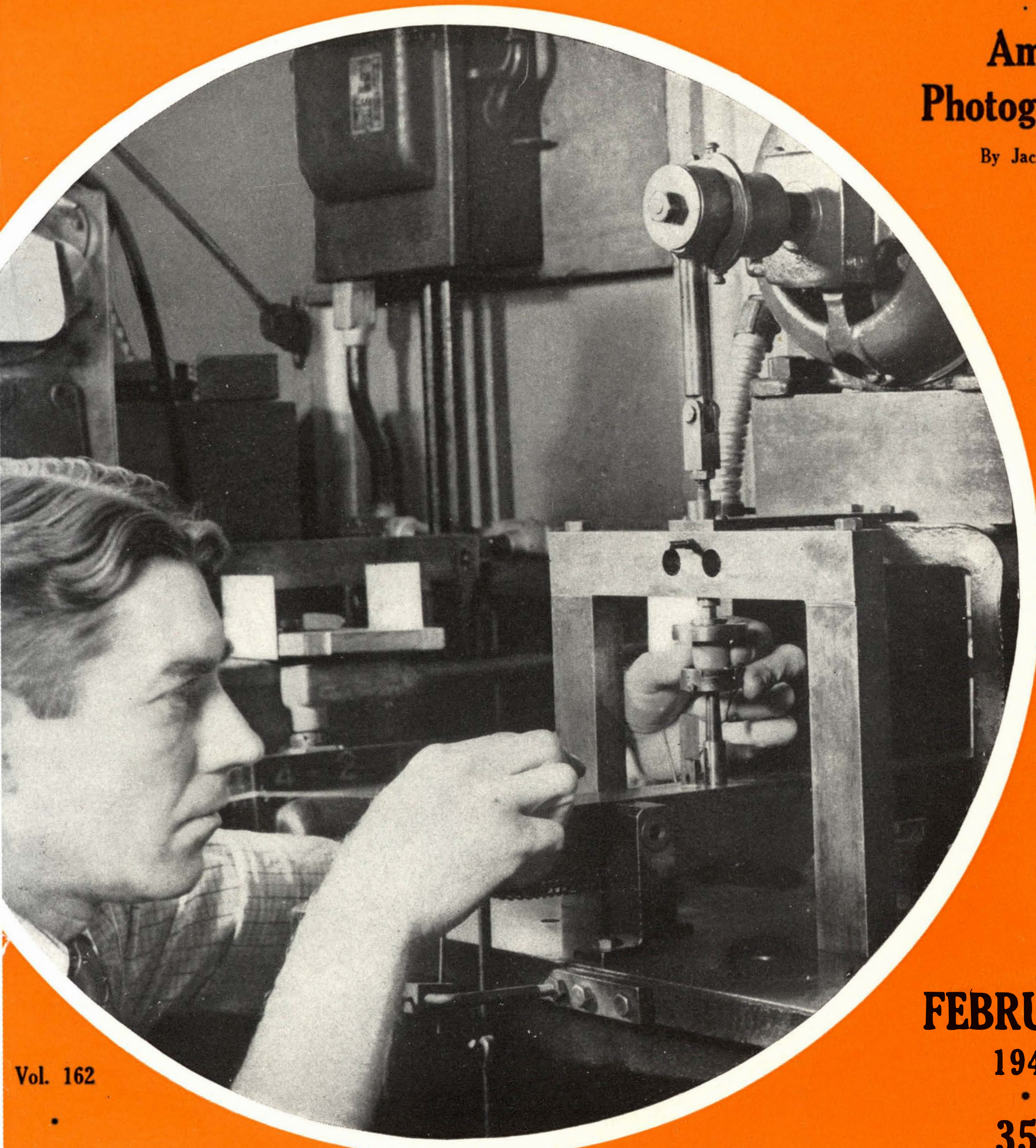
# STOPPING TIME
To Study Motion

# SCIENTIFIC AMERICAN

Including:
A DIGEST OF
SCIENCE & INDUSTRY
. . also . .
Amateur
Photography
By Jacob Deschin



Vol. 162
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1940
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# "Silk Stockings in the Morning? Imagine!"

SILK stockings a luxury? Not today, but they were 25 years ago. So was an automobile, and a telephone. An incandescent lamp—not half so good as the one you now get for 15 cents—then cost more than twice as much. And you couldn't buy a radio or an electric refrigerator for love or money.

These are only a few of the things we accept today as commonplace. We expect wide, smooth, well-lighted streets. We want automatic heat in our homes; we clean our rugs with vacuum cleaners. When we go to the dentist we expect him to use an electric drill; we accept without comment an X-ray examination as part of a medical check-up. Luxuries? Not at all; they're part of the American standard of living.

How did they become common in so short a time? Not by some sudden change in our wealth and habits. It was through years of steady work by American industry—scientists, engineers, and skilled workmen developing new products, improving them, learning to make them less expensive so that more millions of people could enjoy them. And so, imperceptibly, luxuries have changed to necessities.

More than any other one thing, the increasing use of electricity in industry has helped in this progress. For more than 60 years, General Electric men and women have pioneered in making electricity more useful to the American people—have led in creating More Goods for More People at Less Cost.

*G-E research and engineering have saved the public from ten to one hundred dollars for every dollar they have earned for General Electric*

**GENERAL ELECTRIC**

90-208G1

# The SCIENTIFIC AMERICAN DIGEST




# SCIENTIFIC AMERICAN

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NINETY-SIXTH YEAR • ORSON D. MUNN, Editor


## CONTENTS • FEBRUARY • 1940



**HEAT caused by the impact of tires on highways is one of the most important problems tire engineers have to face. Hence they must duplicate that heat in the laboratory. To use actual tires would require large, expensive test machines, and considerable power. As explained on page 95 of this issue, the B. F. Goodrich Company does the job with small samples of rubber in the flexometer illustrated on our cover.**


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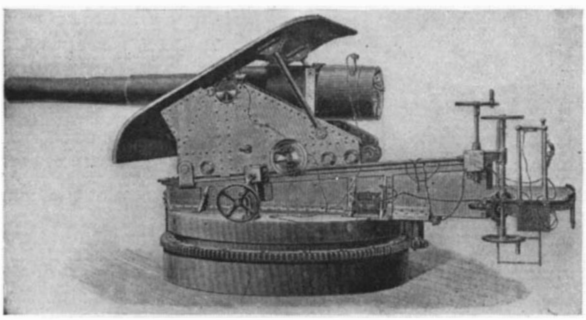
# 50 YEARS AGO IN . . .

## SCIENTIFIC AMERICAN

*(Condensed From Issues of February, 1890)*

PANAMA CANAL—"The indications are that another effort will soon be made to complete the Panama Canal . . . and perhaps on a new basis . . . This new plan . . . is to construct a canal that would allow of the swift and easy passage of vessels, and would render healthful and habitable a large area of land that at present suffers from the juxtaposition of swamps and marshes. The project, in short, is to make a lake in the interior by means of the water from the River Chagres . . . As this lake would be 24 kilometers in length, it would only be necessary to cut 50 kilometers, and nothing would impede the course of vessels along this waterway but the strong double chamber lock that would be built at each end."

GUN—"The 9-inch gun mounting herewith illustrated, and which will serve as an example of the type generally known as a carriage and slide in the British service, is intended to be fired over a 6 ft. parapet or from a gun pit . . . As the platform or slide is mounted on a ring of live rollers, an all-round fire can be obtained . . . A special feature in the gun is its capability of firing at night . . . The ordinary sights are illuminated by a small incandescent lamp, the rays from which, passing through a lens, are converged, so that only a minute point or line of light, just sufficient to distinguish the sight, is obtained . . . The carriage admits of 15 deg. elevation and 7 deg. depression being given to the gun. This allows objects quite close to the gun to be hit, and also of a range of about 8,500 yards being attained. The penetrating power of the projectile, even at this great range, is at least 4½ in. of iron, which is quite as much as some of the older classed, but still serviceable, ironclads carry on their sides . . . There is an electric firing key, in the form of a pistol, which is held in the hand, so that no delay is occasioned by looking for the firing key."



TUNNEL—"Work upon the tunnel under the Hudson River, connecting Jersey City and New York City, has been slowly progressing, but in the course of a few weeks is to take a new phase . . . The north tunnel already extends well toward the center of the river from the Jersey shore, and it is proposed to start a lateral connection therefrom to the line of the south tunnel, in order to work both east and west from its center. This would give, in connection with the shore ends, four separate working faces."

CONSERVATION—"Railroads and the 'man with gun' are proving too much for game, large and small; the first making easily accessible what, not long ago, was remote, almost trackless, wilderness and mountain fastness, and the breech-loading gun, especially the magazine type, enabling the veriest tyro to find his mark . . . . Happily in the Yellowstone Park are collected some herds of the noble game once roaming the broad continent in countless thousands. What remains is in sad need of protection from the pelt hunter and the wanton slayer."

ELEPHANT—"The journals of Ceylon have recently mentioned the death of an elephant that was well known on the island and had been seen by several generations of Englishmen . . . He was one of the hundred elephants that were taken by the English government in 1815, when the Kandyan dynasty was overthrown. At this epoch, the elephant was said to be fifteen years old. If this is correct, he died a natural death at the age of eighty-nine years."

TYPE—"The substitution of mechanism for hand labor in the setting of types, although long delayed, may be now considered as realized, and the day cannot be far distant when the type-setting machine will be the principal reliance in all properly organized printing establishments."

HYDRAULIC TRANSMISSION—"Few Londoners are aware that there are now under the streets of the metropolis forty miles of pipes charged with a pressure of 750 pounds per square inch . . . The mains are of cast iron, varying in internal diameter from 7 inches to 2 inches, and are kept charged constantly at a pressure of 750 pounds per square inch by powerful engines . . . This power is supplied direct to lifts, presses, and other purposes of a similar character without the use of any engine or power-producing machinery, and can also be used for driving engines of special construction in the same way as steam or gas."

PATENT OFFICE—"The place of the Patent Office among governmental agencies is as unique as it is important. It is concerned neither with the collection nor the expenditure of the ordinary public revenues. Unobtrusive and unsensational in its work and methods, it asks nothing of the Treasury excepting moneys which its patrons contribute, and nothing of Congress excepting measures to secure its highest efficiency."

SPEED—"There is no such thing in this day and generation . . . as 'making haste slowly.' If the Chicago business man could be shot through a pneumatic tube into New York City in the space of a few minutes, the limited express train taking twenty-four hours to reach there would no longer be patronized. And if the New Yorker could land in Liverpool in less than two days via an air line, the ocean greyhounds would find their day of usefulnes had fled . . . Speed is the necessity of necessities in our time, and if lightning speed can be obtained, nothing but lightning speed will be tolerated."

AGES—"This century has already passed through the phases of a cotton age, an iron age, and is rapidly being transformed into an electrical age."

**AND NOW FOR THE FUTURE**

**¶ Man is a walking hotel for parasitic worms. By Benjamin Adelman.**

**¶ Beryllium, a strategic material of war, plays its rôle in alloys. By Philip H. Smith.**

**¶ Animals used in ancient Roman gladiatorial combats rode on mechanical elevators.**

**¶ Practical benefits to industry of pure science research. By A. Cressy Morrison.**

# "YOU'RE TELLING ME!"

"That's a funny one. You're telling me what a great thing the telephone is. As if I didn't know!

"Why, I'm one of the main reasons there's a telephone in our house. For you can bet your life I keep the folks pretty busy around here.

"Just think! If we didn't have a telephone, we couldn't order things in a hurry from the stores. And Grandma couldn't call up to ask if I had a tooth. And Daddy couldn't talk to us when he's out of town. And Mother would be tied down just something awful.

"And suppose one of us suddenly took sick? Or there was a fire? Or a robber, maybe? Well, I don't worry about those things when I see the telephone.

"Doesn't cost much either, my Daddy says. And Mother says, 'I don't know what I'd do without it.' "

**BELL TELEPHONE SYSTEM**

# OUR POINT OF VIEW

## Patient Money

YOUR true research worker in any of the fields of pure science is having a wonderful time. He is following a system—if such it may be called—that at first glance would seem to the hard-headed business man to be highly impractical. Yet the results are so often eminently practical that the same hard-headed business man must sooner or later accept the system on faith and let the research worker go his own unhindered way.

When the pure scientist sets out to find something practical, he apparently turns his back on the goal. To the casual observer he strays so far afield as to seem to be entirely off the track. But that is the system of pure science. First you must cultivate a large bump of curiosity, a bump that will urge constantly along unexplored paths, regardless of how unpromising they may seem at first. Then you must set out to satisfy that curiosity about all kinds of things that may have any connection, no matter how remote, with the problem in hand. During this process you will perform all sorts of apparently foolish experiments, these often leading to side experiments along entirely different tacks.

Continuing, you will "play" and "waste money," as our hard-headed business man might say. But during the process you will be learning many things which, correlated, soon start to build a picture that holds promise. You will have investigated fundamental principles, accepted certain facts and rejected premises that have failed to prove up. Keeping both eyes open at all times you will have found a hint here, a fragment there. Your imagination, playing over a broad field, will have enabled you to see clearly many things that would escape the observer who was concerned only with end products, with practicalities. And out of all this may come a new industry, or a rehabilitated old one, based on what you saw in a pinch or a drop of something unexpected.

While du Pont chemists were "playing" with pure-science research, one of them noticed something unusual. A certain procedure yielded a material that was unexpected, unlooked for. The result is told in the article starting on page 78 of this issue. Out of the purposeful playing of these chemists has come a group of industrial products that will definitely influence our everyday lives. Nylon, born of the laboratory and named after nothing, is already "big business." Millions have been invested; indications point toward many more millions; stockings, fabrics, brushes, and other commodities will pour from a figurative test-tube.

Buried in the article mentioned is a near-tragic note, lightly touched upon in passing. At one point in the research, the line of approach that was eventually to lead to success was almost abandoned! Prospects were dark, hope dwindled. But persistent curiosity, backed by "patient money," continued to probe and, probing, came through with a triumph of pure-science research. Here is a lesson that should make many an industrialist hesitate and think deeply before he cuts off the financial life stream which is making possible a piece of research that, at the moment, does not seem to be getting anywhere. —*A. P. P.*

## Technological Unemployment

WHATEVER else this year's census will show, it will, from present indications, put the quietus on the theories of the technocrats. We say their "theories" rather than the technocrats themselves for the simple reason that the latter are very much a going concern —at so much per membership.

Just before the turn of the year, industrial production stood at 125 percent of the 1923-1925 average. This was higher than the 1929 average of 119 percent. The roll of the unemployed last October was about 8,150,000. Unemployed in 1929 averaged less than half a million. It is these figures that provide a field day for the "technological unemployment theorists." "Just as we told you," they'll vociferate, "machines have replaced so many workers that we now have better than 1929 production *and* nearly 8,000,000 more idle than we had then."

But just as thousands of would-be economists have ignored certain truths during recent trying years, these theorists will forget to mention to you a few pertinent facts. The most important of these is that, with production now only slightly higher than in 1929, employment in October was nearly 46,500,000 as compared with 1929's average of 47,925,000. Thus, for practically equal production, machines (and other factors) have displaced about 1,500,000 —not 8,000,000.

The principal point here is that of the 8,000,000 unemployed, the largest proportion are new workers. This will show up in the census this year. Also a large percentage of this total are added in the estimates merely because they have re-classed themselves as workers by reason of being on certain "made work" projects or on relief. Otherwise they would never have been considered workers.

Machines have undoubtedly taken their toll of jobs. Shorter working hours have partly offset this. Yet we have done one splendid thing that many predicted we would never accomplish: carried production to and beyond that of 1929. And we have not finished yet. We still have to supply the needs, not only of the six or eight million increase in population, but also of many who have skimped in their buying for fear of the future or because they had to support these others. The prospective market for both raw and finished products is, indeed, enormous. It is represented by both the normal demand and the deprivations of years. Many more years will be needed to meet that double demand and, in the effort to do so, industry will carry production to new heights, far beyond the 119 percent of the momentous year 1929.—*F. D. M.*

## Do Men Like Them Thin?

OVERWHELMINGLY do statistics just published by the Metropolitan Life Insurance Company—which ought to know—prove that our women are no longer fat. Detailed tables subdivided by ages and heights show that women of every age group and every height group became lighter by an average of three to five pounds in one decade.

These reductions are attributed to four main causes: Health science has constantly been urging that there is an excess of illness and death among the fat. Fashion decreed the slim figure. Science showed that it is better to eat less of the right foods—those rich in vitamins and minerals—than more of the wrong foods, those rich in calories: quality versus quantity. Finally, machines do more of women's work, and so the women need less working fuel. (Some of the reductions have been badly overdone, also, with illness, even death, the sequel to worship of a downright fetish.)

Thus science seems to have changed things around quite a lot; what will Nature do? If there is anything in Darwin's sexual selection, Nature will defeat some of these man-made changes. In about 20 years there may prove to have been a lower marriage rate among women who are slim now, assuming that men on the whole "don't like them thin." Nature may have the last word, after all —the last laugh.—*A. G. I.*

# *Personalities in Science*

PHILO T. FARNSWORTH

PHILO T. FARNSWORTH — inventor of electronic television — might have made an acceptable concert violinist. That is what his mother had hoped for him. He acquired an elementary skill with the bow at an early age, and even at that time exhibited the kind of persistence that leads to success. But how could a youngster keep his mind on delicate shading of musical interpretation when such complex subjects as Einstein's theory of relativity, the structure and behavior of atoms and electrons, and associated mysteries, haunted his every wakeful hour? The lure of science won.

The pattern of this young inventor's life departs greatly from orthodox stories of scientific success. He is large ly self-educated. No hallowed fellowships, no rubbing elbows with eminent researchers in great laboratories, smoothed his way. Yet, in 1921, as a 15-year-old high-school freshman he demonstrated mastery of his theory of television. Farnsworth's very first inventions embraced electronic means for picking up, transmitting, and receiving images via radio waves. There were no moving parts. This was in 1927 when the art of radio broadcasting was still young and Farnsworth was not quite 21.

Today, Farnsworth is vice-president, director of research, and a member of the board of a going concern that bears his name: Farnsworth Television & Radio Corporation.

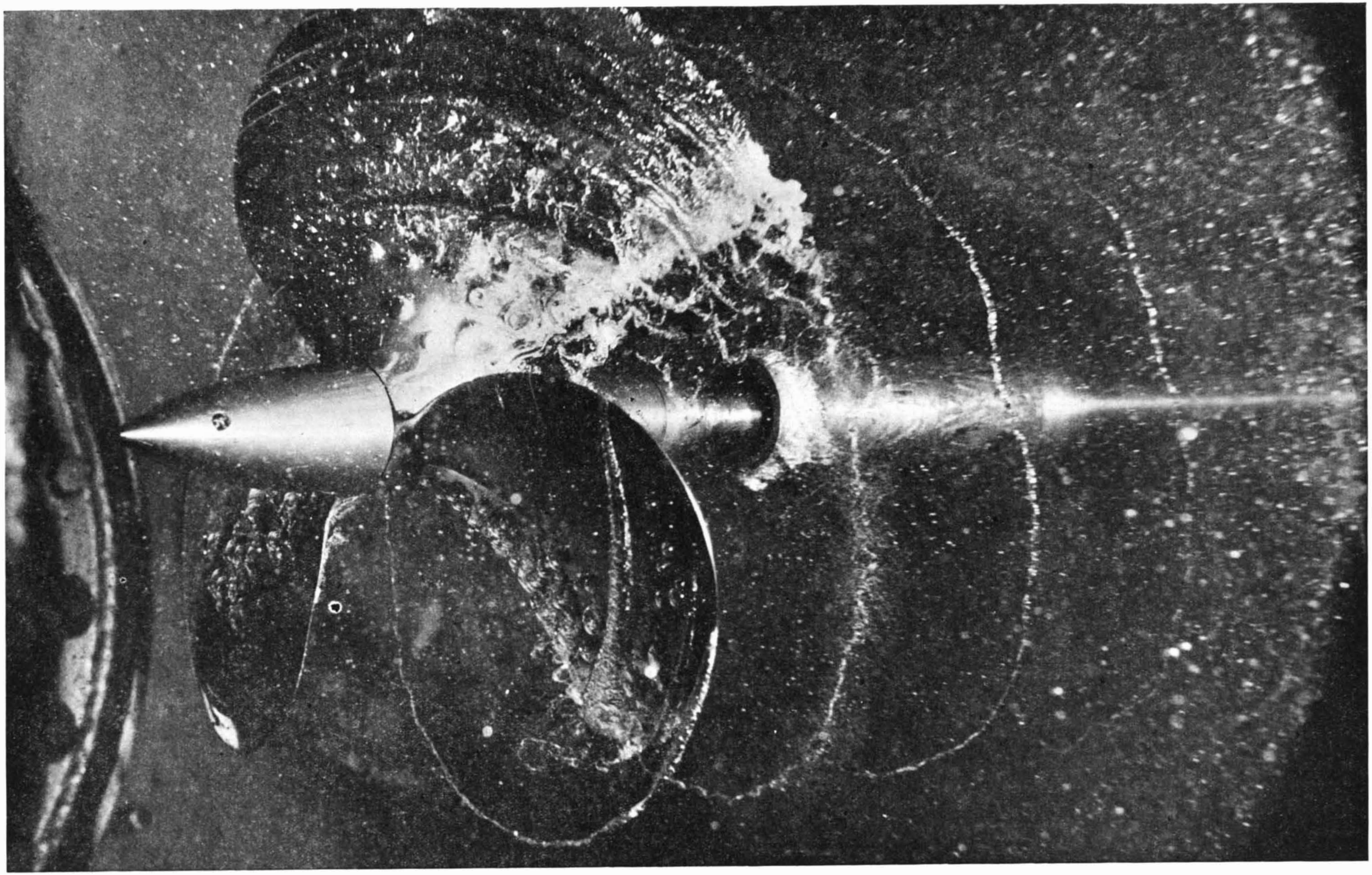
More than 100 Farnsworth patents cover all manner of television development; applications for 80 additional patents are pending. A long list of these represents unquestionably, original art, and form the basis for significant patent interchange agreements that the company has recently consummated with the Radio Corporation of America and other important factors in the industry.

