printing* of the fourth edition (that of 1935—the most recent *edition*) we suggest that you rearrange page sequence as follows: Change p. 37 to 42, 38 to 39, 39 to 40, 40 to 41, 41 to 37 and 42 to 38, and thereafter read in that sequence. How these pages ever got out of sequence, and stayed so many years thus without being complained of by any reader, is a second puzzle. How the book's editor also failed to discover this is more easily explained: he just hadn't, until recently, ever sat down and read the book straight through—too much like a busman's holiday!

CURRENT BULLETIN BRIEFS

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

SEEING, by Dr. Matthew Luckiesh, is a 20-page booklet devoted to the human eyes, their uses and abuses, and how they may be adequately protected against early deterioration by the proper use of light for various purposes. A number of illustrations serve to emphasize pertinent parts of the text, and a table of "recommended foot-candles" summarizes the whole subject. *General Electric Company, Incandescent Lamp Department, Nela Park, Cleveland, Ohio.—Gratis.*

FOTOSHOP ALMANAC CATALOG, 172 pages, is virtually an instruction book for amateur photographers, plus a comprehensive illustrated directory of hundreds of photographic items including cameras and all sorts of accessories. Feature articles cover "How to Choose a Camera," "How to Use Filters," "Movie Photography," and many other subjects. *Fotoshop, Inc., 18 East 42 Street, New York, New York.—25 cents on a refund basis.*

PRACTICAL AIR NAVIGATION AND THE USE OF THE AERONAUTICAL CHARTS OF THE COAST AND GEODETIC SURVEY is a 209-page book which describes the detailed information to be found on these charts and explains their use in the four present methods of aerial navigation—finding position by reference to land marks, by direction and distance flown, by radio bearings, and by celestial observations. A chapter is included on meteorology and the interpretation of aviation weather maps. Well illustrated. *Coast and Geodetic Survey, Washington, D. C.—65 cents.*

THE A.R.R.L. ANTENNA BOOK is a 144-page paper covered book, well illustrated with drawings and photographs, which gives not only the fundamentals of radio antennas, but also presents complete specifications and designs for various modern types. *American Radio Relay League, West Hartford, Connecticut.—50 cents.*

THE RESISTANCE OF NI-RESIST TO CORROSION BY SEWAGE is an 8-page illustrated folder which discusses the results of experimental testing in sewage disposal plants. The desirable characteristics of the alloy Ni-Resist are pointed out. *The International Nickel Company, Inc., 67 Wall Street, New York, New York.—Gratis.*

SNOW AND ICE PHOTOGRAPHY, by H. W. Wagner, is a 96-page booklet, with stiff paper covers, that gives the amateur photographer a broad knowledge of the conditions which must be met and overcome in successful photography of this type. *Camera Craft Publishing Company, 425 Bush Street, San Francisco, California.—$1.00.*

THE MERCK INDEX, fifth edition, is a 1060-page limp bound book containing 5900 descriptions of individual substances; 4500 chemical, clinico-chemical reactions, tests and reagents by the author's name; formulas for preparation of culture media, fixatives and staining solutions; useful tables; antidotes for poisons; literature references and other dependable information. *Merck and Co., 161 Sixth Avenue, New York, New York.—$3.00.*

GREATER SAFETY IN NIGHT DRIVING is devoted to a discussion of the sealed beam headlight system which is being used on over 95 percent of all 1940 motor cars made in the United States. It describes the system completely and presents numerous illustrations showing its advantages over older types. *Automotive Safety Foundation, 366 Madison Avenue, New York, New York.—Gratis.*

101 WELDING IDEAS FOR LOW-COST MAINTENANCE is a 16-page thoroughly illustrated pamphlet which tells clearly and simply of the many ways in which welding can be applied by users of machinery and metal products. The illustrations show the wide variety of jobs that can be handled by this process. *The Lincoln Electric Company, 12818 Coit Road, Cleveland, Ohio.—Gratis.*

SYMPOSIUM ON PATENTS is a 121-page book which presents eight papers on various aspects of the subject, ranging from "The American Patent System" through "Inventions and Civilization," "Industry and Patents," and "Chemistry and Patents" to "Our National Welfare and Patents." *Anthony William Deller, 67 Wall Street, New York, New York.—Gratis to Educational Institutions: to others, $1.00 to cover printing, handling, and mailing.*

WRATTEN FILTERS is a 40-page illustrated booklet which deals with filters from both the practical and theoretical standpoints, and will appeal equally to the commercial photographer and the serious amateur. Reference tables aid selection of the proper filter for a given need. *Eastman Kodak Company, Rochester, New York.—15 cents.*

DOWMETAL DATA BOOK contains important new information concerning the fabrication of the alloy Dowmetal. Among other things, it covers such operations as roll forming and die drawing, hand forming, power pressing, die design, and forming of extruded shapes. *The Dow Chemical Company, 30 Rockefeller Plaza, New York, New York.—$1.00.*

COMMERCIAL PHOTOGRAPHY WITH THE MINIATURE CAMERA, by C. A. Goldner, is a 96-page book that can do much to guide the footsteps of the amateur photographer who would like to make a business of his hobby. It tells where to look for business, how to get started, and details the most profitable markets. *Camera Craft Publishing Company, 425 Bush Street, San Francisco, California.—$1.00.*

FLUORESCENT MINERALS, by W. Scott Lewis, is a 15-page mimeographed pamphlet which explains phenomena of fluorescence and phosphorescence, and tells how various light sources may be employed in experimental investigations. A listing of fluorescing minerals is included. *W. Scott Lewis, 2500 Beachwood Drive, Hollywood, Los Angeles, California.—15 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., L.L.B., Sc.D.
New York Bar
Editor, Scientific American

APPORTIONMENT

A RADICALLY new basis for calculating damages in suits for copyright infringement was established in a recent Federal Court decision. Heretofore, when a literary or dramatic creation was found to be an infringement of a copyright, it was generally held that the copyright proprietor had the right to recover all of the profits realized by the infringer through the use of the infringing composition. In the case under consideration the Court held that where part of the profits were properly attributable to the copyright work and where the remaining profits were properly attributable to other factors, the profits should be apportioned and only that portion resulting from the exploitation of the copyright should be paid to the proprietor.

The suit was brought by the owner of a copyright on a play, against a moving-picture producer, and after rather extended litigation the Court found that a moving picture made and distributed by the producer infringed the copyright on the play. The case was referred to a Special Master for the purpose of determining the amount of damages. The moving-picture producer introduced evidence before the Master, which apparently was not refuted by the copyright owner, that many factors in addition to the story contributed to the success and popularity of a play, such as the popularity of the actors, the reputation of the director and producer and the amount and quality of advertising. On the basis of this evidence the Court awarded 20 percent of the profits received from the moving-picture play to the copyright proprietor and concluded that the remainder of the profits were properly attributable to factors other than the story.

UNRECONSTRUCTED

THE difficulties encountered by the Reconstruction Finance Corporation in connection with trade marks pledged as security for loans is illustrated by a case before the Federal Court in New York. In return for a loan, a shoe manufacturer had pledged its assets, including the trade mark "Arch Aid," to the Reconstruction Finance Corporation. Thereafter the shoe manufacturer went through bankruptcy. During the bankruptcy proceedings the trustee did not continue the business but proceeded to wind up the affairs of the bankrupt as soon as possible. At a public sale conducted by the trustee, the Reconstruction Finance Corporation purchased the real estate, fixtures, and trade marks, together with the good will of the business and thereafter attempted unsuccessfully to sell the business intact. Finally it was forced to sell at public auction all of the physical assets with the exception of the factory. However, it did not sell the trade marks and good will. In the meantime a former officer of the bankrupt company organized a new company and proceeded to manufacture shoes and to use the trade mark "Arch Aid." In order to protect its assets the Reconstruction Finance Corporation brought suit against the new company to restrain use of the trade mark.

After reviewing the factors outlined above, the Court pointed out that under our law a trade mark does not exist in gross but must be a part of a going business. In the present instance the Court pointed out that the trustee in bankruptcy had discontinued doing business, that the Reconstruction Finance Corporation had sold the furniture, machinery, dies, and patterns which were necessary to conduct the business, and that accordingly there was no good will or business to which the trade mark could attach. Under the circumstances the Court concluded that the Reconstruction Finance Corporation did not own the trade mark "Arch Aid" and was not entitled to restrain its use by the new company.

In reaching this conclusion, the Court stated:

"The plaintiff's acts amounted to more than abandonment. They amounted to the destruction of what was necessary to the existence of a business to which good-will, trade marks and trade names might attach."