Farnsworth was a farm boy; at the age of 6 he connected his mother's sewing machine to a toy dynamo and used the power thus generated to drive a toy motor. Later, when assigned as "muscle man" to run his mother's manually operated washing machine, he devised an electric motor drive and spent the new-found time reading science books at the nearest library. He attended school some miles from the farm, covering the distance on horseback. As a high-school freshman, he exhibited definite mathematical genius, "sold" the science instructor on the idea of admitting him to advanced courses, waded through every scientific book on which he could lay his hands, sought special instruction before and after school hours, "crammed" on certain subjects, and jumped into college courses in science.

His father died in 1925 and Farnsworth faced the necessity of contributing to the family upkeep. He opened a radio shop. It failed. He took a job in the railroad shops, but the work was too strenuous for a youngster of slight build. He answered a "help wanted" advertisement and was hired as a helper by a professional fund raiser. At this time, the "electronic television theory" appeared to be a long way from realization and Farnsworth decided to write it up as an article and sell it to a magazine. His new employer became interested, took Farnsworth to a Los Angeles patent attorney, who in turn arranged for a consultation with an eminent scientist. The latter expressed amazement at the originality and daring of Farnsworth's plan and said: If you have what I think you have, you have the world by the tail." This statement impressed a banker. The latter "sold" friends on the idea of backing Farnsworth. The youngster promptly married the girl of his choice, rented a small house in Los Angeles and converted it into a research laboratory — the first Farnsworth had ever seen. He and his wife built most of the shop equipment.

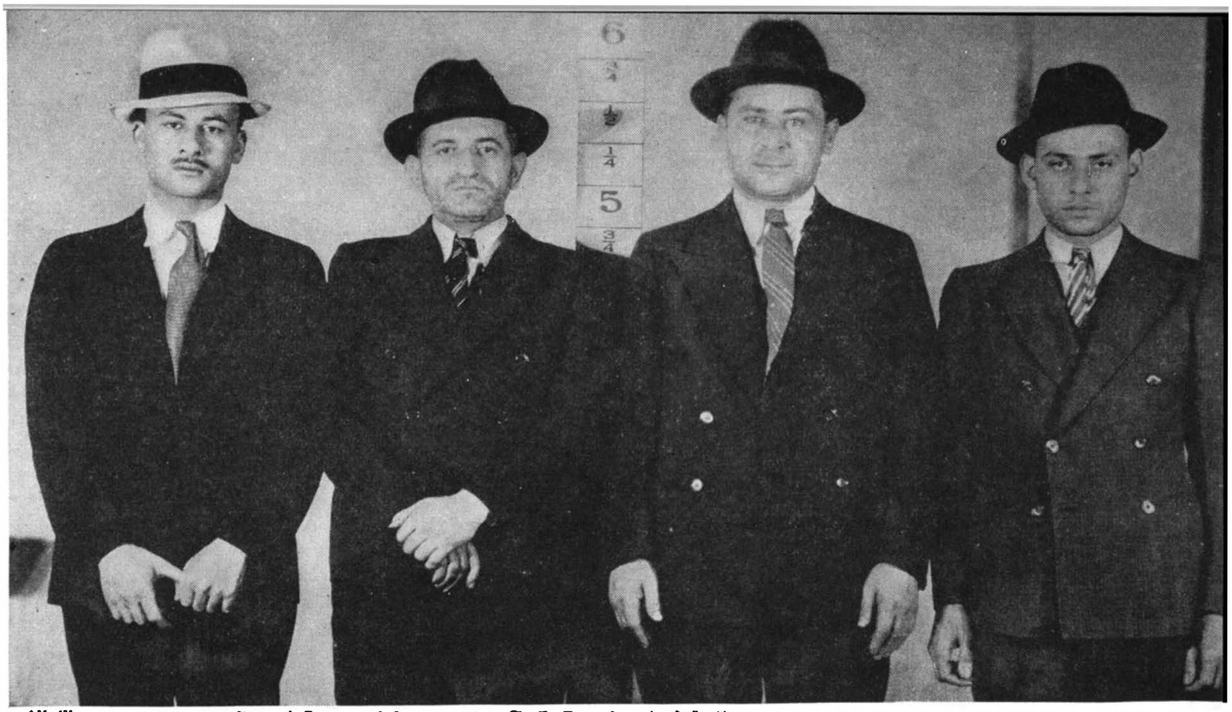
Then came the more complex task of creating his pick-up, transmitter, and receiver. Meeting with difficulty in finding skilled persons capable of building his specialized parts, he proceeded alone. Farnsworth repeatedly demonstrated his genius by acquiring knowledge of optics, glass blowing, and several other arts essential to the progress of his experiments. Piece by piece, he gradually transformed his theory into fact.

In some respects. the inventor of electronic television resembles a hero of "Horatio Alger" fiction, yet few men of flesh and blood have reached such heights of scientific actuality in the short span of years that cover Farnsworth's life.



FOR PROPELLER DESIGNERS TO STUDY

EFFICIENCY of design of marine propellers, as well as many machine movements, may be studied in photographs such as this one made by light from the stroboscope discussed on page 82. This photograph courtesy "Flash," fascinating book of "stopped motion" pictures



**As pointed out in the accompanying article, many crime investigators feel that the old-time head-and-shoulders "mug" pictures of criminals should be replaced by some such modern method of photographic technique as that shown at right**

All illustrations courtesy Federal Bureau of Investigation, U. S. Department of Justice

# Photography In Crime Detection

### Valuable Contributions . . . Need Seen for Uniformity of Photographic Records . . . Automatic Cameras for Picturing Criminals in the Act

By J. EDGAR HOOVER

Director, Federal Bureau of Investigation, United States Department of Justice

PHOTOGRAPHY makes many valuable contributions to modern scientific crime detection. Without it, the law enforcement officer would be minus many valuable records, deprived of a most efficacious method of personal identification, and seriously handicapped in his technical laboratory investigations of crime.

The police were quick to recognize the value of photography; its first landmark in police history is the early use made by Alphonse Bertillon, Chief of the Judicial Identification Service of France, in the latter part of the 19th Century. For many years thereafter the use of photography by the police was generally confined to its application to the problem of personal identification, and in this respect the record and filing factor of the photograph of the criminal was much more highly stressed than it is today. In those days the facial features of the criminal were measured, as well as the bony structures of various parts of his body. These measurements were worked into a classification system in an effort to record his individuality for filing purposes. An important supplement to the classification was the photograph of the criminal which was filed beneath the classification.

**Suggested method of obtaining front, profile, and full-length views in a "mug" photograph.**

The Bertillon system of personal identification, as it was called, has been supplanted today by the fingerprint system which is infallible and more easily handled. And today, even though the photograph of the criminal is still placed on his fingerprint record card, it is not for the purpose of supplementing the identification system, but rather to have available a copy of his photograph if needed for investigative purposes.

In more recent times photography began to find a new place in police work in providing an accurate record of the scene of crime, traffic accidents, and the like. Figuratively speaking, this permitted bringing the scene of crime directly into the court room and thus giving the jury a comprehensive understanding of the setting.

Naturally, as scientific laboratory practices were adopted in law enforcement for the analysis of evidence, laboratory uses of photography became frequent and most helpful; and today the application of photography to the scientific analysis of evidence is highly developed.

"MUGGING" is the police term used to designate the photographing of a subject in custody for record purposes. It is a highly valuable phase of the police record. No longer necessary as a means of classifying the individuality of the person concerned for filing purposes, it is rather used to have on record a recognizable photograph which can be displayed to victims of other crimes for their identification or used if the subject becomes a fugitive sought by law enforcement authorities.

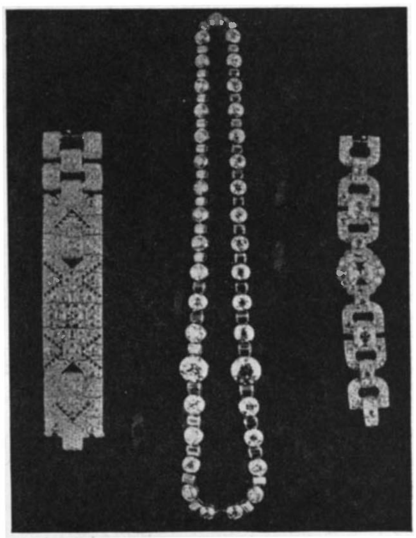
There exists in the United States today a rather deplorable lack of uniformity among police and penologists in the preparation of these "mug" photographs. Perhaps the most prevalent method is to take a portrait type, front

**Such photographs of dentures may eventually lead to the identification of unknown dead**

and profile view of the head and shoulders of the subject. Some effort is being made to standardize the procedure of preparing this front and side view so that a uniform perspective is obtained by all police photographers. There are, however, many critics of this method. Many investigators consider that a full-length portrait—the so-called "stand-up" photograph—of the subject should be prepared. These advocates contend that such a picture is much more natural and more readily recognized by a lay witness. To this is added the criticism from another school of thought which recommends that the criminal not be photographed alone, either head and shoulders or stand-up, but should always be photographed with his associates in crime, this being the so-called "gang" photograph in which a group of three, four, or five criminals are lined up and photographed together.

THE next controversy ranges around the clothing which the subject should wear in the photograph. Many contend that the picture of the newly committed penitentiary inmate, made after he is clean shaven as to face and head, or otherwise barbered and clothed in a uniform manner, amounts to almost a deliberate effort to render the photograph difficult for use in investigative purposes. Again, penologists are being urged to prepare a photograph of the criminal in street clothes just before his release after serving a long sentence in order that the existing photographic record may not be so obsolete as to be useless. To this might be added the controversy between those who feel the subject should appear in at least one view with his hat on, as against those who would primp him up with nicely brushed hair for the occasion.

Routine photographs are made by police of amnesia victims and of unknown dead. This procedure permits wide circularization for identification purposes, including newspaper publications if deemed desirable. Of course, the amnesia victim presents no special problem in the photographic procedure. In the case of unknown dead, however, a number of law enforcement agencies have made many advances in the development of special methods designed to produce as near a life-like photograph of the features as possible. Some of this work approaches the artistic in a rather remarkable way. Special preparation of this kind not only increases the likelihood of reliable identification but lessons the shock which a gruesome photograph might



**Photographs of valuable jewelry are of assistance in case of theft**

**Searching the photographic file of the single fingerprint section of the Federal Bureau of Investigation at Washington**

have on bereaved relatives. Where decomposition is in an advanced state it is sometimes possible to photograph only parts of the body such as the teeth, for identification purposes.

Another application of photography to the person in police work concerns its use in making a pictorial record of wounds or other special conditions of the body. In cases of vicious assault or murder, photographs of the victim are frequently made and include close-up pictures clearly depicting wounds and other effects of weapons. These make a valuable record in discussing the effects of such assaults and graphically illustrating the exact nature of them for the information of the court and jury.

In an effort to improve the likelihood of identification from photographs, police research workers are not only striving for uniformity in making the photographs but are conducting interesting experiments in the use of stereo-photographs, color photographs, and sound motion pictures of the criminal.

No discussion of police "mug" photographs is complete without a mention of the use of "protrait parle." This system of the "spoken photograph" was initiated by Bertillon and today it has a valuable use in crime detection. Investigators are taught how to analyze a photograph in order to memorize the features and readily recognize the countenance of the individual if he is met in the flesh. The investigator learns to divide photographs into types and the classifications are based on such factors as slant of the forehead, the length and shape of the nose, the eyebrows, the ears, and other features of the countenance. As a result of such detailed study of the picture, he is able to memorize it and a great many others, and thus recognize persons on the street or elsewhere when he has never seen them before except for a study of the photographic likenesses.

Other uses of photographing for identification purposes include the photographic recording of inanimate objects, such as jewels and stolen articles of various kinds. When the article is being sought after it has been stolen the investigators are limited to the use of pictures made prior to its loss. These are usually in the possession of the owner, frequently made for some other

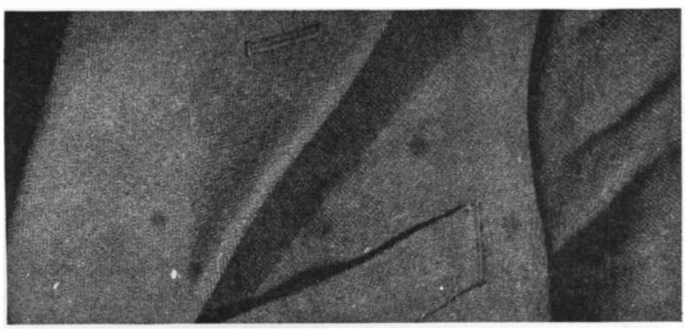
purpose On the other hand, booty is often recovered from thieves or their fences and the true ownership established only after photography and publication. The police usually recommend that photographic records be made by owners of unique and valuable property which may be stolen; many insurance companies follow this practice.

Photography offers the ideal way of graphically portraying the scene of crime, and sometimes in rare instances the crime itself. The modern investigative agency provides for routine and efficient photography of the scene of action in murder cases, assault, certain robberies, automobile accidents, and the like. Such photographs become invaluable in a subsequent study of the crime and a re-accounting of the action before the jury or persons not familiar with the scene. They become most useful at times in the interrogation of suspects and of witnesses, when they are not only valuable as a pictorial reproduction of the situation for reference purposes, but sometimes act as a surprise inducement to confessions when presented to the criminal who up to that point has reassured himself that the action of the commission of the crime is unknown because there were no eye witnesses at the time of its commission.

Particularly graphic in this latter respect are those rare photographs depicting the commission of the crime itself. Several instances of this kind have come to the attention of the Federal Bureau of Investigation. A photograph in the collection of a Larkspur, California, citizen depicts a stagecoach holdup reported to have taken place at Ahwahnee, California, in 1901. The picture clearly shows the robber dominating his victim and is said to have been taken by one of the passengers on the coach. Another such picture resulted when a storekeeper of St. Louis, Missouri, after being the victim of a number of burglaries, arranged an automatic camera system equipped with flashlights, whereby he is reported to have been successful in obtaining an excellent photograph of a burglar following entry into his store, the picture subsequently receiving some prominence in the national press. Still another such photograph involved the use of a home-made affair by means of which a vagrant was automatically pictured when he opened a refrigerator door which was on the porch of a citizen's home in a Maryland suburb of Washington, D. C. The latter case is particularly interesting in that this same photograph was the means of identifying the thief—when his body was found a few weeks later after having been struck by a railroad train—as a criminal with a previous police record.

There are frequently in use today secret automatic cameras designed to take photographs of criminals committing an unlawful act. With the highly sensitive film emulsions now available, these devices would seem to have some value if the actuating means of operating the camera is a practical one. Such cameras have been reported as installed in theater ticket booths where the overhead canopy lighting is favorable, and in institutions where, because of the existence of large sums of money, attempts at robbery are anticipated. A good photograph of a criminal act whereby the perpetrator can be identified is indeed a rich prize, but, so far, success has been rather infrequent. With further improvements in the manufacture of photographic equipment and film, and possibly with the utilization of infra-red light, greater success may follow. Ultimately, perhaps, photographs of marauders will be obtained in pitch darkness.

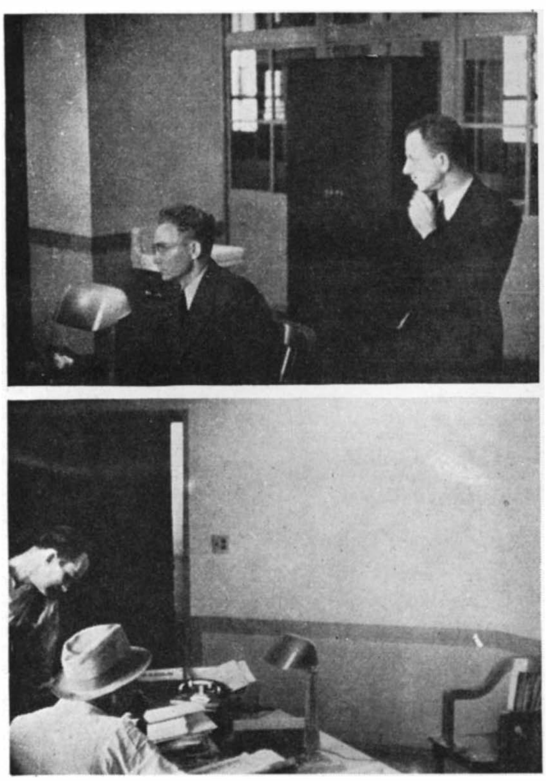
**Section of a piece of carbon paper, photographed under slanting light, reveals message**



**Blood spots on a blue coat, invisible to the unaided eye, were brought out vividly when the clothing was photographed**

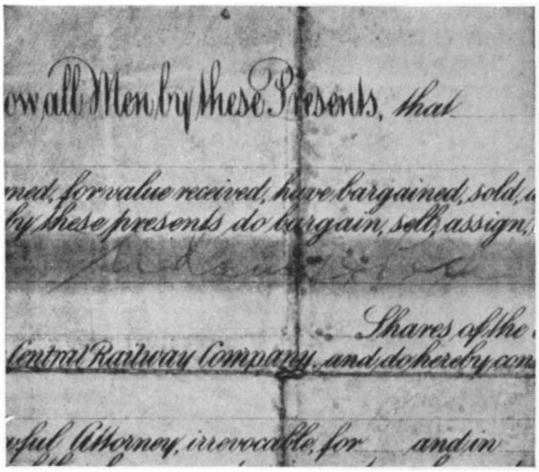
The miniature camera is also used to advantage. Candid shots of the criminal or of his activities are sometimes made. In this work such accessories as the telephoto lens and right-angle view finders are often helpful.

Occasionally a photograph, instead of placing the person charged at the scene of crime, may be used by the defense to show that the suspect was *not* at the scene of crime. Such photographs were important in a case some time ago; pictures showed the accused with other persons at a location a long distance from that where the crime took place. These pictures also recorded an event, the time of which was identical with the time of the crime. Pictures of this latter kind are usually made for some other specific purpose. Frequently, however, details are recorded in the photograph which later become valuable in an inquiry or controversy which may be quite unrelated to the original object of making the photograph and without any intention on the part of the original photographer to have included the incidental information. In this respect photographs are frequently more valuable and complete than the recollection of an individual concerning what he visualized at the time, especially when his attention during the time in question was not necessarily focused on the subject of later discussion.



**Two examples of pictures taken with concealed cameras, without the knowledge of the subjects pictured. Such photography may be of great assistance to law enforcement men**

There was a time when photographers would often say: "What you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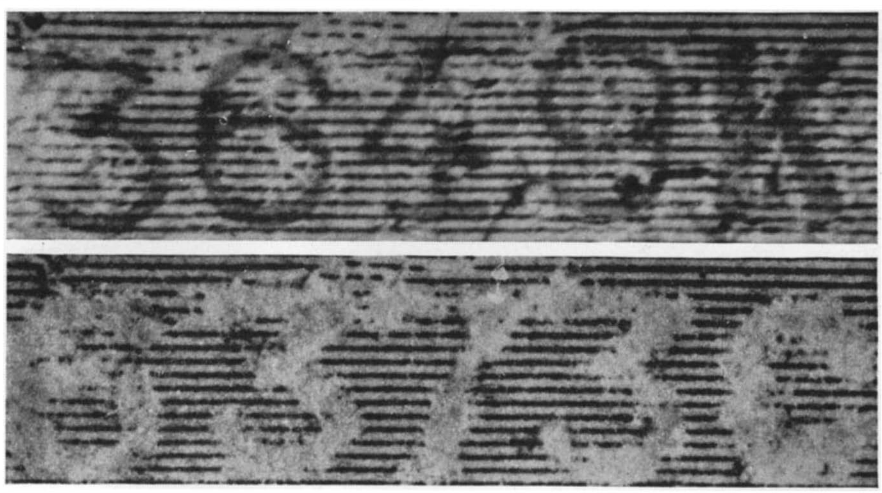
*Left:* An example of erased writing that was made visible by photography with ultra-violet. *Below, center:* The lettering on a leather bag was removed so as to be invisible to the unaided eye, yet shows plainly when bag is photographed by infra-red. *Below, right:* Upper picture shows a serial number that was changed; lower picture, taken by infra-red illumination, reveals original number plainly

can't see you can't photograph." In the Scientific Crime Detection Laboratory this adage is certainly a fallacy. Over and over again the camera is utilized to produce a record of that which cannot be seen with the unaided eye. In the Technical Laboratory of the Federal Bureau of Investigation at Washington, photography is an all-important part of the routine handling of cases submitted for examination. An "object shot" is made of every piece of evidence submitted to the Bureau's Laboratory for examination. This constitutes a valuable record in the files of the condition of the evidence upon receipt. It furnishes the possibility of secondary evidence in the remote event that the original evidence may become damaged or deteriorated. It is used at times in court to establish positively that the original article then in the court room is the same one which was examined in the Bureau's Laboratory at some previous time.

DURING one stage of the chemical development of latent fingerprints on paper, fugitive iodine fumes are utilized. If good, readable fingerprints are thus found, they can be recorded only by photography for they soon disappear from the paper. This is done in the FBI Laboratory by means of a fixed-focus automatic timing camera which produces a picture of the document with the fingerprints thereon at exactly 1 to 1 size.

Special photography is essential in the examination of many problems involving questioned documents. Chemical erasures are detected, and the original writing before erasure made readable, by photography in ultra-violet illumination. Hardly noticeable indentations in the paper caused by the pressure of pen or pencil perhaps on another sheet are made plainly visible through photography utilizing special side lighting which throws the hills and valleys of the paper into sharp relief. Special photographic methods have been devised for producing a readily readable photograph of the impressions left on carbon paper. Ink strokes which appear to the unaided eye to be the same color and kind can sometimes be definitely segregated due to their different effects on the photographic plate.



Photography with infra-red illumination produces other results. Writing prepared with an ink which is opaque to infra-red, and subsequently obliterated with an over-layer of another kind of ink more transparent to the red rays, may be readily restored by means of photography. Sometimes the ink pigment is worn from the surface so that no evidences of it appear, yet it may be found below the surface by infra-red photography. A particularly good illustration of this is the case of a leather money bag, on the surface of which could be seen no writing; an infra-red photograph graphically disclosed the name of the bank from which it had been stolen.

X-ray photography in the Laboratory is sometimes used to disclose the contents of suspicious packages. The application of X-rays and photography for the determination or identification of materials is also usable. X-rays will disclose many kinds of hidden objects in the shoes or clothing of a prisoner. Objects swallowed by persons, or bullets in the bodies of victims, are clearly disclosed through use of the X-ray.

The technical testimony of the laboratory witness in court nearly always is supported by photographs. Frequently he prepares large photographic charts in which the fingerprints, the handwriting, or the bullet markings are magnified many times so that the jury can clearly follow his exposition of the identification. An additional advantage of this procedure is that the photographs are introduced in evidence as official exhibits. They thus become a permanent record of the case and may be taken into the jury room where they are of considerable assistance to the jury in reaching its verdict.

In order to complete the story of photography in crime detection we must not omit its importance in police training. The Training Division of the FBI, which includes the FBI National Police Academy, is fully equipped with every modern apparatus for visual education. Sound motion pictures, projection slides in color, and large photographic charts combine to provide in a few weeks or months of concentrated training the experience of veterans of many years service.

# A Bridge That Floats

## Four-Lane Highway on Monster Pontoons . . . Over a Mile Long . . . Tied By Cables to Great Anchors in Bottom Mud . . . Safe, Vibrationless, Permanent

By CHARLES F. A. MANN

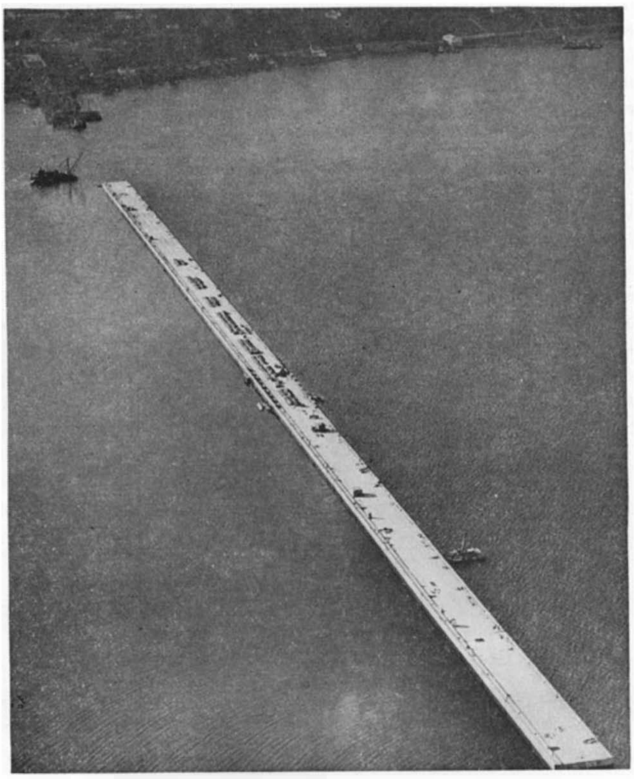
THE world's most remarkable highway bridge—with a floating portion 6561 feet long made up of huge concrete and steel pontoons which carry a four-lane express highway—is now the center of engineering interest in the Pacific Northwest. It is part of the Snoqualmie Pass East-West highway across the Cascade range where that highway enters the city of Seattle, on the shores of Lake Washington. This great eleven-unit bridge-highway project runs from the southern heart of the Seattle business district for six and one half miles due east, directly across the middle of the beautiful lake which bounds Seattle on the east, on across Mercer Island, and thence to the mainland. Work on the project is being speeded to have it ready for the rush of summer tourist traffic by July first of this year.

The bridge project is costing $8,854,000. The Washington State Tollbridge Authority, which public body is also constructing the Tacoma Narrows suspension bridge, is the developer of this project. The State Highway Department let a contract on November first for a nine-mile stretch of fast, four-lane, arterial highway that runs directly east toward the mountain town of Issaquah. This stretch is at the eastern end of the bridge project.

The two projects — the bridge and the above-mentioned stretch of highway—chop nine miles off the total distance between Snoqualmie Pass and Seattle, eliminate 65 percent of the curvature and 50 percent of the rise and fall, and save an hour for passenger cars and two hours for trucks on the mid-state highway to the east.

For 25 years, local people dreamed of a way to cross Lake Washington with a huge bridge and avoid the twisting Seattle-Cascade route through Renton, at the southerly end of the lake, and over the rough wooded foothills and canyons. The lake is 20 miles long and runs along the entire eastern boundary of Seattle between the city and the Cascade range. Lake Washington Canal, for deep-water ships, connects the lake with Puget Sound. Even at Seattle's famed Seward Park Peninsula, where the lake is narrowest, the cost of a bridge would be fantastic and too far south of the needed traffic route into the city's downtown shopping area.

It would cost between $35,000,000 and $50,000,000 to build a suspension span across the lake itself, and there was no precedent for such a bridge because no piers have ever gone down to 400 feet below water level. Pier footings would, in fact, have to go much deeper than that. Lake Washington, only a few feet above the level of Puget Sound, is very wide and deep. The water varies from 150 to 200 feet deep, and the bottom is soft mud for over 100 feet below that. Jet borings have gone down into this mud nearly 325 feet below the surface of the lake, but there is nothing firm enough on which to rest a giant bridge. Such deep piers were, therefore, out of the question.



A recent air photograph of the Lake Washington Bridge showing work progress. "Gate" span will be near gap

Engineering research on this problem finally centered on the present route as the best, and a pontoon bridge was decided upon. The decision sprang, not from desire or design, but from simple necessity. Conditions were favorable for the construction of a floating structure. There is no current or tide and only a slow seasonal variation of three feet in the water level. The lake water is fresh so that it would not deteriorate a floating concrete structure. No ice of any consequence forms on the lake in winter. Finally, the mud of the lake bottom would provide a strong foothold for heavy anchors which would hold the bridge in place with huge cables.

FOR a long time after the decision was made to construct the bridge in this fashion, innumerable questions were directed by Seattle citizens toward Mr. Charles E. Andrew, Chief Engineer of the Lake Washington Bridge. They wanted to know why a concrete pontoon was to be used, and would it sink in a storm, and what holds the pontoons together?

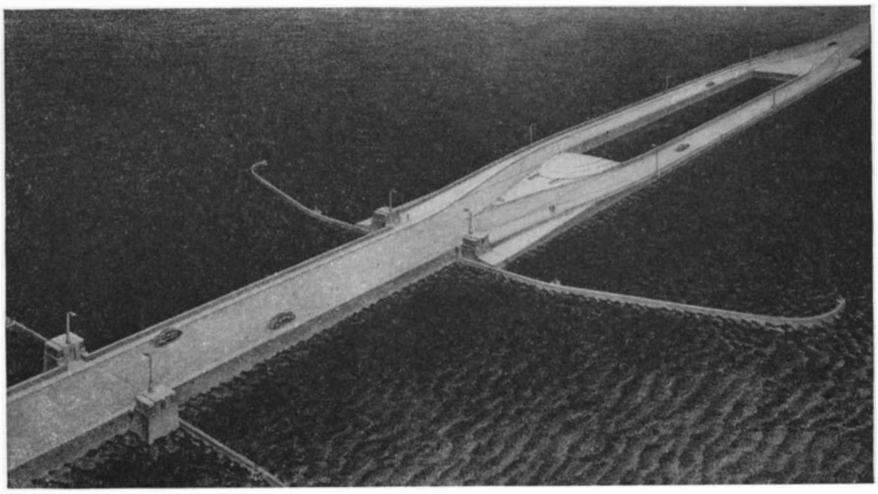
Even the Seattle newspapers were so puzzled that they condemned the project editorially as technically impossible. They were sure the whole thing would sink in a storm. As layman, they can be excused for their bewildered attitude for this will be the first bridge of its kind ever built anywhere in the world. It is true that there are pontoon bridges across the Rhine at Coblenz; across the Golden Horn at Istanbul; and at Ebrie Lagoon, Ivory Coast, French West Africa—but these are simply bridge decks built across floating boat-shaped pontoons anchored like scows. The only other concrete pontoon bridge is now being constructed at Hobart, Tasmania.

The key to the six and one half mile project is the lake crossing of 7800 feet.

At each end there is a low steel truss span, a heavy steel transition span, and a novel floating "gate" on the Mercer Island side. This gate opens the structure to provide a clear 200-foot channel to allow the biggest ships to pass. The end-span system is of ample clearance (30 to 38 feet, with water depth of from 46 to 60 feet) to take care of 95 percent of the lake boat traffic, including tugs; and the floating draw-span will amply care for all the rest.

The floating section is 6561 feet in length, made up of 10 identical middle-section pontoons, and 12 of special shape. These special ones, with but a slight variation in design, are used at each end in connection with the transition (ferry-slip type) spans and the ship lock on the Mercer Island side. The principal, or typical, pontoons are 349 feet 10 inches long, 59 feet wide, 14 feet six inches deep. Each is made of dense concrete and slightly under 350 tons of closely spaced reinforcing steel bars 5/8 of an inch in diameter. This steel is placed in all walls, bottom, top, and railing.

Each pontoon weighs 4558 tons, and normally floats about seven feet two inches deep in the water. The unusual feature of this construction is the utter simplicity. The outer walls of the pontoon, the bottom slab, and the roadway slab on top are eight inches thick, while the entire system of inside compartments and the end walls are six inches thick. The interior of each typical pontoon section is divided into 96 cells of about 14 cubic feet each. Each strip of four cells across is connected by openings to another strip of cells, making eight cells in each of 12 water-tight compartments, any three of which can be injured and flooded without disruption of traffic due to lack of buoyancy.



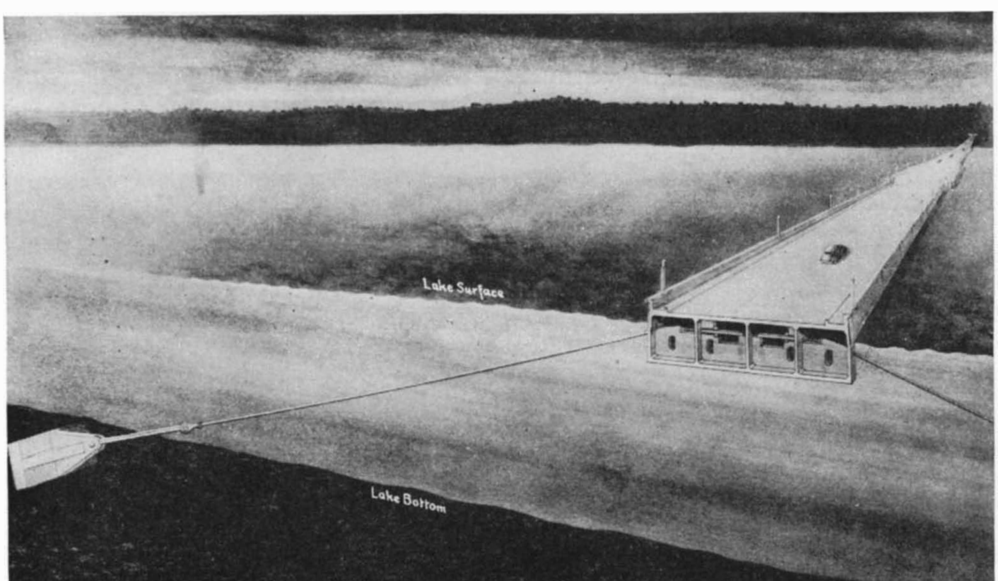
**Sketch of draw span through which large ships will pass. The pontoon between the guard "wings" will be pulled back into the "U" of the section at the top**

The roadway slab, which carries a four-lane, 45-foot roadway, 24-foot sidewalks, and a three-foot concrete guard railing on each side, is integrally a part of the pontoon. For each 53 tons of load on the roadway, the pontoons sink into the water *one inch.* Thirty passenger autos on one pontoon would just about add enough weight to sink them down a mere inch!

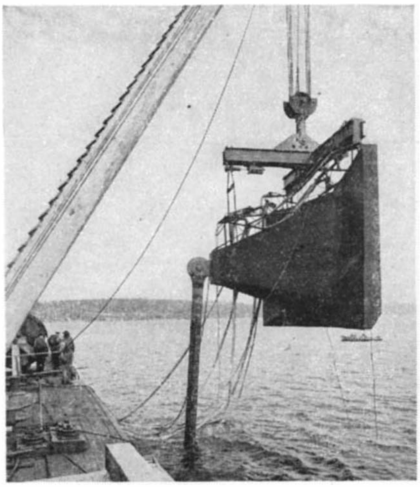
THE loading capacity of the floating section is figured for a 90-mile wind plus four lanes of 20-ton trucks, bumper to bumper. Thus the factor of safety is adequate because such a combination is unlikely. Should it occur, the pontoons would sink about 22 inches into the water. Obviously, the total weight of each pontoon is so great in proportion to any possible load that a 50 percent capacity load driving down one side of a pontoon in a high wind would cause so little vibration and movement that a pedestrian could easily imagine that he is walking on a highway on solid ground. A six-foot wave height has been provided for by making the railing three feet above the sides of the structure, or normally 10 feet above the waterline.

Transversely, through the middle of each pontoon, runs a cable channel and racking mechanism, in a steel beam channel, that carries the ends of two 2¾-inch steel cables into the side of the pontoon. These cables run up on a low angle from flat, umbrella-shaped concrete anchors, sunk by water jets into the soft lake bottom, to the racking mechanism inside the middle of each pontoon. Hydraulic jacks can be quickly lowered to rack these cable-ends back and forth to take up or let out slack to compensate for seasonal variations of the lake level. A movement of 12 feet has been provided for, and their peculiar method of connection with the pontoon prevents, or rather acts against, any tendency of the pontoons to rock in a storm. The cable saddles literally tie the pontoon to the lake surface and exert a downward pull. The wing-type anchors are 26 feet wide and 14 feet deep.

Each of the pontoon sections is connected to the adjoining pontoon in an unusual manner. Around the top, bottom, and sides of each end runs a row of huge three-inch bolts, 54 in all, that run through steel tubes imbedded in the concrete end-walls. A double nut locks them securely. A soft rubber ring, located around the outside ring of bolts, is squeezed watertight when the pontoons are bolted together. The remaining space between the pontoon ends — slightly over one inch—is unwatered and grouted with dense cement-sand mixture. A third system of shear-stress between pontoons is provided. This consists of two three-foot-




**Sketch showing section of one pontoon and manner in which a single pair of cables is attached to the middle of each pontoon and to heavy anchors in the mud on each side**



**Lowering one of the immense anchors, the size of which may be indicated by comparison with the men**

square concrete plugs, or keys, projecting into the adjacent pontoon 12 inches. Thus with these concrete shear keys, the 54 three-inch bolts, and the continuous ring of cement grouting, the entire floating section becomes one continuous concrete monolith, with any two pontoons capable of sustaining a completely flooded middle pontoon until any possible repairs can be effected. In such a case traffic would have to be thinned out, of course.

And, say the engineers, nobody knows just how much "bend" or "give" there is in a mile and one-fifth of concrete ribbon, but it is estimated to be several feet, particularly because of the dense steel reinforcing system used in all the walls.

NO painting, or any other repair expense will ever be necessary. The steel anchor cables rest in fresh water, submerged and away from the air. Slight seepage may occur in a faulty panel, but a portable pump outfit can keep the bridge bailed out. Once a month the manhole covers—12 on each pontoon—will be lifted and the interior inspected. It is estimated that about 100 gallons of water per year will seep into the entire bridge, and this is less than normal "creep" of water up the walls and onto the roof, or highway deck, slabs!

Even if all the rubber sealing gaskets give way, the concrete grout extending to within eight inches of the outer rim will keep all water out of the bolt-holes and away from the end compartments.

It is claimed that this is one of the most remarkable pieces of concrete construction ever attempted. Approximately 2110 cubic yards of concrete will go into each pontoon.

On Harbor Island, Seattle, 16 miles from the bridge site, a pair of graving docks was built especially to construct the pontoons. One graving dock is 70 by 365 by 15 feet deep and the other is the same width and depth but is 400 feet long. Steel tide gates are placed at each end. The concrete bottom slab of each dock is floored with wood which makes the bottom form of the pontoon's bottom slab. Concrete for the pontoon bottom is poured on this after the steel mat is laid. After a few hours delay, the interior cell walls, three longitudinal central walls, two outer walls and 25 transverse walls are made in one continuous pour. Vibrators make the concrete very dense around the steel reinforcing wire. Finally, the top slab is poured after the cell forms are removed. All forms are heavily oiled.

Four and one half days from the time the deck slab is poured, the end gates are raised and the graving dock flooded so that the pontoon is simply floated out to be towed by two tugs to the bridge site 16 miles away. After all pontoons are assembled, deck railing and sidewalks and curbing will be poured, and electric lamp posts set.

The entire project begins on Rainier Avenue in Seattle and runs through twin, two-lane self-ventilated tunnels under Mt. Baker Ridge, a distance of 1400 feet from portal to portal. Thence it goes down to the lake on simple truss spans and one 215-foot arch span to the novel transition span mentioned before. This span permits movement between the rigid portions of the bridge up and down and sideways to compensate for changes in the lake level, traffic load, misalignment of piers due to wind pressure, and wave action. From there the highway crosses the first 15 floating concrete pontoons and runs to the draw-span located 1500 feet out from the Mercer Island shore.

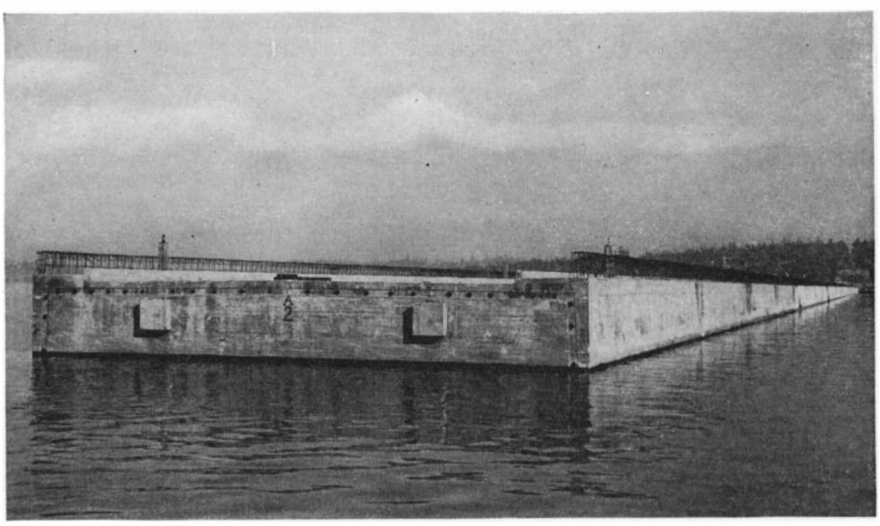
At that point, a 378-foot movable pontoon section can be telescoped into a "U"-shaped section to give a 200-foot clear channel for ships. Special steel buoyancy pontoons will be floated under the "U" arms to compensate for the extra weight of cable drums, motors, and heavy steel track for the floating movable section. Two 75 horsepower, geared motors will work the cables that move the floating draw-section. Each half of the "U" pontoons (a forked pontoon and two narrow side pontoons) will carry a two-lane road. Anchors at the sides, as well as fore and aft, are provided here to carry the extra stresses.