RECTIFIED

WE have heretofore discussed on this page the rights of an inventor who discloses an unpatented invention in confidence to a manufacturer. Where an invention is disclosed under such circumstances it is generally held that there is a legal obligation upon the manufacturer not to breach the confidence and the inventor can restrain the manufacturer from using the invention without his permission and can collect damages for the unauthorized use. In certain cases the Courts have gone so far as to hold that the manufacturer was bound by the confidence even though the idea disclosed to him did not form proper subject matter for a patent.

In a recent decision a Federal Court has placed a very important restriction on this principle and has held that in order to impose an implied obligation upon a manufacturer under such circumstances the invention or idea submitted must be new. In the case in question an inventor alleged that he had suggested to a metal refining company the possibility of separating zinc from cadmium by means of a rectifying column and through the use of fractional distillation and rectification. Thereafter it was charged that the refining company used this process without the inventor's permission. After reviewing the testimony submitted at the trial, the Court concluded that the idea of refining metals in this manner was not new and held that under the circumstances no obligation was placed upon the refining company to refrain from using the process.

In this connection the Court stated:

"The evidence also fully supports the finding of the District Court that at the time of the alleged disclosure the plaintiff's idea was not novel. Consequently, even if he had succeeded in convincing the trial court that he had disclosed his idea to the defendant's employees, he still failed to sustain the burden upon him of proving that the idea was novel. This it was necessary for him to do in order to impose an implied agreement upon the defendant to refrain from its use."

REPACKAGING

MERCHANTS sometimes repackage the products of a manufacturer and the question then arises as to the right of the merchant to use the manufacturer's trade mark to designate the repackaged product. It has generally been held in the United States that the trade mark may be used on the repackaged product in a descriptive manner so as to indicate the contents thereof but cannot be used in a denominative manner so as to enable the goods to be passed off as the product of the original manufacturer. In order to prevent confusion the Courts require the package to contain a legend or statement pointing out that the product has been repackaged by the merchant independently of the trade-mark proprietor.

In a recent case a merchant purchased a well-known face powder in relatively large packages and then repackaged the powder in smaller packages for sale in the popular-priced chain stores. His package was marked with the following statement:

"Bourjois, Evening in Paris, Face Powder, Repacked by Hermida Laboratories, Wholly Independent of Bourjois."

This statement was objected to by the trade-mark proprietor on the grounds that it did not clearly indicate that the package was not the original product of the proprietor and that the proprietor was not responsible for the contents thereof. The Court agreed with the trade-mark proprietor and required that the repackaged merchandise be marked with the following notice:

"Hermida Laboratories, Inc., not connected with Bourjois, Inc., states that the contents are Bourjois' Evening in Paris Face Powder, independently repacked by Hermida Laboratories, Inc., at Linden, New Jersey, without the authority or consent of Bourjois which assumes no responsibility for the contents."

In its opinion the Court pointed out that in most countries, as for instance England, France, and Germany, the trade-mark law does not permit the unauthorized use of a trade mark on a repackaged product. However, under the law in the United States as interpreted by the Supreme Court, the Court concluded that a descriptive use of the trade mark was permitted as long as it was accompanied by a statement adequately indicating the true circumstances and which was not likely to lead to confusion.

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L. WARRINGTON CHUBB, Director of Research Laboratories, Westinghouse Electric and Manufacturing Company.

JACOB DESCHIN, A. R. P. S., Amateur Photography.

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WALDEMAR KAEMPFFERT, *New York Times.*

D. H. KILLEFFER, Chemical Engineer.

IRVING LANGMUIR, Associate Director, Research Laboratory of the General Electric Company, Schenectady.

M. LUCKIESH, Director, Lighting Research Laboratory, Incandescent Lamp Dept. of General Electric Company, Nela Park, Cleveland.

D. T. MacDOUGAL, Associate in Plant Biology, Carnegie Institution of Washington.

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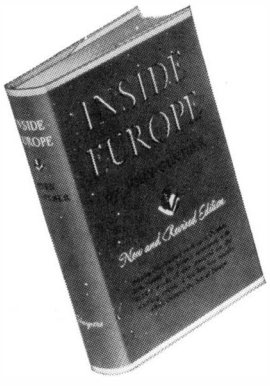

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