East of the draw section will be another transition span, another arch span, and the approach spans. On Mercer Island will be an eight-lane tollgate. The tolls at this gate will be about 25 cents for each passenger car plus five cents for each passenger; and for trucks it will be from 50 cents to $3.50 each.

THE Mercer Island end of the project consists of a four-lane express highway, with under- and over-pass for local island boulevards and an approach road on both sides. Between Mercer Island and the East shore, two major sections are necessary. The first is a truss and East Channel span 215 feet long, with a clearance of 39 feet and a total length of 1360 feet. This is followed by a 2000-foot highway section and then a 2000-foot concrete viaduct across Mercer Slough.

So long and involved was this project that it was split into eleven units, each under a separate contract. Nearly twenty large Pacific Coast Contractors are engaged in rushing this complicated project through in time to meet a PWA deadline of July 1, 1940.

The Lake Washington Bridge is being built by the Washington Tollbridge Authority, headed by Lacey V. Murrow, Director of Highways. Charles E. Andrew, R. B. McMinn, Admiral Luther E. Gregory, and R. H. Thompson constitute the board of consulting engineers, with Mr. Andrew as chairman. Mr. Andrew is, in fact, in charge of both the Lake Washington and the Tacoma Narrows Bridges. Mr. G. A Gregory is project engineer and L. R. Durkee is the resident engineer inspector for the PWA.



**Pontoon end, showing shear blocks and holes for bolting (with three-inch bolts) to the next unit. Cement grout and rubber ring around bolts provide a seal**

# AIR, WATER, COAL = HOSIERY

## Fiber From Abundant Raw Materials . . . Fiber is Only One of a Large Family of Chemical Products Known As Nylon . . . Research That Led To Them

By H. T. RUTLEDGE

FOR many years the du Pont Company has carried out research directed to the improvement of existing products and the development of new products, but it was not until early in 1928 that "pure" or fundamental research was started. Whereas the "applied" research previously carried out was directed to immediately practical ends, the "pure" research begun by the Chemical Department some 10 years ago was designed primarily to develop fundamental information about chemical products and processes, with no thought that the information developed would be of immediate practical value.

The first study undertaken in connection with this fundamental research program was directed to a better understanding of how and why certain of the tiny building blocks or molecules, of which all matter is made, unite to form "giant" molecules such as those found in rubber, cellulose, and resins. Chemists have long been vitally interested in this subject of giant molecules, technically known as superpolymers, and in learning everything possible about the mechanism of what the chemist calls polymerization, which, after all, means only the process by which large molecules are formed from small molecules. Such information has a two-fold value. First of all, it satisfies the chemist's inherent curiosity about the constitution of matter. He wants to know, for example, what rubber is and why it stretches, and why the cellulose of cotton is in the form of long fibers.

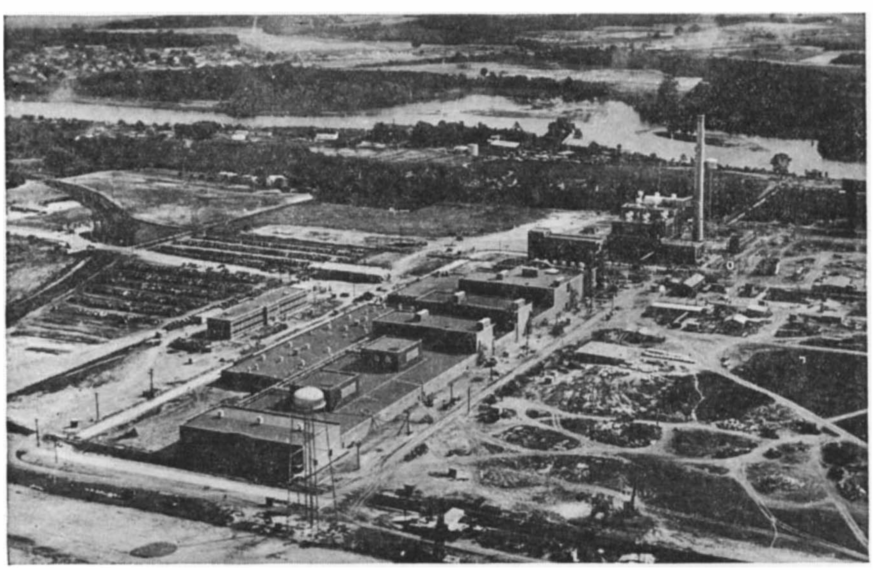
An understanding of such processes as polymerization also enables the chemist to direct certain of the forces of nature along desired lines, one result of which is that he is able to make things which nature failed to provide. It is, indeed, fortunate that man is endowed with this insatiable curiosity concerning the things which surround him, since it has been through his efforts to understand these things that he has been able to master his environment.

Out of the study of polymerization begun by the Chemical Department in 1928, fundamental information of much academic importance was developed. It was demonstrated, for example, that certain small molecules could be made to unite in such a way as to form giant molecules of great length — so-called linear superpolymers, the small molecules being joined together end to end somewhat like a chain of ordinary paper clips.

As yet this information was only of interest to chemists who wanted to know more about how matter is built up from the tiny molecular building blocks, but after this fundamental research had been under way for about two years, something happened which was destined to be of far-reaching practical value. In attempting to remove a sample of a molten long-chain superpolymer from the still in which it was prepared, one of the research chemists engaged in this study noted that the molten polymer could be drawn out in the form of a long fiber, somewhat like that of silk. He noted also that, even after the fiber was cold, it could be further drawn to several times its original length. Such a phenomenon had never before been observed.

While this original fiber was not very strong or elastic and, in addition, was softened by hot water, it, nevertheless, suggested the possibility that some related type of superpolymer might give fibers which would possess the characteristics desired for use in textiles. Further research was accordingly undertaken, directed to the synthesis of a superpolymer from which strong, elastic, and water-resistant fibers would be drawn or spun. This particular research was, of course, of a very practical nature, and we shall not here follow further the fundamental research on polymerization which, however, was continued and is still being carried on.

PRACTICAL research directed to the synthesis of a superpolymer from which fibers could be drawn suitable for textile purposes did not bear immediate fruit. Many difficulties were encountered. Numerous superpolymers were synthesized, but some of the resulting fibers were deficient in strength and elasticity, while others, although sufficiently strong and elastic, softened at quite low temperatures, or were sensitive to water. In other words, they did not possess the properties required of a textile fiber. The outlook at one time was so dark that consideration was given to suspending this particular line of applied research. But finally a superpolymer of a different type was prepared, known as a polyamide, from which fibers that were spun by hand



**Aerial view of the new nylon yarn plant near Seaford, Delaware, which started operation in December. Production will shortly be 3,000,000 pounds a year**

were found to possess such characteristics as to warrant extraordinary efforts to bring the development to commercial success.

Much work was yet to be done, however, between that day when the first polyamide fiber was extruded through an improvised spinneret made from a hypodermic needle, and the announcement of nylon by du Pont. Hundreds of different polyamides had to be synthesized before superpolymers having the desired characteristics were found; it was then necessary to investigate sources of raw materials for the intermediates needed in making these superpolymers, and to devise practicable processes for making these intermediates.

BUT painstaking study, together with the "patient money" necessary for successful research, finally won out, and on October 27, 1938, du Pont announced to the world the development of a group of new synthetic superpolymers from which, among other possible applications, textile fibers could be spun surpassing in strength and elasticity any previously known textile fiber, whether cotton, linen, wool, silk, or rayon.

Nylon is the generic name chosen for the synthetic linear superpolymers developed in connection with the research just outlined. Nylon is officially and scientifically defined as "a man-made, protein-like, chemical product (polyamide) which may be formed into fibers, bristles, sheets, and other forms which are characterized, when drawn, by extreme toughness, elasticity, and strength."

Note that nylon is a "protein-like chemical product." This means that it has somewhat the same chemical composition as the proteins, of which silk, hair, and wool are common examples. Nylon does not, however, have an exact chemical counterpart in nature, and fibers made from it cannot, therefore, properly be referred to as "synthetic silk," although resembling silk in certain respects. The synthetic material — or rather, family of materials — known as nylon is not only new, but different from any existing natural product.

Again, nylon "may be formed into fibers, bristles, sheets, and other forms." From this definition, it follows that nylon does not refer simply to the fibers or yarn spun from a polyamide, as many thought, but rather to the polyamide itself from which fibers, bristles, sheets, and the like, may be formed. The term "nylon" does not refer to any particular form of the polyamide any more than does the term "glass" refer to any particular form or item of glass. Also nylon does not have reference to one particular chemical compound, but rather to a family of related compounds: the polyamides, of which there are many members.

The superpolymers of the nylon polyamide family can be made in several different ways. One of the simplest involves the reaction of a dibasic acid, of which there are many, with an organic diamine, the two hooking together in chains. This reaction, which results in the formation of relatively small molecules, is followed by heating to bring about the union of many of these small molecules to give the giant polyamide molecules.

This is, in effect, what happens when a dibasic acid and a diamine are heated together, and the product produced by the reaction is called an amide. When the chain is made up of many links, the resulting product is a polyamide.

Since a product formed in this way is a polymer, long-chain polyamides are also spoken of as superpolymers. The polyamide superpolymers made from a dibasic acid and a diamine are known as nylon.

Though it was indicated above that the polyamide chain might be infinitely long, in actual practice, those in nylon, by proper control of the reaction, are purposely limited in length in order that the nylon may have desired physical qualities for proper mechanical processing of different types.

Since there are dozens of different dibasic acids, diamines, and the so-called amino-acids, as well as other compounds which may be used in making polyamides, it follows that many different types of nylon are possible. For example, if there were only 10 different dibasic acids and 10 different diamines, it would be possible to make 10 times 10 or 100 different nylons. Actually, by inter-polymerization of various dibasic acids, amino-acids, and diamines, thousands of different nylons are possible; for example, one dibasic acid could be made to react with two different diamines at the same time, and in varying proportions, or vice versa. Also, two or more different nylon polymers might be blended to give a composition different from that of the parent nylons. It should be apparent, therefore, that an almost unlimited number of nylons are possible — with different melting points, solubilities, and so on. Some, for example, might be quite flexible, while others would be stiff or rigid.

Since nylon is not one particular polyamide, but rather a *family* of related polyamides, it might be expected that various raw materials could be used in making various types of nylon, and such is the case. One particular type which now appears quite promising for making textile yarns can be made from a dibasic acid derived from phenol, and a diamine likewise derived from phenol. Oxygen from the air is also needed in making the dibasic acid, and ammonia is used in making the diamine. Since phenol is commonly derived from bituminous coal, and since ammonia is made synthetically by causing the hydrogen from water to unite with nitrogen from the air, it follows that this particular nylon is derivable from coal, air, and water. Other raw materials might, however, be used to advantage in making other types of nylon. For example, one type which has been found useful for certain purposes involves the use of a dibasic acid derived from a vegetable oil. It is thus evident that agricultural raw materials as well as mineral raw materials may enter into the manufacture of nylon.

**These "blenders" contain nylon chips about to be transformed into yarn for various textiles**

WHILE it is of economic and industrial significance that nylon can be made from domestic raw materials such as coal, air, and water, of which this country has an abundance, this is only a part of the story. The layman may sometimes wonder why a product based on cheap and abundant raw materials should not itself be "dirt cheap." He frequently fails to appreciate that, in order to make a product such as nylon from "coal, air, and water," many intricate chemical reactions must be carried out, involving elaborate and costly equipment, with rigid control at each and every step of the process.

The most interesting physical property of nylon is that it can be cold drawn. If a fiber of nylon which has been made under low tension is subjected to further tension, it can be drawn to from four to seven times its original length, depending upon the particular polyamide being used in that type.

A highly interesting phenomenon occurs during this stretching operation. The long, chain-like molecules which make up the undrawn fiber are arranged in a helter-skelter fashion like the individual straws in a haystack but, on drawing this fiber to several times its original length, the long-chain molecules take on an orderly arrangement. They become parallel to one another.

This peculiar behavior, known to the chemist as "orientation" of the molecules, is more than just an interesting phenomenon, for on this property hinges the very important industrial value of nylon. The practical significance of this property, particularly as applied to textile fibers, is that, on cold drawing, nylon becomes exceedingly strong and elastic. One might think it is originally elastic, since it can be stretched to several times its initial length. But elasticity means more than "stretchability."

THE degree to which a stretched material comes back to its original length is a measure of true elasticity. A piece of warm molasses candy, for example, can be stretched to great lengths but it isn't elastic; it will not spring back. Similarly, if a nylon fiber, made under low tension, is stretched to, let us say, double its original length, it will not spring back, but will remain double its original length. If, however, it is drawn to some four to seven times its original length, depending upon the type of nylon, it becomes truly elastic, with the result that, if it is stretched farther, it does spring back —not, of course, to its original length before being stretched at all, but to the length it had when it assumed the property of true elasticity. Even if kept stretched for days, the oriented nylon fiber does not lose its high degree of elasticity.

Drawn nylon fibers possess not only a high degree of true elasticity, but also great tensile strength. Nylon can be drawn into fibers which, for a given size, are stronger than corresponding fibers of cotton, linen, wool, silk, or rayon. The superior strength of drawn nylon is due in part to the fact that the long, oriented molecules lie so close together as to give rise to powerful intermolecular forces which resist slippage of the molecules when tension is applied. Breaking of any material is due only to separation by force of the molecules that make up the material; and closely packed, parallel molecules like those in drawn nylon offer great resistance to separation.

Another factor which contributes to the high tensile strength of drawn nylon is the extreme length of the molecular chains in a nylon filament. Just as a thread made from long cotton fibers is stronger than a corresponding thread made from short cotton fibers, so is an individual filament made up of long molecules stronger than a similar filament made up of short molecules. Although the molecues of nylon are spoken of as extremely long, they are long only in comparison with ordinary molecules. Actually, the "extremely long" molecules in nylon are only of the order of 10 or 12 millionths of an inch in length—too small to be seen even through a microscope.

It is the combined strength-elasticity factor of drawn nylon which causes the yarn to lend itself so well to the manufacture of fine hosiery. Neither strength nor elasticity alone would be sufficient. Until the development of nylon yarn, silk was the only textile fiber which possessed the combined strength and elasticity demanded of a yarn for fine hosiery, but from nylon it is possible to spin yarn having a strength-elasticity factor superior even to that of silk.

Oriented nylon is also extremely tough. It is this property, among others, which causes the "bristles" made from relatively large, oriented nylon filaments to be well suited for use in many types of brushes. It is likewise this quality of toughness which causes fishing lines of nylon to wear so well. They are not only strong and elastic, but highly resistant to fraying; that is, they are quite resistant to abrasion.

Durable and sanitary, nylon bristles are here being used to wash bottles, one of many uses

Nylon, in common with other crystalline materials, has a fairly sharp melting point, the temperature depending, of course, upon the particular nylon. Some of the nylons melt at quite low temperatures, while the melting point of others may run as high as 600 degrees, Fahrenheit, or even higher. The melting point of the type which now appears suitable for textile purposes is about 480 degrees, Fahrenheit, which, fortunately, is above the temperature normally used in ironing fine fabrics.

Fabrics made from the commonly used textile fibers will, of course, blaze when brought into contact with a hot flame, unless specially treated to make them flameproof. Fabrics made from nylon yarn, however, do not blaze when brought in contact with a flame. The nylon fabric simply melts and, although the molten nylon is ultimately consumed if kept in the hot flame, the fabric itself does not blaze and propagate flames.

Nylon of the type to be used in textiles is not injured in the least by water or any liquid commonly used about the home, such as dry-cleaning fluids. It is attacked only by certain chemicals, such as phenol (carbolic acid), and certain mineral acids which are normally found only in the chemical laboratory. Furthermore, nylon fibers are substantially as strong when wet as when dry.

Nylon fabrics are at least equally as resistant to indoor and outdoor light as are corresponding silk fabrics. Nylon fabrics undergo no appreciable deterioration in the absence of light, and may accordingly be stored for long periods of time without injury. They are proof against attack by moths as well as by fungi, such as those responsible for mildew.

Because of its good insulating properties and high abrasion resistance, experiments are now being made looking to the use of nylon coatings as insulation for the wires in various types of electrical machinery and apparatus. For this purpose the wire is not simply wrapped with nylon yarn, but is encased in a continuous film applied from molten nylon polymer.

AS made ordinarily, nylon in the massive state — that is, in relatively large pieces — is opaque, but sheets no thicker than about one fourth of an inch are somewhat translucent. Nylon films may, however, be made quite transparent by special processing. Nylon of the type suitable for textile purposes has a refractive index of 1.53 to 1.57.

One of the most promising outlets for nylon will be in the manufacture of yarn for fine hosiery. The properties of nylon yarn are such, however, as to suggest its use for a wide variety of textile purposes, particularly where a high degree of strength and elasticity are essential. Among the possible textile applications for nylon yarn are knit goods of various kinds, woven dress goods, lace, bathing suits, underwear, upholstery material, and the like. Nylon yarn is now finding commercial application in the manufacture of sewing thread and fishing lines, but only in a limited way.

A highly specialized possible application for nylon yarn is its projected use in making parachutes, including both the fabric and shroud lines. Hitherto, these have been made from silk, only.

"Exton" bristles made from nylon have been used on a rather large commercial scale as the bristling filaments in the Dr. West's "Miracle-Tuft" toothbrushes. Bristles made from nylon have been introduced commercially into various other types of toilet brushes, including hair, nail, clothes, hat, and complexion brushes as well as in many types of industrial brushes. Since nylon bristles are resistant to chemicals, oils, greases, and other destructive agencies. they are well suited to many industrial applications.

Since one of the major outlets for nylon will be yarn suitable for hosiery and other textile purposes, the process by which nylon yarn is made is of particular interest.

**Nylon yarn being processed. Machines twist the bundle of slender filaments for ease in handling. Finished yarn consists of many fibers twisted into thread**

THERE are two major processes which may be used in spinning nylon yarn. Nylon polymer may be dissolved in a suitable solvent, such as a phenol, and while in solution forced out through a spinneret into a bath which would remove the solvent and leave behind the tiny, solid nylon filaments. A spinneret quite similar in general design to that used in making rayon may be used; that is, a cup with as many fine holes in the bottom as the number of individual filaments desired in the yarn.

The method now being used is, however, quite different. The nylon in molten form is forced out through a spinneret by a suitable pump. As soon as the filaments strike the cool air outside the spinneret, they instantly freeze; that is, become solid.

The filaments from one spinneret are wound up on a suitable device, and later given a twist of a few turns per inch to facilitate further handling. The process from this point on involves stretching the bundle of fibers, now known as yarn, to the desired degree; applying a "size" or lubricant, or both, to facilitate knitting or weaving; and packaging the yarn in the form of skeins, "cones." or other forms suitable for shipping.

Filaments of extreme fineness can be made from nylon — much finer, in fact, than ordinary textile fibers. In general, however, such extremely fine filaments are not desired. Different textile materials call for filaments and yarns of different sizes and. accordingly, the size of a yarn, as well as the individual filaments, is adjusted to suit the particular use for which it is designed.

As normally made. nylon yarn has a high luster but, by adding a finely divided white pigment to the molten polymer before it is spun, yarn of the desired degree of dullness may be obtained. Since this dullness is due to pigment particles *within* the filaments, and not simply on the surface, the dullness is not affected by wear or by washing.

In the same way, colored yarns may be had by incorporating suitable pigments with the nylon prior to spinning. For the most part, however, nylon yarns and finished fabrics will be dyed in the usual way — after the yarn is spun or the fabric knitted or woven. Fortunately, nylon yarns and fabrics take a wide variety of dyes.

In its Trade Practice Rules for the Rayon Industry, dated October 26, 1937, the Federal Trade Commission defines rayon as follows:

"The word rayon is the generic term for manufactured textile fiber or yarn produced chemically from cellulose or with a cellulose base . . . "

Since nylon is not produced chemically from cellulose, nor does it have a cellulose base, it follows from the above official definition that nylon yarn cannot properly be considered as a type of rayon. Furthermore, the properties of textile fibers and yarns made from nylon are quite different from the properties of any existing type of rayon, particularly as regards strength and elasticity.

A plant for the commercial manufacture of nylon yarn, erected by the du Pont Company at Seaford, Delaware, went into production on December 15 last; in addition, extensions are being made to the du Pont Ammonia Department plant at Belle, West Virginia, to provide facilities for making nylon intermediates. The initial plant at Seaford will have a capacity of approximately 3,000,000 pounds of nylon yarn per year. Nylon polymer for monofilament purposes (bristles, surgical sutures, and so on) as well as for other possible applications, will also be produced at Seaford. The nylon development will provide employment initially for about 1000 persons.

NYLON hosiery will be made by a number of nationally known hosiery manufacturers, and it is anticipated than nylon hosiery for both men and women will be put on the general market by late spring or early summer of 1940. Nylon yarn will be made in several different sizes, and hosiery will be available in various weights, ranging from light sheer to service weight. No special precautions are necessary in laundering nylon hosiery. Indeed, no more care is necessary in the case of nylon hosiery than with other fine hosiery of the same weight. Nylon hosiery knitted in the orthodox manner will, when a thread is broken, run just like any other fine stocking so knit. Since, however, nylon yarn has a high strength-elasticity factor, nylon stockings should be less liable to runs than other high-quality stockings of the same knit.

The manufacturers say that the word "nylon" has no significant derivation; that it was selected as a generic name because it is non-technical and is easy to pronounce; its individual letters do not stand for anything. Yet that simple, coined word has taken on a nobility unequalled by any other, at least in so short a time. It represents enormously significant achievement. And it should become a symbol of that exploratory research which starts with no practical end in view but results so often in new products that enrich man's life and help to further civilization.

# STOPPING TIME

## That is What "Whirling Watcher" Does . . . Newest Stroboscope is Light Weight, Portable . . . Allows "Stills" and Movies of Extremely Fast Movement

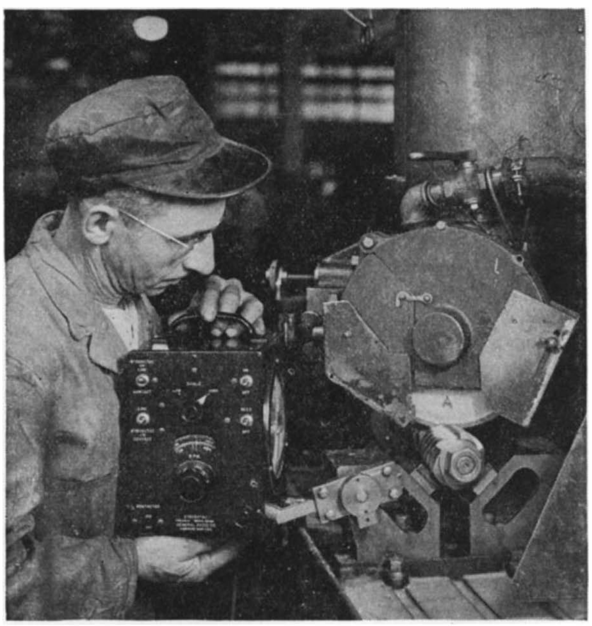
By ROBERT LITTELL

WITH microscopes and telescopes, science has conquered space, making it possible for man's feeble eyesight to pierce the mysteries of things unimaginably small or far away. And now, much later than these instruments, science has developed another, the modern stroboscope, which freezes the swiftest motions while they are still going on, and seems able to stop time itself.

In the laboratory of Professor Harold E. Edgerton, at the Massachusetts Institute of Technology, one can see time not only arrested but practically handcuffed. Here in a corner, for example, stands an ordinary electric fan, with the letters "M.I.T." painted on one of the blades. When the fan is turned on, the letters quickly vanish, of course, in a rapidly revolving blur. And any layman would be willing to bet that the letters won't be visible again until the fan slows down and stops. But Professor Edgerton aims at the revolving fan with what looks like a sort of searchlight framed in a black box. He turns a knob, and suddenly the letters re-appear on the fan, perfectly legible and stock still, although the blades are whirling furiously. Another turn of the knob, and the letters crawl forward as slowly as the second hand of a watch. Then, uncannily, they stop and begin to move slowly backward, contrary to the motion of the fan, which all this time has been revolving 1100 times a minute.

In the next demonstration of the handcuffing of time, the bright light from the black box is flashed onto a stream of water which in ordinary light appears to be continuous. In a moment the stream becomes a series of drops that stand still — queerly misshapen little jewels poised in midair. A turn of the knob, and they seem to climb back up into the faucet, defying the law of gravity. Now Professor Edgerton focuses a second flashing box on the water. Suddenly the top half of the stream drips down, while the lower half drips upward against gravity to meet it. The stream of water is composed of drops caused by pulses created by a small pump that circulates the water.

The stroboscope is not merely a toy for the creation of uncanny hallucinations. It is a very useful and important tool of science which, though the optical principles behind it have long been known, and practical models of it long been made, has only recently been fully developed. It is a serious student of the natural world, telling us things we would otherwise never know about how birds fly, how glass cracks, how drops of liquid behave when they fall or splash. And it is an increasingly valuable tool of industry. Thanks to the stroboscope, women's stockings are sheerer than ever before; guns will find their targets more accurately; there is less and less unpleasant and costly vibration in your automobile.



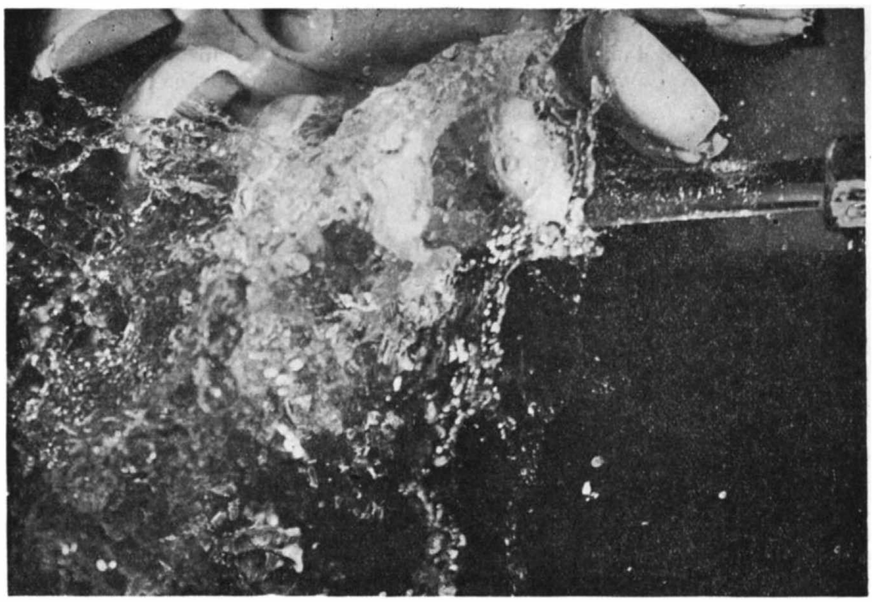
A portable stroboscope is used by the Boston Gear Works to watch gear-grinding angle and check speed

The modern stroboscope is a device for producing extremely short flashes of very bright light at regular and controllable intervals of time. The stroboscope which Professor Edgerton shone upon the fan blade marked "M.I.T." produces flashes of light only five millionths of a second long — five thousand times faster than a human wink. And by turning a knob and reading a dial, it can be made to flash anywhere from 600 up to 14,400 times a minute. Even the rapidly revolving fan blade, during such a super-wink as five millionths of a second, will move only a few ten-thousandths of an inch. Now if the light is made to flash 1100 times per minute — just as many times per minute as the fan blade is revolving — the light will always catch the blade marked "M.I.T." at exactly the same spot, and the letters will not only become visible, but appear to be motionless. And what are actually 1100 separate images a minute, we see blended into only one because our eyes are able to retain the image of things for a brief moment after they have disappeared.

This peculiar ability of the human eye, which scientists call "persistence of vision," you can demonstrate for yourself by a simple experiment with a lighted lamp. Close your eyes. Then open them to look at the lamp only as long as it takes to wink. Even after your eyes have closed again, the bright light of the lamp persists for the fraction of a second. Now if the lamp can be turned very rapidly on and off, and you keep your eyes open, persistence of vision will bridge the gaps of darkness between the flashes of light, and the lamp will seem to be continuously lit. This optical "afterglow" explains the magic produced by the stroboscope in Professor Edgerton's laboratory.

By making the stroboscope flash a little slower than the fan is turning, or a little faster, the image of the letters on the blade will seem to be moving forward — or backward against its own true motion. The trick of the two-way cascade of water-drops is done with two stroboscopes — one flashing a trifle slower than the rhythm of the drops, the other a trifle faster.

The intensely bright and extremely brief flashes of the stroboscope's light have made it possible to photograph motion far too rapid for even the fastest camera shutter. Some of the startlingly beautiful high speed photographs taken by Professor Edgerton with the aid of the stroboscope are already familiar to the public. They are now collected in his book "Flash," with lucid explanatory text by J. R. Killian, Jr., also of M.I.T. Here one can see the slow death of soap bubbles, the squashing of a golf ball at the moment the club hits it, the eddies of smoke at the tip of a whirling propeller blade, the first shy ooze of coffee from between the jagged fragments of a breaking cup. With his swift flashing light, Professor Edgerton has caught drops as they fell through the air—and discovered that they weren't streamlined, as had been supposed, but flat on the bottom and lacking the pointed tail. He has snapped milk as it splashed; and one of the pictures of the splash pattern, like a beautiful regal crown, is hung in the American Museum of Modern Art. He has caught birdshot as it left the shot-gun, flying somewhat like geese in a V, with the wads tumbling after it. A series of his photographs, each taken with an exposure of one millionth of a second, shows what happens when a rifle is fired at an electric light bulb: the bullet peeking out of the muzzle at a speed of 2700 feet a second, the first cracks in the bulb as the bullet nudges it, the bullet coming out the other side before the bulb has had time (about one six-thousandth of a second) to collapse.



**Operation of a Pelton water wheel, and the efficiency with which the stream of water is thrown aside, can be studied by stopping action with a stroboscope**

SUCH photographs can be taken with an ordinary camera. In a darkened room, the shutter is left open, and the exposure is made by a single flash of the stroboscope's light, which, though incredibly brief, is equal to the light from 40,000 50-watt household bulbs. Often, to take the picture at the precise moment desired, the flash mechanism of the stroboscope is tripped by sound. For intimate snapshots of a bullet in action, the stroboscope is set off by a microphone at a predetermined position some distance from the camera. As the speed of the bullet and that of sound are both known, it is a comparatively simple matter, by moving the microphone away from the revolver, to take a picture of the bullet at any given distance from the muzzle.

More amazing even than these stills are the slow-motion movies which the stroboscope makes possible. In Professor Edgerton's laboratory I saw films in which humming birds flapped their wings as lazily as a crow. One could see how they used their wings like propellers with a variable pitch; one could study the mechanics of their hovering, their ability to fly straight up and down. Slow-motion films of pigeons showed how the feathers open on the up-beat. I saw exactly how a cat, held upside down a foot above the ground, rights itself in a twinkling to land on all four paws. A snake put his forked tongue out and drew it in again in the tempo of the Volga Boatmen. I saw what no human eye was ever quick enough to see until the stroboscope put time into low gear — the quivering vibration of muscles as a football player kicked the ball, and the huge temporary dent his foot made in it. Water flowed from a jug with the slow oiliness of glycerine; high-speed cutting tools stumbled and jerked as if lame, and the decline and fall of a soap bubble when dropped to the floor was as stately as a chapter from Roman history.

The slow-motion pictures of prize fights and steeplechases which we see in the newsreels are taken at about six times the normal camera speed of 24 frames a second, and then run through the projector at normal speed. But even this speed isn't nearly fast enough for making slow-motion films of humming birds, snakes' tongues, or the action of water bubbles. Ordinary movie cameras operate by intermittent motion: each frame is stopped short for a fraction of a second, just long enough to record the image admitted by a synchronously intermittent shutter. If speeded up beyond a rate of several hundred frames a second, the film may tear or catch fire by friction, and the shutter will be open too short a time to let in sufficient light. This problem is solved in one way by a stroboscope synchronized with a moving picture camera from which the intermittent mechanism and the shutter have been eliminated. The film speeds evenly past the open lens aperture at rates up to 2000 frames per second, while the necessary intermittent illumination is supplied by the rapid, brilliant, regular flashes of the stroboscope focused on the subject to be photographed. What made the letters on the fan seem to stand still, here records on the racing celluloid an image so nearly instantaneous that the film, during one flash, does not move far enough to cause a blur. As many as 6000 pictures a second have been taken by reducing the size of the frames and using the alternating flashes from two stroboscopes.

Photographs taken at extremely high speeds, and projected in slow motion, are beginning to be used in industry for the analysis of rapid irregular movement. The stroboscope by itself can function only when the motion to be observed is uniform and periodic. But when used in conjunction with this special moving picture camera, unsuspected phenomena often appear.

IN technology and industry the stroboscope is rapidly coming into its own. Its commonest uses are the observation of rapidly revolving machinery and the measurement of the rate of revolution. Already it is used by many textile companies to regulate spindle speed, on the uniformity of which depends the uniformity of the cloth made from the yarn. A workman plugs his portable 10-pound stroboscope into the nearest electric outlet, sets the dial at the desired number of revolutions per minute, and walks down the row of spindles. When the flashing light seems to stop a spindle's motion dead, the spindle is functioning properly. The speed of spindles turning too fast or too slow is quickly and accurately determined by varying the number of flashes per minute until they, too, seem to stand still. In the same way, shuttles and ring travelers are also kept going at the most efficient speed.

The automobiles we ride in are freer from "bugs" than they used to be, thanks to the stroboscope. The vibration of crankshafts, the operation of valve springs, the splash of oil in the cylinders — all such operations and many more can be fully understood only when the stroboscope catches their secrets and foibles with its motion-freezing eye. Only by means of the stroboscope and high-speed photography can engineers observe exactly what happens when fuel is injected into the combustion chamber of a Diesel.

Propeller shaft torsion in a famous transatlantic liner, which made its first passengers complain of unbearable vibration, was located, measured, and finally eliminated with the aid of the stroboscope. A stroboscopic moving picture of a movie projector showed that one of the two little metal claws which pull the film ahead was not doing its share of the work, causing the film to tear. Electric razors harvest morning beards more painlessly because factory inspectors adjust the cutters by flashes of stroboscopic light. Electric refrigerators are easier to sell when their moving parts, "frozen" still by a stroboscope, are exhibited in salesrooms. High-speed color printing is more accurate because the stroboscope can "stop" the presses without moving a lever, and allow the pressmen to see whether the different colors are accurately registered.

Thanks to the stroboscope, engineers are better able to forecast what certain heavy materials and unwieldy structures will do under conditions of strain. At Columbia University's School of Mines, Professor Philip A. Bucky can predict, for example, how much an 83-foot steel beam, weighing 265 tons, will sag under its own weight. An exact scale model of the beam is made, one one-hundredth the dimensions of the prototype. To produce a pull upon it equal to 100 times that of gravity, the model is spun in a centrifuge, and its deflection is observed by a stroboscope and recorded on photographic film. In this case, it was found that the giant beam would sag one inch. Professor Bucky has applied the same method to models of the various strata in a mine shaft. The stroboscope helps to find at what point of stress the roof will begin caving in.

At the Cambridge, Massachusetts, laboratories of the General Radio Company, manufacturers of the stroboscopes most commonly used in industry, is a stroboscopic clock by means of which time intervals can be read to two ten-thousandths of a second. This clock, indispensable for radio frequency calibration, consists of two synchronized dials. The left-hand dial, like an ordinary clock face, has a minute hand, an hour hand, and a second hand. The right-hand dial has only two hands. The shorter one rotates around the dial once a second; the longer, ten times a second. This is too fast for the human eye to observe. But the stroboscope easily freezes the motion of the faster hands, making possible a reading of time in seconds, accurate to four decimal places.

THE stroboscope was born in 1832. Like so many inventions, it was discovered by two men, Stampfer of Vienna and Plateau of Ghent, quite independently of each other. But apparently both men were inspired by some investigation of Michael Faraday's who, in turn, had become interested in the phenomenon of "persistence of vision" through observations made by Peter Mark Roget, British physicist and compiler of the famous "Thesaurus." Plateau called his device a "phenakistoscope." Stampfer had a less unwieldy name — stroboscope — which stuck. Composed of two Greek words, it means, roughly, "whirling watcher."

THE first "whirling watchers," disks with slots cut into them at regular intervals, were soon used to interrupt a steady beam of light. Professor Edgerton's stroboscope is a logical advance made with the aid of modern electronics — a practical, inexpensive instrument to interrupt the light itself at its source. As often happens, his development of the stroboscope to its present high point was a by-product of other research. Professor Edgerton, in studying the "hunting" and irregular motion of synchronous motors, needed a more reliable and penetrating extension of the feeble human eye than was to be had at that time. The work done since, by him and his associates, Messrs. Germeshausen and Grier, has startlingly widened the horizon of man's knowledge.

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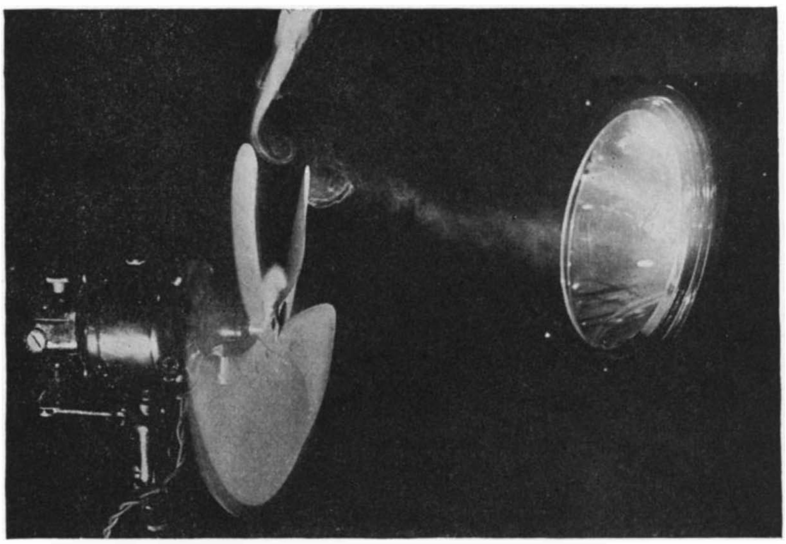
*Coming soon: An article that answers some puzzling questions as to the serious shortage of diamonds that is hampering Nazidom's war efforts; and the optimistic, but baseless, promise of an adequate supply from the Urals in Red Russia. The discussion is an absorbing one about "worker" diamonds and their elegant and romanticized cousins—or should we say brothers? Count this as one of the inside war stories we promised; other fine ones are coming.* —The Editor.



**What about wind turbulence and how well designed are the blades of an electric fan? Streamers of smoke blown through the fan give the answers to designers when photographed "still" under the light of a stroboscope**

**The new, portable stroboscope, valuable in many industries, does a regular job of "stopping" motion of the high-speed cutters of an electric shaver so that they may be adjusted. Photograph courtesy General Shaver Division, Remington Rand, Inc.**

# WINNERS in the FOURTH ANNUAL SCIENTIFIC AMERICAN PHOTOGRAPHY CONTEST

The judges (left to right) Ivan Dmitri, Robert Yarnall Richie, and McClelland Barclay, eliminating photographs in the final judging of our latest contest

AMATEUR photographs by the hundreds deluged the editorial offices of Scientific American as the Fourth Annual Photography Contest drew to a close. From all over the world they came, forming in the aggregate one of the finest displays of amateur work in this field that we have ever seen. When the cream of these pictures had been selected in the semi-finals and hung on exhibition, they were viewed by representatives of the leading manufacturers of photographic equipment and accessories. Blasé though this group might be expected to appear, they expressed the deepest interest, several going on record in the following composite manner: "Outstanding among displays of amateur photography. The pictures here are far above the average."

Justly proud were we to feel (and see for ourselves) that there are among readers of Scientific American such a large number of advanced amateur photographers who could turn out fine examples of work. Even more proud must be the winners whose names appear on this page. They were up against stiff competition and the fact that their pictures survived the gruelling examination of the judges is proof of outstanding excellence.

Because of the large number of prize winners, and limited magazine space, we are not reproducing the prize winning pictures this month. We have, however, listed, following their names, the cameras, film, and enlarging papers used by the major prize winners. First and second prizes in each division were solid gold Longines watches listing at $250 and $125, respectively. Third and fourth prizes in each group were Federal enlargers. In addition to these prizes, and 15 honorable mention awards, each consisting of a one-year subscription to Scientific American, a special prize of $50 cash was presented to Nathaniel Field, Brooklyn, New York, by the Federal Stamping and Engineering Company, for the best photograph made with a Federal enlarger, entered in the contest.

Watch for announcement of the 1940 Scientific American Contest.

### DIVISION 1

*1st.* Ladislas Freeworth, Budapest VII, Hungary.

*2nd.* Alvin W. Prasse, St. Louis, Missouri; Voigtlander Bergheil, Agfa Super-Plenachrome, Agfa Projection.

*3rd.* Thomas E. Benner, Urbana, Illinois; Speed Graphic, Agfa Superpan, Eastman Portrait.

*4th.* Elise Voysey, Bayville, L. I., New York; Super Ikonta B, Agfa Superpan, Velour Black.

#### HONORABLE MENTION

Kenneth Mazawa, Chicago, Illinois. Joseph G. Danley, Trenton, New Jersey. Wm. Carlson, Morris, Illinois. Ladislas Freeworth, Budapest VII, Hungary. Rev. F. M. Wetherill, S. T. D., Philadelphia, Pennsylvania.

### DIVISION 2

*1st.* A. H. Timmons, Glenwood Landing, New York; Zeiss Ikonta, Agfa Superpan Press, Brovira Kashmir Hard.

*2nd.* Wm. H. Keaton, Wheeling, West Virginia; Voigtlander Brilliant, Eastman Super XX, Defender Velour Black.

*3rd.* James Liccion, Rochester, New York; Bantam Special, Eastman Super XX, Kodabrome.

*4th.* Henry Reid, New York, New York; Leica, Agfa Infra-Red, Kodak Royal.

#### HONORABLE MENTION

Henry M. Blatner, Albany, New York. Alvin W. Prasse, St. Louis, Missouri. James Liccion, Rochester, New York. Thomas E. Benner, Urbana, Illinois. Harold B. Stoddard, Westfield, New Jersey.

### DIVISION 3

*1st.* Harry B. Forse, Victoria, B. C. Canada; Kine Exacta, Agfa Supreme, Agfa Portrait.

*2nd.* Charles W. Fairbanks, Rochester, New York; Contax II, Agfa Supreme, Kodabrome.

*3rd.* Joe Larber, E. Lansing, Michigan; Leica, Eastman SS. Pan, P. M. C.

*4th.* Stephen F. Harris, Dover, Massachusetts; Auto-Graflex, Eastman SS. Pan, P. M. C.

#### HONORABLE MENTION

Robert S. Holzman, New York, New York. Harry B. Forse, Victoria, B. C., Canada. Zia Qadri, Los Angeles, California. Ben B. Hains, Ogden, Utah. Nathaniel Field, Brooklyn, New York.

# ALGOL'S ECLIPSES

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

"WITH the exception of the Sun, probably no star has been so intensively studied by astronomers as the 'demon' star Algol." So begins the latest discussion of the system—just published by Dr. John S. Hall of Amherst.

Algol was the first star to be suspected, on the ground of observation, to be really a binary. Before Herschel had observed orbital motion in telescopic double stars, Goodricke, in 1782, discovered that this star lost the greater part of its light at regularly recurring intervals of two days and a little less than 21 hours, and pointed out that this might be due to eclipses by an enormous planet revolving around it.

Fully a century later, Pickering, having developed instruments for accurate photometric measures, showed that the changes in light agreed precisely, and in detail, with those predicted by the eclipse theory, and so settled the matter beyond question.

Since then, several long series of precise observations have been made. The first of these, by Stebbins in 1910, showed half way between the main eclipses a small but definite secondary minimum, due to the eclipse of the companion by the principal star, and proving that this was not a dark planet but a star shining on its own account, though but feebly compared with the other. It was in this work that Dr. Stebbins—then a junior member of the faculty—was asked to explain a requisition for "2000 pounds of ice to be used in astronomical observations." His photometer, now superseded, would work only when the sensitive cell was kept at a uniform low temperature. Eleven years later, with a still more accurate photo-electric photometer, Stebbins obtained a light-curve of exemplary accuracy and completeness, and one might have supposed that no more observations were needed, except to keep track of possible changes in the period and the like.

But the photo-electric cells of 1921 were sensitive only to blue and violet light (of an average wavelength of 4500 A). It is now possible to make cells in which the active surface consists of cesium oxide, which are highly sensitive to the red and even the infra-red. It is with such a cell that Stebbins and his colleagues made the observations of the reddening of the stars by absorption of light in space, of which we spoke last month, and with similar ones that Dr. Hall has worked—first at the Sproul Observatory and later at Amherst. In this way observations were secured with infra-red light, of wavelength 8660 A—quite invisible to the eye.

The figure, which is here reproduced by courtesy of *The Astrophysical Journal* shows what a wealth of new information comes from the new observations. The lower curve is Stebbins' for blue-violet light, the upper, Hall's for infra-red—differences in magnitude being shown respectively at left and right, phase in fractions of period across the bottom. The dots represent the observations—each one an average of many settings—and define the course of both curves with accuracy.

The principal features—the deep primary minimum and the shallow secondary—are visible in both curves. Both are round-bottomed, with no constant phase, showing that the eclipses are partial. But, with infra-red light the secondary is much deeper and the primary a good deal shallower.

The meaning of this is plain. At the middle of the primary eclipse the fainter star *B* hides from us a part of the brighter star *A*; at the other eclipse *A* hides a part of *B*; and this eclipsed area is the same, no matter what kind of light we use for our observations. The deeper secondary minimum thus means that *B* gives out more infra-red light, in proportion to the violet, than the average of the two stars, and the opposite is obviously true for *A*. Hence the two stars are of different colors, and *A* must be hotter than *B*. Many similar cases have been known, but the accuracy of the present observations, and the great difference of wavelength, make them noteworthy.

The loss of violet light at the principal eclipse is 65 percent, and at the other 3.8 percent. The orbit is circular (as is shown by spectroscopic observations). Hence the real distances of the stars from one another are the same at the time of the two eclipses, and the eclipsed areas are the same. It follows that, per square mile, star *A* gives out 17 times as much violet light as star *B*. In the infra-red, the light losses are 50 percent and 11.2 percent, and the ratio of surface brightness is 4½.

From these data, we can find the temperature of one star from that of the other. The spectrum of Algol, that is of star *A*, is B8—with faint helium lines. Dr. Hall adopts 15,000 degrees for its "color-temperature" and finds 5900 degrees for star *B*—slightly hotter than the Sun. The "enormous planet," though undoubtedly enormous, is therefore far from being a dark body but is brighter than the Sun itself.

But there is much more to be learned from the light-curves. It is obvious that, between the eclipses, they are not horizontal, but run up toward the secondary eclipse. This phenomenon, discovered independently by Dugan and Stebbins in different stars, is also easy to explain. Star *A* is very bright and hot; its powerful radiation heats up the near side of star *B*, and makes it brighter than the far side. At the time of primary eclipse, or just outside it, we see the side of *B* which is remoter from *A*—that is, the darker side; near secondary eclipse, we see the brighter side. This "reflection" effect (which ought properly to be called heating effect) is decidedly greater in the infra-red than in the violet. The whole range in brightness, due to it—that is, the difference in light between the bright and faint sides of star *B*—is found to be 6.9 percent of the total light of the system in the first case, and 3.0 percent in the second. These amounts must be subtracted from the light of the bright side of *B* (which is the one which undergoes the secondary eclipse) to find that of the fainter side. We do not yet know the former—only that fraction of it which is eclipsed; later calculations show that this fraction is close to 50 percent. The bright side of star *B* therefore gives out 7.6 percent of the whole amount of violet light, and 22.4 percent of the infra-red; for the dark side these become 4.6 and 15.5 percent; that is, 61 percent and 69 percent as much as for the bright side. The dark side is therefore somewhat redder, and must be cooler. Hall calculates a temperture of 5600 degrees instead of 5900 degrees. Only very precise observations could have detected this from an effect nearly drowned out by the powerful light of star *A*.

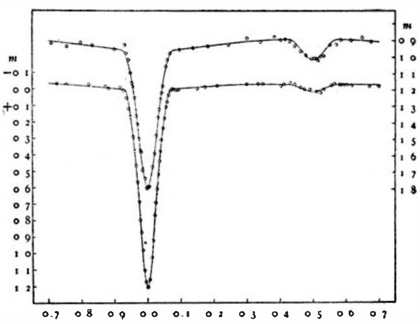
A very close inspection of the figure will show that the curves between eclipses bulge up slightly in the middle. This effect—which is much more conspicuous in some other systems—arises because the stars are pulled out by each other's tidal attraction and become slightly egg-shaped, with their long ends pointing toward one another. Half way between eclipses we see them broadside on, and they look brighter. In the present case the stars are rather small compared with the distance between them, and the ellipticity is small, the difference of the long and short diameters being 1.9 percent, according to the violet observations, and 2.0 by the infra-red. Even this tiny difference makes sense. Star *B* is less massive than star *A*, and should be more distorted than its companion. The observed effect is an average between the values for the two stars, taken in proportion to their light. Since *B* is brighter in the red, it should affect the average more. An accuracy even surpassing that of the present admirable observations would be necessary in order to find out in this way just what the shapes of the separate stars were.

The question of the actual size and brightness of each star remains to be settled. With such fine light-curves, this should ordinarily be an easy matter. We first "rectify" the curves so as to eliminate the heating-effect and the ellipticity (which is easy). Then—to understand the principles involved—we could proceed as follows. Begin by guessing at the light of star *B*, say 25 percent of the whole in the infra-red. Then star *A* gives 75 percent, and at the middle of eclipse 50/75, or 67 percent of the light of this star is obscured, while for star *B* this fraction is $\frac{11.2}{25}$ or 45 percent. Assuming that the star-disks are uniformly bright all over, this eclipsed area is 67 percent of the disk of *A*, and 45 percent of that of *B*. Hence the fainter star *B* must be the larger, and have 1.22 times the radius of the other.

IF we know the relative size of the stars, and the maximum percentage of eclipse, an easy calculation (with the aid of tables prepared for the purpose) gives the form of the whole light-curve, if we are given the width at the point where half the maximum amount of light is lost. This can be read from the observed curve. If the calculations are repeated, with different values of the assumed brightness of *B*, we will get different calculated curves. All will agree with observation at the half-way point, and at the bottom, because they were made to do so; but some will be narrower in the lower portion, and wider at the top, than others. Comparison with the observations shows what value of the light of *B* fits the facts. The actual process of calculation is less clumsy than this but based on the same principles.

It ordinarily leads to quite definite results; but in just this one case of Algol there is an unusual complication. Spectroscopic observations show, as was to be expected, that star *A* is moving in a circular orbit about the center of gravity of itself and *B*. But long-continued observations have proved that this close pair is itself a part of a wider one, with a period of 670 days— revolving in a slightly elliptical orbit about the center of gravity of itself and a distant companion *C*.

Neither star *B* nor star *C* is bright enough for its spectrum to escape being drowned out by that of *A* in the violet region where radial-velocity observations have been made—even when this star is partially eclipsed. But this means



Light curves of Algol's components

only that *C* does not give more than 10 or 12 percent of the total violet light of the three together—and possibly more of the red light.

We have now a new uncertainty in our calculations. Assuming, for example, that *C* gives 10 percent of the total infra-red light, and *B* 25 percent, as above, we have 65 percent left over for that of *A*, and, proceeding as before, find that 77 percent of the area of *A* is eclipsed and that *B* has 1.31 times the radius of *A*. By the same method as before, we can find a new value for the brightness of *B* which will give a good fit to the observed light-curve. It turns out that whatever guess we make about star *C*, we will get practically the same calculated best-fitting light-curve, and will have no way of telling which of our guesses is the best.

We have still one recourse, of a different kind, depending on the masses of the stars. We cannot calculate the masses from the spectroscopic data unless we know how far stars *B* and *C* are on the other sides of the centers of gravity of their respective orbits; but, at least, we know a *relation* between the masses—which with due apology to our readers, it appears easiest to express by means of algebra. If *A*, *B*, *C* now represent the masses of three stars (with the Sun's as unit) the data for the close pair give

$$B^3 = 0.026\ (A + B)^2$$

and for the other

$$C^3 = 0.059\ (A + B + C)^2$$

(Here it is assumed that the orbit of the wide pair, like that of the close pair, is nearly edgewise to the line of sight.)

If we can find the ratio *B*/*A* in any way, the first equation gives their values, and the other then gives *C*.

Now there is, on the average, a close relation between the mass and luminousity of the stars, and, from the ratio of brightness of any two, we can estimate the ratio of their masses. On this basis, *A* should be about twice as massive as *B*. Setting $A = 2B$, we find at once $A = 0.47$, $B = 0.23$, $C = 0.42$. This will not do, for several reasons. First, the actual brightness of Algol (star *A*) is about four times that of Sirius, and we should expect it to be more massive than Sirius, that is of at least three times the Sun's mass. Secondly, if *C* is almost as massive as *A*, it should be about as bright—which it certainly is not.

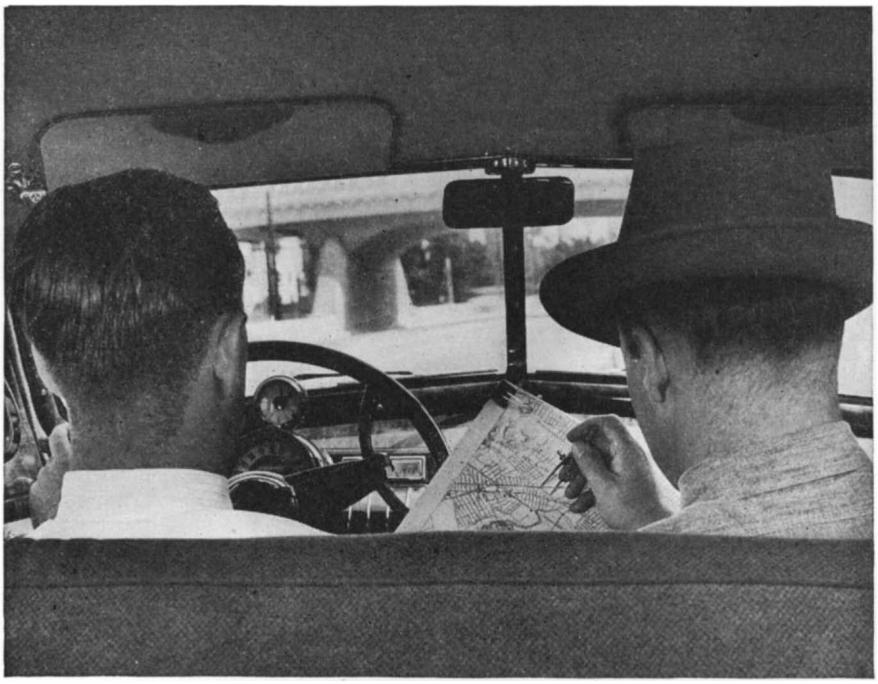
HALL adopts $A = 1.6$, which makes $B = 0.48$, $C = 0.79$. Star *C* should then give one sixth as much light as star *A*, and the spectroscopic observations are explainable. But the brightness of star *B*, calculated from its mass, comes out only a quarter of the observed value. There is something queer about one of these three stars. The assumption that star *B* is too bright for its mass appears to be the most reasonable one to make, for we know that such things actually happen.

The bright star, Zeta Herculis, for which we have accurate data, has very nearly the Sun's mass—or slightly less—and almost exactly the same spectrum and color as the Sun. We should expect it to be a little fainter than the Sun; but it is four times as bright, and must have about twice the Sun's diameter.

Stars of this sort appear to be moderately uncommon. But the best place to look for them is among the large faint companions of eclipsing variables. Sirius, for example, is probably 1.8 times the Sun's diameter. If it had a close companion just like the Sun, an eclipse by this would at best be annular, and cut off about 35 percent of the light. But a companion of the same mass and spectral type, like Zeta Herculis, could eclipse it totally, and cut off 85 percent of the combined light, producing a conspicuous eclipse when the other would stand a poor chance of being discovered.

When we hunt for eclipsing variables we are making a special search for large companions of low density, whether we realize it or not. So it is not remarkable that we find them.

If only the spectrum of either star *B* or star *C* could be observed during the principal minimum, a great deal more could be found out about Algol. Spectroscopic observations in the red might help—and would be worth a good deal of trouble to make.—*Princeton, December 5, 1939.*



Double-check by engineers who are laying the groundwork for new maps for motorists by driving over the area with government topographical maps

# SEVEN MILLION MAPS

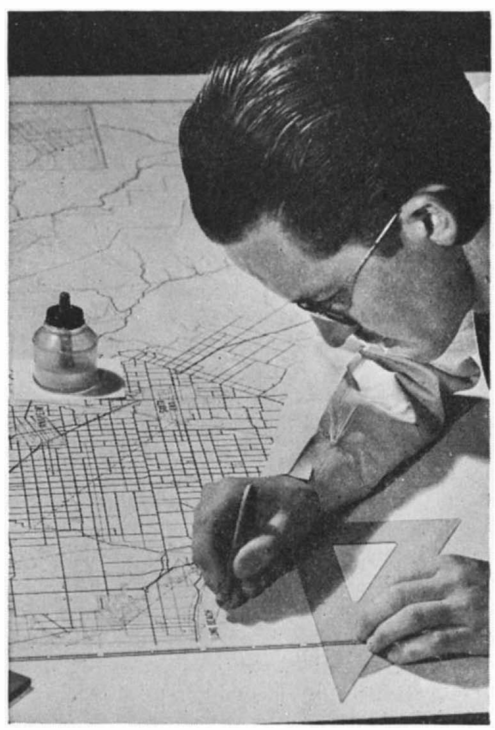
By ANDREW R. BOONE

USING United States Government topographical maps as a base, engineers for the Automobile Club of Southern California chart streets and roads by actually driving over the territory. Driving thousands of miles monthly, they keep up to date 1000 maps and help make available 7,500,000 maps each year to motorists. As they drive, they also consult California highway, county engineer's, and United States Forest Service maps. In the laboratory, scale of the base map is changed by a pantograph to conform to size of map desired. The original layout is first made on tracing paper by pencil, and from the layout an ink tracing is sketched. Following completion of the tracing, a photographic negative is made, and a positive black-line picture printed. The black-line is then mounted on pressed wood. After printed lettering is pasted at the appropriate positions, the map is photographed and reduced in the form of a wet-plate negative to printing size. A color separation is made on this negative from which various lithograph color plates are produced; at the same time another print is made from the wet plate on sensitized zinc, on which mountain relief is sketched with wax crayon. These plates are now made ready for printing the completed color map.

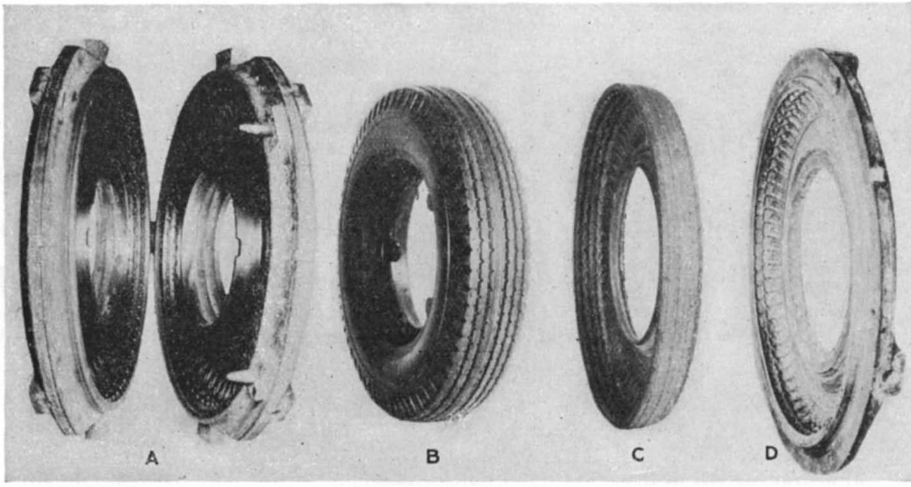
Preparing wet-plate negative from which lithograph plates are made

After all available data are collected, the completely corrected map is put under a pantograph and redrawn to a new scale that will be in keeping with the motorist's finished road map

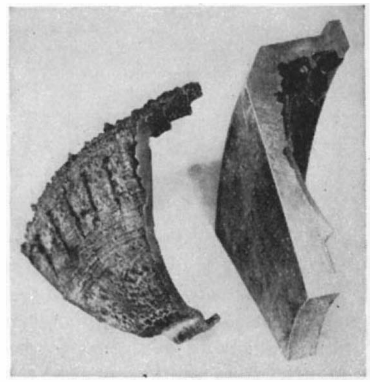
■



Proofs of type-set wording are trimmed to size and pasted in place on a large-scale black-line print that has been mounted on wood




Tire molds, made by usual engraving process, require over 165 man-hours to produce



**Sections of electro-formed tire molds before and after being backed with cast aluminum. Such molds are harder than older types and are excellent conductors of heat**

# Molds By Electro-Forming

RESEARCH, desined to find a process for the cheaper production of tire molds, has resulted in the development of a method of producing a variety of elaborate articles hitherto prohibited by tool costs. The new process, known as Ekko, comes from the laboratories of the United States Rubber Company, and has now been made available to industry at large.

The Ekko process produces molds and dies by electro-forming iron against a pattern it is desired to reproduce. Electro-forming is the same as electroplating except that deposits up to ½ of an inch thick are produced instead of the 1/1000 to 2/1000 of an inch thickness of metal applied by the usual electro-plating processes. Electro-plating is used for decorative purposes or to provide corrosion resistance, while electro-forming is used to build up a mass of metal.

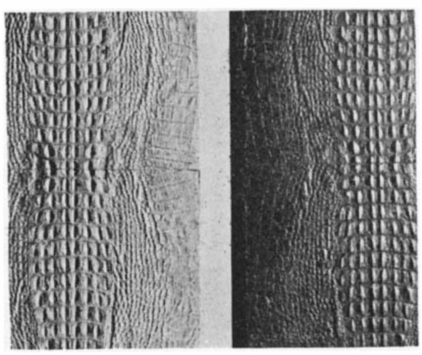
THE electro-formed mold, with which is to be made tires or other products. can be made at a considerable saving over the cost of an engraved mold. It requires considerably less labor and, in the particular case of tire molds, finished forms can be mounted in what are known as "watch cases" already available from old molds. A further advantage is that the iron deposited by the electro-forming process is 99.98 percent pure and is substantially free from porosity. It is about 50 percent harder than cold-rolled steel but can be softened to the normal value of pure iron by annealing or so hardened by carburizing that it will scratch glass. It has a heat conductivity nearly twice that of cast iron or steel—a valuable property for heat molding where a high rate of heat transfer is desirable.

In making an electro-formed mold of a tire, a pattern or matrix is first obtained from an engraved mold. An adjustment is made to provide extra metal where the new mold must later be cut in two. Then the pattern is made an electric conductor by dusting it with powdered graphite and polishing it vigorously with a light brush. Following this, it is placed in the electrolytic bath and electro-plated. The essential difference between this and ordinary electro-plating, as indicated above, is the much greater length of time the plating is continued.

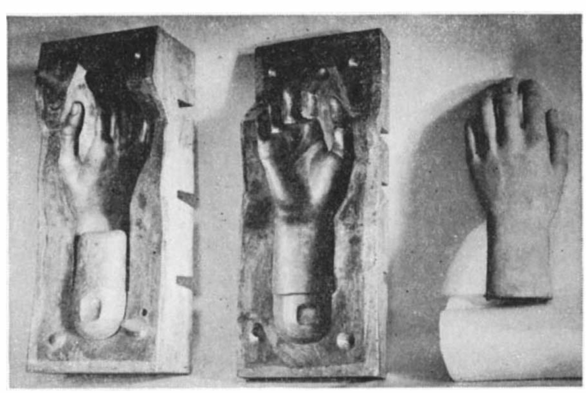
Many types of materials such as wood, glass, plastics, and so on, not attacked by the plating bath, may be used for making the pattern upon which the mold is to be deposited.

One of the first applications of the electro-forming process to other than tire molds was the preparation of a sponge rubber hand for a young girl who had been in an automobile accident. This was made at the suggestion of a sculptor friend of the young girl because of a feeling that the usual type of artificial arm would be highly unsatisfactory with long sleeves as well as with short ones. The sculptor prepared a model of the missing hand in plaster of Paris, correct in every detail. This reproduction was used as a pattern to electro-form an iron mold, which was then used to mold a reproduction of the hand in sponge rubber. This artificial hand provided lightness and resiliency, was tinted to match skin coloration, and required no straps or braces but permitted the wearer to open doors and drive a car.

Since the successful preparation of the mold for the sponge rubber hand, which indicated the desirability of electro-forming in the rubber industry, the Ekko process has been successfully applied in the plastics, glass, embossing, and metal stamping industries.



**The embossing trade can also use the new process for making such molding plates as that shown at left above. It was made on the imitation leather pictured above at right**



**The electro-formed mold for a hand, described in text, is shown in two parts in picture at right. The finished hand slips on the stump of the girl's wrist**

# Engineering In Dentistry

## Dentists' Main Problems are to Get Strength Plus Resiliency . . . Add to This: Art . . . Precious Metal Alloys and New Porcelains Meet Needs of Dentists

By A. W. JESSUP

"WHAT! Engineering in dentistry? Absurd!" So might most of us speak.

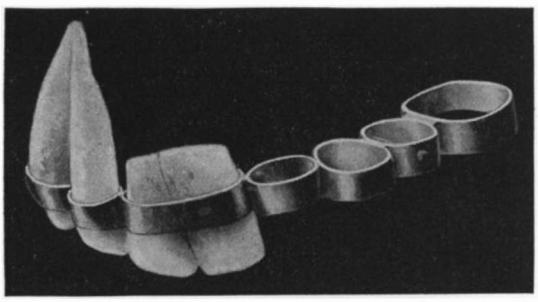
But there is engineering in dentistry today along with metallurgy, ceramics, and art. It is quite probable that the dentistry of tomorrow will require the same combination, although many hope that it will be replaced by preventive measures. Some of the best minds in the profession are concentrated on efforts to attain this much desired end, yet there are mysteries that are just as imponderable today as they were hundreds of years ago.

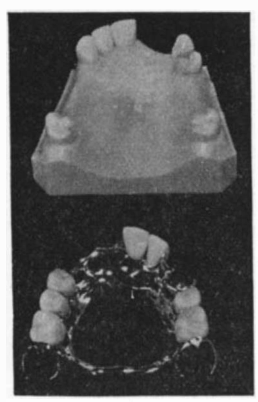
Despite the fact that dentistry can be traced back to long before the Christian era, the present technical and scientific advances have been very recent. A hundred years ago dentistry was not very much different from that practiced by the Etruscans over 2500 years before. The oldest denture in existence was found in the jaw bone of an Etruscan who lived before the Sixth Century B. C. It consisted of four loose teeth secured by a ribbon of gold to the firm teeth on each side of the cavity. Often the teeth in these crude dentures were not human teeth but were carved from the tusks of animals.

For the most part, early Nineteenth Century restorations were similar contraptions of loose human teeth, wire, and springs. Solid plates were being carved from ivory but were little, if any, better and were much more expensive. An ivory set belonging to George Washington is now in a museum. Some work was then being done in Europe with porcelain teeth set in gold bases, but centuries-old processes and designs were most common.

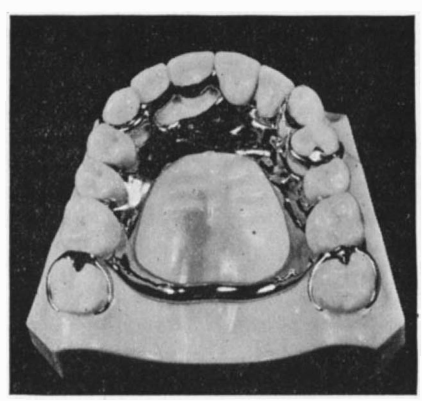
Much of the transformation from these clumsy devices to the durable, comfortable, and good looking dentures of today is due to the application of engineering to dentistry. As the engineer builds a great river bridge, so does the dentist of today make a restoration for the human mouth. He follows the two engineering steps of design and selection of materials, aiming to secure the greatest all-around efficiency from the most suitable materials. Poor design and inferior materials mean failure for both engineer and dentist. Instead of fastening loose teeth in the mouth as of old, the dentist plans a denture that will be strong, long wearing, comfortable, and compatible with the wearer's natural appearance. All of these are important.

The first step for bridge and denture building is design. For the dentist, the design problems are complex and exacting. He is under greater restrictions as to the size, shape, and weight of his structure than is the engineer. Each restoration, furthermore, is an entirely new job, for no two human jaws are exactly alike. The denture must be strong, for the forces exerted by the jaw, in masticating, range from 25 to 275 pounds with different individuals. The dentist must reinforce those points that have to bear the greatest load and shift some of the pressure to less taxed parts.





**Ancient and modern dentures. Above is a crude Etruscan affair of gold and carved animal tusks, dating from 500 B. C. (Courtesy the book "Geschichte der Zahnheilkunde.") At the right and below are views of an elaborate modern denture, with a model of the mouth it is to fit. The latest alloys and porcelain teeth were used to make this one**



The patient's comfort and physical appearance depend on proper designing of the denture to fit the oral cavity perfectly. It is easy to see how a too-large or badly shaped restoration would be painful and would detract from a person's natural appearance.

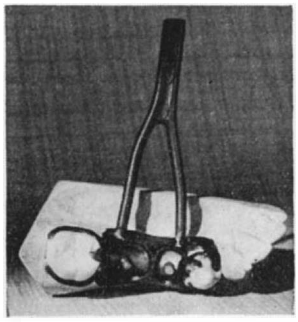
In recent years, the demand for appearance has become almost as important a requirement as comfort and serviceability. This is true not only of people who are continually in the public eye but also for those in ordinary walks of life as well. Hence our dentists have so perfected their processes that most dentures improve the wearer's looks. Also contributing to inconspicuousness are smaller artificial teeth, and precious metal alloys and porcelains which match the natural coloring of mouth tissues and enamel. Dental science has advanced so far that the fulfillment of the esthetic desire does not necessitate the sacrifice of the other desirable qualities in a restoration.

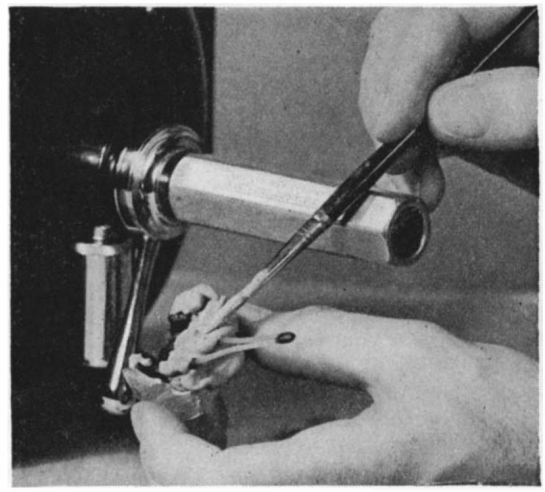
All of the dentist's labor on design would be useless if he selected inferior materials for his dentures. Dentists of the past have used wood, wire, tacks, and both human and animal teeth for restorations. Today, they turn to the many precious metal alloys and to porcelain. Various combinations of platinum, palladium, and gold meet the many present day needs. The premier requirement of a dental metal is an ability to undergo the stresses of mastication without permanent bending or loss of shape. To the patient, this retention of form while in use means a long-lived, comfortable restoration. The clearest examples of this property are the clasps by which partial dentures are secured to the natural teeth. These metal clasps are sprung over the contours of the teeth and, if made of an inferior alloy, would soon be spread and bent out of shape by the pressure of insertion and removal. Frequent readjustment and much discomfort and inconvenience would be the price paid by the patient.

What about the natural teeth still in the jaw? Nothing must be done to harm them and cause their early loss. The dentist, therefore, at every turn selects materials that will not injure them. The alloys must be hard enough to wear well, but must not be so hard that they will abrade the adjacent and opposing teeth. Wear and injury would be rapid if materials harder than the natural enamel were used. Since dentures must absorb the stresses of mastication, resiliency, as opposed to rigidity, aids in preserving the natural teeth.

As temperature has a marked effect on the sensation of tasting, conductivity in full dentures has to be compatible with that of the natural teeth and mouth tissues; otherwise the patient's dietary habits would be violently disrupted. Ability to discern temperature of food and drink at near the natural rate has the added advantage of helping prevent serious mouth burns.

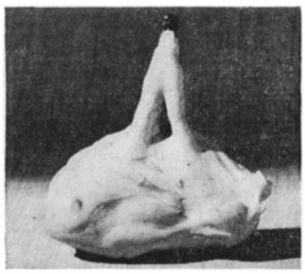
While the dentist was perfecting his dentures, he was demanding better and better materials from the metallurgists and ceramicists. As a result of their mutual cooperation, the producers of precious metals created alloys to meet the increasingly rigid requirements. Further aid came from the Bureau of Standards which began research in 1919 that resulted in numerous specifications for dental metals. Thus the dentist can obtain alloys which accurately fulfill his various requirements.



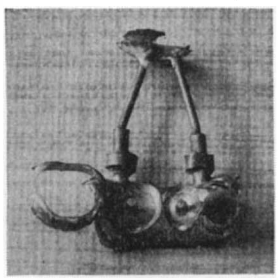


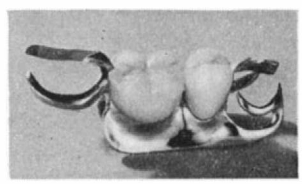
Photos, except Etruscan denture, courtesy J. M. Ney Co.

**Dentures are made by what is essentially the lost-wax process of casting. In the first step, *above*, the denture is formed and sprued (provided with a gate to receive the molten metal) in wax on the model that was made in plaster from a plaster cast of the patient's mouth. Then, *right, above*, the wax pattern is removed from the model and painted with investment, a dense, plaster-like material**



**The wax pattern with painting completed, *above, left*, is placed, point down, in the casting flask *above, center*. The top of the flask ready for casting is shown at *right, above*. This is placed in a centrifugal casting machine, the platinum-palladium-gold alloy is melted with a gas and air torch in a cup before the sprued mold, and the machine is whirled to throw metal into all parts of the mold hollows left by melted wax.**





**At *left* is the rough casting and at *right* is the completed denture after trimming away the sprue metal and any minute roughness, and then polishing the piece**

METALS have been used in dentistry as far back as there is record. Until the middle 1800's, gold retained its place as the premier dental metal. To procure a harder and stronger metal, small amounts of silver and copper were alloyed with gold. Later additions of platinum and palladium were found to give even more desirable physical properties. Experimenters, combining platinum with gold in 1875, found a 12 percent platinum alloy had exceptional strength properties. In more recent decades dental metallurgists investigated palladium for dentistry. It does not have the same weight and cost-limitations as platinum, and may be used in much larger quantities as an alloying element with gold.

In the natural course of searching for the ultimate alloys, dentistry will probably never stray very far afield from the use of the precious metals: platinum, palladium, and gold. Combinations of these meet all of the dentist's requirements for strength. Moreover, all of the precious metal alloys have a hardness compatible with the natural enamel, and a suitable resiliency.

The new alloys and porcelains make possible smaller teeth that previously were not strong enough to be practical. Porcelain has been developed on a mass production basis and, from stock molds, more than 90 percent of the natural teeth can be matched perfectly for size and shape.

Besides being an engineer, the dentist is also an artist. The recent esthetic demands have caused this. Cutting down the size of artificial teeth was a big stride toward the fulfillment of this desire. Teeth, furthermore, are made in shapes to match the three facial forms—square, tapering, and oval. Also contributing to denture appearance is color. Precious metal alloys are available in all shades from platinum-white to yellow for inlays, crowns, dentures, clasps, and wire. Nearly all shades reflect the natural color of the mouth and are therefore less noticeable. Porcelains are also colored to match the natural enamel.

Not only have rapid strides been made in the scientific aspects of dentistry, but also in the training of the practitioners themselves. Webster's first American dictionary published in 1828 defined the dentist as "one whose occupation is to clean and extract teeth and repair the loss of them." What it failed to reveal was that he was also occupied with the business of cutting hair and shoeing horses. Today they must undergo at least six years of intensive university training—two years pre-dental and four years in one of the more than 50 accredited dental colleges in this country.

Dentistry is no longer a hit-or-miss business. When we have need for dental work, we can sit with confidence in the dentist's chair—confidence because we know that he knows what he is doing, that he has the best materials and that he won't spoil our good looks. This is a far cry from the operations of barbers and blacksmiths of a century ago.

# Spare Parts

By G. H. ESTABROOKS
Head of the Department of Psychology at Colgate University

WE are all familiar with certain losses which the human can sustain and still live. An arm, a leg, even both arms and both legs may be amputated. Eyes are very important to happiness but not to life, while, of course, the loss of an ear is a mere trifle. If your teeth don't suit you, get a new set; while the disappearance of one's hair is merely "a sign of intellectuality." Tonsils and adenoids are only encumbrances, while our old friend the appendix is a new version of the white-man's burden.

All these possible alterations we more or less take for granted, but when the surgeon opens up the body and starts tinkering with our "innards," then we feel he is treading on very dangerous ground. And he is. Yet, for all that, large portions of our internal anatomy can be removed, altered, or replaced and we are still a going concern.

Man is like your auto—his engine will keep running after you have removed a whole carload of mud guards, hoods, body parts, even tires. To be sure, it may be a sorry looking wreck with which you end, but the essential life-producing engine, both in auto and in man, will still be turning over even after the wrecker had done a pretty thorough job. Interfere with any vital part of the engine, however, and no matter how beautiful your car—or your human—it is dead on the instant. Modern surgery gives us some fascinating glances at the human engine, revealing to us many "spare parts," once considered essential but without which the human can now function very nicely.

IT is, of course, absolutely necessary that we have a supply of air. Without the oxygen contained in the air, the human engine simply cannot run. Nature, foreseeing trouble in this area, has given us considerably more lung capacity than we really need. We can get along very nicely on one lung or even half a lung, provided we don't go in for athletics.

Man has learned some interesting tricks in handling lung diseases. Tuberculosis, for example, is a very dangerous disease, best treated by giving the involved part complete rest. Then your body handles the bug at its leisure. But how can you put a lung out of action? There are several ways. One is to literally pump you up. Immediately outside the lung is the pleural sac, made up of two very smooth surfaces which slip over each other every time you breathe. Sometimes these surfaces become irritated and you have pleurisy, which can be very painful. So, when the tuberculosis specialist wishes to give one of your lungs a holiday, he punctures this pleural sac with a large needle and pumps it full of nitrogen, using this gas because of its inert nature. This compresses the lung so that it cannot work. The nitrogen will be absorbed only slowly by the tissues, but it is absorbed, for all that, hence every two or three weeks you have to report back and get inflated. *No*—you *can't* insert a permanent bicycle valve and pump yourself up with free air.

Another way in which this lung can be given a rest is to cut the nerve which supplies it. Then the lung is literally paralyzed, and if the situation is handled properly this nerve will grow back again and the lung will be restored to activity at the end of, say, six months. Still another, and much more dangerous way of handling the situation, is the technique of removing an entire lobe of the lung. This is a major surgical operation in which the doctor has to cut through the ribs, the chest wall, and disconnect part of the lung itself. When you realize how great is the blood supply to these parts it is a wonder that death from hemorrhage is not the invariable result. However, this operation is used only as a last resort and modern surgery is making immense strides in controling just such situations.

One of the most curious of all methods in modern medicine is one in which they literally cut your throat in order to make you more comfortable. It sometimes happens that certain nerves supplying the larynx or "voice box" become paralyzed, resulting in a disagreeable situation wherein breathing is very difficult. The intake of every breath requires a gasp but, strange to say, you can breathe out or talk with perfect ease, once you get the air into the lungs. So the surgeon nonchalantly cuts your throat. He bores a neat little hole into the windpipe below the larynx and you breathe in through this. The air also passes out by way of this route—unless you want to talk; then you hold a handkerchief over the hole, thus forcing the air through the vocal cords, and you talk as well as ever. Generally this hole is concealed by a neck band or other covering. You could actually talk to a person who had had such an operation without noticing the injury or suspecting why he kept his handkerchief pressed to his throat.

At times the surgeon finds it necessary to remove the entire larynx. Cancer may render it useless and the disease might also spread to other nearby structures, so he cuts it out and installs one made by Western Electric. Not quite as good as the original, to be sure, but it makes speech possible and you certainly could never contract laryngitis in that contraption.

The so-called "artificial lung" is not a spare part. It is just an ingenious machine for supplying artificial respiration—for forcing you to breathe when the lungs become paralyzed, as in infantile paralysis. Given time nature may —or may not—be able to repair the paralysis resulting from this disease. By "time" nature means from three to six months, a long period to go without breathing. The artificial lung manipulates the pressure on your chest so that air is forced into and out of the lungs. If these recover from the ravages of infantile paralysis, you can be taken out of the "lung"; if not, it is only a matter of time before death ensues. Many people have literally been snatched back from the grave with this spectacular device.

MODERN medicine can do a great deal with the breathing apparatus, but nature flashes a bright red warning light when we approach the heart. The individual's life is in danger when we even touch this complicated and beautifully coördinated blood pump, while only the most skilful surgeon dares operate. Even so, his invasions are confined to the surface of the organ. Instant death would be the result of any such liberties as he might safely practice with the lungs. To be sure, we may tie off an artery or even remove a vein, and so modify circulation, but the heart we must respect. Even this matter of tying off an artery is not so simple. If, in an automobile accident, you cut the great artery leading down your leg or arm, the surgeon will probably amputate irrespective of bone conditions. You have cut off the blood supply, which may easily lead to gangrene, and just about anything is preferable to this form of tissue clot.

Of course, in one sense of the word, your blood is really a spare part. To be sure, you cannot live without it, but the doctor can remove a couple of quarts of blood without doing you any particular harm. This he can then inject into the veins of a very sick patient, who for

## The Human Body Contains a Remarkably Large Number of Parts Without Which it Can Survive or Even Function Normally . . . Some are Duplicates

one of many reasons may need blood, and so save his life. He has to be very careful that you are in the same blood group as the recipient and, needless to say, must exercise every precaution that you are not suffering from any disease, such as malaria or tuberculosis, which can easily be passed on by blood transfusion. But there are less obvious dangers. I just noticed that a case of hay fever has been thus transmitted. Probably all these allergic conditions act thus, while immunities, even susceptibilities to certain other diseases, may be passed along by way of the blood route. Of more interest is the trick of inserting glucose directly into the veins. Sugar is the fuel on which our engine runs and this insertion of it is of tremendous importance in certain cases where the patient has not the time or the ability to take in the food by the stomach.

The endocrine glands are now almost being relegated to this spare part rôle. We cannot do without them but we can prepare their secretions outside the human body and inject them should the gland become diseased. Diabetes was once practically a death sentence. It is caused by the absence of insulin secreted by cells in the pancreas. We now manufacture this substance from animal glands and the diabetic can be healthy and happy with his hypodermic needle, if he just won't overdose or underdose. If he does, then insulin shock or diabetic coma offer a quick and painless road to eternity. The deadly Addison's disease, caused by a deficiency in the cortex of the adrenal gland, we now control by the recently discovered "cortin." The thyroid gland can cause any condition from idiocy — the cretin — up to a maniac state of insanity—which often accompanies exo-pthalamic goiter. The cretin we can at least help by injecting thyroxin and in the maniac state, caused by too much thyroxin, we remove a large part of the gland.

In certain rare cases man loses the four little parathyroids in the neck. This was almost invariably fatal until a Canadian discovered an injection which keeps the patient alive. These little glands are literally spare parts. If the individual can live six weeks after their removal, the body will compensate for the loss and he is healthy without either the glands or their secretion. Several of the glands, however, still hold their secrets. We cannot prepare the secretions from the pineal, thymus, or pituitary. One obvious solution to this gland problem would appear to be that of grafting, but grafts have been quite unsuccessful except in certain cases associated with the sex glands and these are questionable.

Plastic surgery of one kind or another gives us startling examples of interchangeability in body parts. These days of automobiles yield some bad face wounds and here the plastic surgeon does his most spectacular work. A new nose bridge, jaw, or other facial part needs only live bone tissue and proper modeling for a graft — and any of us can spare a rib. So the surgeon converts part of a rib into a nose bridge, borrows a few square inches of skin from your chest to make an upper lip or a cheek, does a very neat job of sewing things up, and you'll pass at tea in any drawing room. Grafts of skin, bone, and muscle are also possible in other parts of the body, ravaged by disease or accident.

FROM the biologists' laboratories we are getting some very fascinating hints as to possible developments along these lines. The biologists have found, for example, that they can graft eyes, in the case of the salamander. The new eye grows into place and apparently functions quite as well as the old. With insects they can even take developing eye tissue, shift it to a totally different part of the body and get an eye on abdomen or tail. One enterprising biologist has transferred heads in insects, even to different species! Needless to say, such experiments have no practical value whatsoever to the human — but give us time. In all great centers of research humanity is literally following Aristotle's great dogma: "The highest study of man is man."

Some of the surgeon's most spectacular work in this spare part field is found in operations on the food tract. We regard the stomach, for example, as essential to human life. But you can get on very nicely without a stomach. You may have to watch your diet a little more carefully or eat at different intervals than you do at present, but when your stomach becomes cancerous or the walls become weakened with gastric ulcer, the surgeon may take the whole thing out and call it a day. The food then enters the small intestine direct, without this stomach stop-over. The main task of this organ was to break down proteins, a job which is also done in the intestines, so it merely means that certain intestinal juices have to work overtime.

Similarly, we find that you can lose a yard or two of small intestine with no particular discomfort. The whole of this 30-foot organ is used for digestion; that is, to break down food substances into very simple combinations which can then be absorbed through the intestine walls, thus entering the body proper. The small intestine is really more important to digestion than is the stomach, but there is a lot of it. So a few odd yards don't really count too heavily.

And the same applies to the large intestine, the colon. Here, waste from the food is stored prior to being ejected from the body. A certain amount of absorption takes place, but the colon is also a potential seat of infection. It is an easy matter for this food waste to start decaying and this may quickly infect the intestinal wall, especially if its free passage from the body happens to be blocked. So, when this condition occurs, the surgeon may remove the entire colon, having the food leave the body directly from the small intestine.

We seem to get on very nicely without the gall bladder or the spleen, two organs whose functions are still more or less of a mystery. Nature draws a line, however, at the liver. This organ is the body's gasoline tank. Here the muscle fuel — sugar — is stored prior to use and nature will not allow any tinkering with the fuel supply.

Kidney function is of vital importance to bodily health. The kidneys are responsible for removing waste products of a great food group, the proteins. Interference with this function to any degrees is dangerous. Its stoppage results in death: the body simply clogs with its own refuse and the machinery stops. But nature seemed to realize that infection or injury here might be very probable, for the kidneys, from the nature of their work as refuse removers, can easily become infected. So we have two kidneys, always in running order and always functioning, but we can get along very nicely with only one. When necessary the surgeon can operate and remove an infected area of a kidney or a whole kidney, if necessary.

Similarly, the bladder may become involved. This condition is not as common as is kidney trouble, for the bladder is a very simple organ, in striking contrast to the very complicated structure of the kidney. Nevertheless, disease may occur here and, when necessary, the doctor adopts heroic methods and removes the entire organ, with no serious danger to the patient's health but considerable inconvenience as to habits of cleanliness for his remaining life.

Nature exercised the greatest foresight in the care of the brain, the control station for the human engine. Not only did she enclose the brains in a case of armor—the skull—but she literally gave us two sets, just in case one got put out of action in the battle of life. Generally speaking, the human body is controlled from the left hemisphere of the brain. In left-handed people this localization of control is reversed, but the general principles remain the same. So unimportant, indeed, is this unused side of the brain that it would be quite possible for a skilful surgeon to remove the entire right hemisphere in a right-handed individual without causing any serious effects. Death, in the case of head injury, is because of blood pressing on certain structures at the brain base which control the action of heart and lungs. The injury can be extensive but if no pressure is put on these parts the individual will not die. Indeed, the odds are all in favor of his recovery, especially if he is young.

One very curious fact about the brain is the very clear-cut localization of certain functions. For instance, if you are a right-handed individual, you hear with the left side of your brain, just in from the temple. You see, curiously enough, in the extreme back of your head, left side. This is where the nerve from your eyes ends. You feel a burnt finger near the top of your head, just forward of the center line. You talk with the extreme front of your brain, just over the eyes, and you play the piano, another motor activity, a little above your speech area, both left side. If you are left-handed, reverse the sides and you have it. If ambidextrous, heaven only knows what you do, but you probably favor the left side.

A FRENCH-Canadian friend of mine was hit in the head by a shell fragment. The left side of the skull above the ear was so fractured that a large silver plate was installed in its place. The brain was, of course, badly injured. The shock rendered him unconscious for a couple of weeks. On recovery he presented a fine example of auditory aphasia, that is, loss of memory for all sounds. He couldn't speak and he couldn't understand what you said, for the auditory memories were all wiped out. But the right side of his brain was unhurt, so nature switched over to this "spare part." He learned very rapidly to speak, although he never did get back his native tongue, French. A brilliant philosopher before his wound, his later views on Aristotle would have disgraced a college freshman, but he relearned his military manual in short order, returned to the front in a year's time, and ended as a colonel of infantry!

Nature will make interesting use of these spare parts in the brain when forced so to do. For instance, we take a rat and teach him a visual discrimination test, such as to distinguish between a square and a triangle: you feed him on the square but when he trespasses on the triangle he gets his paws shocked. So he learns very quickly. Like all mammals, humans included, he sees with the back of his brain, and there are stored his visual memories. Now we operate on this section of his anatomy, removing the brain tissue next the visual nerve's end. On recovery he has completely forgotten his trick, but he will learn it or a similar one again and just as quickly, using brain tissue farther removed from the nerve ending. In other words, these large, so-called "blind areas" of the brain are simply masses of reserve brain cells, of spare parts, waiting to function if and when necessary.

Some of the problems presented by these curious shifts in control are still very obscure. For example, the so-called primary motor area is situated roughly above your ears. When you have a "stroke," it is generally caused by a blood vessel bursting in this area and paralyzing the motor nerves which control arm, leg, or what-not. Such a mishap is very serious in those of advanced years. Now, suppose we operate on a dog and carefully remove the motor area that supplies his hind legs. On recovery he is, of course, paralyzed. Then a very curious thing happens. At the end of a month, he begins to regain the use of his legs. In two months he is as good as new. And, to be quite frank, no one knows where the control has gone. Nervous tissue never grows back, and in this case the neighboring tissue does not take over the management. Our best research men have written reams on the subject, but that particular spare part is still missing. It's like having an extra timer in your car, of whose presence you are certain but which is so cleverly concealed that the best mechanic in the country cannot locate it.

The medical eye of the future will be even more concentrated on this problem of spare parts. Three groups of diseases are steadily increasing in frequency. These are diseases of the heart or circulatory system, of the lungs or respiratory system, and finally our old enemy, cancer. The reason for this increase is obvious. Your life expectancy has jumped from about 20 years to over 50 years in the past century. We won't let you die of tuberculosis, typhoid fever or smallpox, but you've got to die of something sometime. The machine just wears out, like any other engine and the two pumps, air and blood, generally go first. Perhaps some day we may literally have an artificial heart or lung.

Cancer is the very worst example of a misplaced spare part. It is simply ordinary body tissue gone wild. Some cells in your skin, stomach, bone, or brain decide they are going to grow and do so, invading other organs and crowding everything out of place. Here are spare parts which could easily be spared with loss to no one. The dickens of it is that there is no germ to jump on—just ordinary body tissue and anything which kills this cancerous tissue will probably kill the other body parts at the same time. This is about as neat a stalemate as anyone could name; yet even here there is hope, for this cancerous tissue has certain peculiarities which may some day prove its undoing.

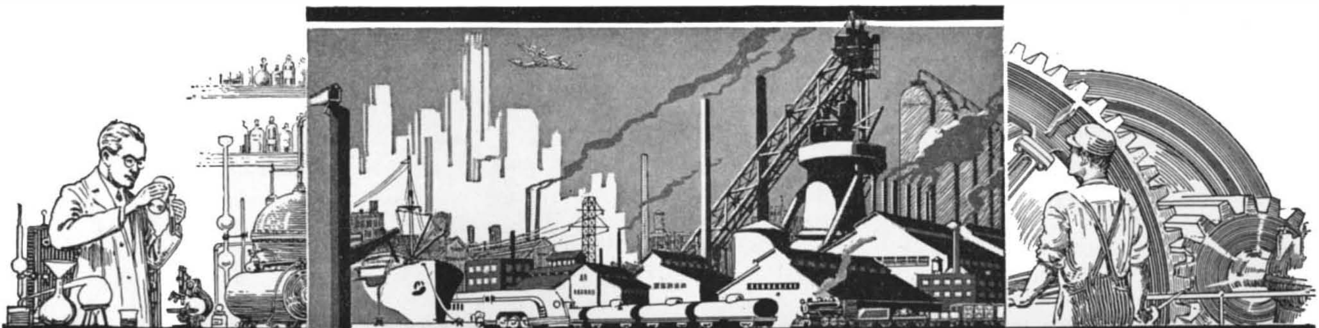
But we must have patience. Medicine with its allies in other sciences will continue to master the secrets of man, the machine. All it demands from the layman is an enlightened ignorance—in other words, co-operation, but not interference. Here, as nowhere else, a little knowledge may be a very dangerous thing.

INTERESTING, also, are certain "spare parts" which man has added of his own accord. It seems fairly certain that he evolved in a sub-tropical or tropical climate. Here he could survive very nicely without a coat of fur; also, as a forest animal, he needn't worry about too much sun. But ambition has always been his downfall. First, he decided to leave his forest, then to go north. That meant clothes, for his naked skin was poor protection against blizzard or the burning heat of the tropical veldt.

These spare parts became just as necessary as many we have mentioned. If you were a savage or even an early colonist in, say, northern New York State, and had your choice of living without your clothes or losing an eye, you would make the best of a bad bargain and part with the eye. Therefore, to early man came more demands for spare parts. Furs and a fire can support life even in Canada, but if man is to have any peace of mind some form of house is absolutely necessary. Hence this tropical animal endowed with intelligence moved his southern climate north in the form of an artificially heated home. When winter comes, he hibernates—with brief excursions into the outside world for farm chores, a dash to the office, or a ski trip. Yet, take away his clothes, rob him of his fire and the wolves could have all America north of Mexico, with some of the Mexican highlands thrown in!

The trend of evolution seems fairly clear. Man will add more of these external spare parts and lose some of those in his own body. Your glasses are becoming more and more essential. Even the auto and the radio have almost become essential to human existence, not to mention many older inventions. On the other hand, man's teeth are going. They already are baby-like compared with those of the Java man, the Piltdown man or the Heidelberg man, his precursors of a mere few hundred thousand years back. His little toe is also on the way out.

However, a good many of us suspect that man himself will fool Mother Nature and prevent further evolution—simply by himself becoming extinct within the next 100,000 years.



# SCIENCE AND INDUSTRY

## A MONTHLY DIGEST

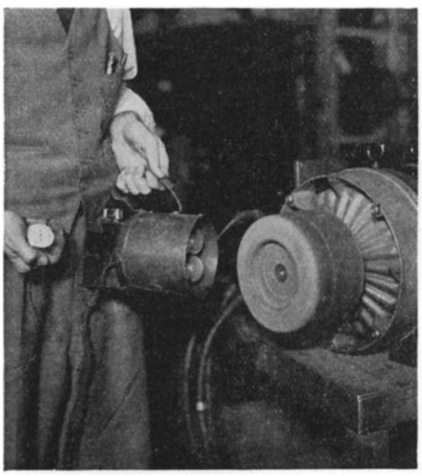
**Conducted by F. D. McHUGH**

**Contributing Editor**
**ALEXANDER KLEMIN**
**In charge, Daniel Guggenheim School of Aeronautics, New York University**

### NEON LAMPS SIMPLIFY SLIP-SPEED CHECKS

IN addition to the more involved and more expensive stroboscope equipment with which the test department of The Reliance Electric and Engineering Company is supplied for obtaining speed values of alternating-current machinery, its engineers have devised a simple, portable unit, using neon lamps, which is ingenious and as easy to use in the field as in the shop.

Four, clear bulb, three-watt, neon glow lamps in a group, arranged as shown in the accompanying illustration, are used. This is



**A simple hand-held neon lamp unit accurately checks A.C. motor speed**

necessary because the lamps are made for 115-volt circuits and to use them directly in the motor circuit, as must be done in testing, requires that provision be made for operation on 220 volts and on 440 volts.

Four standard lamp bases are mounted on a small board. A conical hood of steel, painted black inside, serves to keep out other light rays. On the back of this board is mounted a switch for connecting the lamps for either 220 or 440 volts.

The neon lamp can be used for obtaining the slip-speed of any alternating current motor with the exception of high-slip motors, operating at more than 100 revolutions per minute slip. The device is easy to use by directing the light on the end of the shaft and counting the number of revolutions per minute of the keyway or other fixed parts on the rotating element. Marking the end of the shaft with a single chalk mark simplifies the counting, and using a stop watch increases the accuracy of observance of the time interval used. Subtracting the slip revolutions per minute from the synchronous speed gives the motor speed.

Of course, in a plant where all alternating current comes from the same source of controlled frequency, only a single neon lamp is needed.

### WEIGHTING "TOP-HEAVY" DESTROYERS

TOPHEAVINESS in 12 American destroyers, subject of much recent discussion, can be corrected by adding 40 or 50 tons of lead to the keel of each ship, rearranging stores, and removing some of the deck furnishings, Navy engineers state. Total cost for work on the entire group of 12 destroyers is estimated at between $600,000 and $1,000,000.

Weighting the keels may reduce speed by about half a knot. This, however, is not regarded as serious, since the ships, designed for 37-knot speed, actually made 39 on trials.

The destroyers of this group are among the most formidable armed craft of their class in the world. On a designed displacement of 1570 tons, they carry 12 21-inch torpedo tubes, five 5-inch guns, and a number of lighter anti-aircraft pieces. The 5-inch guns in all recently built American destroyers can also be trained for high-angle fire against aircraft.—*Science Service.*

### KOROSEAL PAINT FOR CORROSIVE CONDITIONS

AGAIN extending the use of its recently introduced synthetic elastic, Koroseal, The B. F. Goodrich Company announces a new Koroseal paint, designated as No. 495 Korolac. A Korolac primer for use with the new paint is also available.

The new paint gives a semi-gloss black finish and is recommended wherever extremely corrosive conditions disqualify any other kind of paint or coating. Applied to metal surfaces after they are prepared as for any other kind of paint or lacquer, the primer forms a strong bond between the Korolac and the metal itself.

Korolac No. 495, when thoroughly dry, will withstand all acids, alkalies, and salts in the concentrations commonly met with in industry, up to temperatures of 150 degrees, Fahrenheit. It is not affected by chrome, nickel, cadmium, zinc, copper, brass, silver, or tin plating solutions, nor are such solutions contaminated or fouled by the paint when it is thoroughly dry.

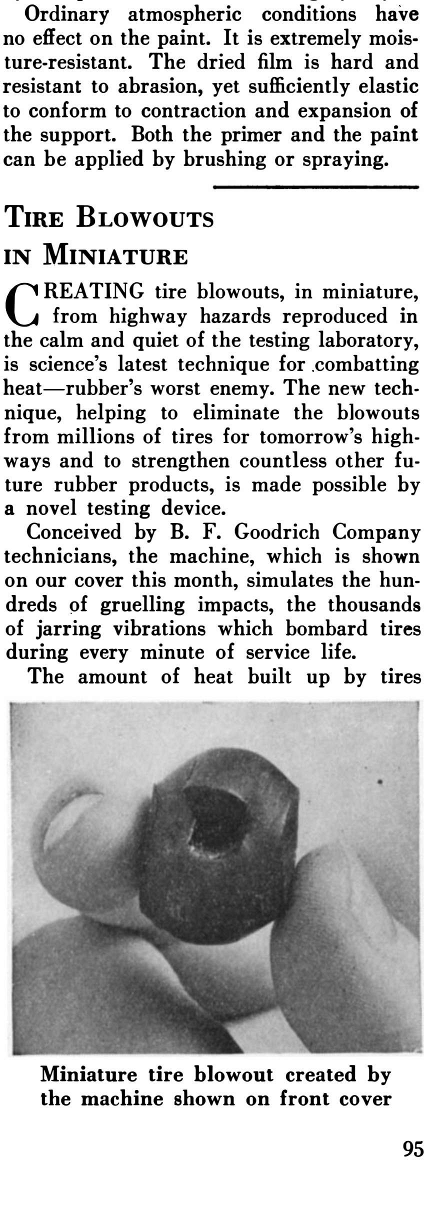
Ordinary atmospheric conditions have no effect on the paint. It is extremely moisture-resistant. The dried film is hard and resistant to abrasion, yet sufficiently elastic to conform to contraction and expansion of the support. Both the primer and the paint can be applied by brushing or spraying.

### TIRE BLOWOUTS IN MINIATURE

CREATING tire blowouts, in miniature, from highway hazards reproduced in the calm and quiet of the testing laboratory, is science's latest technique for combatting heat—rubber's worst enemy. The new technique, helping to eliminate the blowouts from millions of tires for tomorrow's highways and to strengthen countless other future rubber products, is made possible by a novel testing device.

Conceived by B. F. Goodrich Company technicians, the machine, which is shown on our cover this month, simulates the hundreds of gruelling impacts, the thousands of jarring vibrations which bombard tires during every minute of service life.

The amount of heat built up by tires

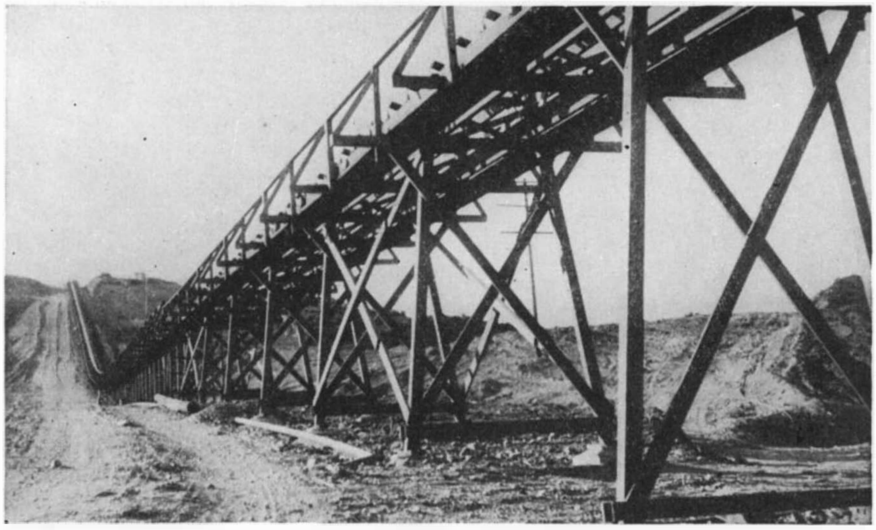


**Miniature tire blowout created by the machine shown on front cover**

under various conditions is charted by the machine using tiny cylinders of rubber, about as thick and half as long as your little finger, or equally small blocks of rubber and fabric, as test samples.

These sample "tires," each cut out of finished tire tread compounds or carcass constructions, are pounded with 1800 impacts a minute until the inside rubber is changed by the intense heat to a liquid and gaseous mass which blows out.

Already rubber compounders are converting technical data from tests on the machine, known as the Goodrich Flexometer, into sturdier and safer tires and other finished rubber goods.



Typical conveyor belt installation such as that described on this page

## Longest Belt Conveyor

CONTRACT for manufacture of the longest belt-conveyor system ever installed (9.6 miles, from Redding to Coram, California) for use in connection with construction of Shasta Dam, has been awarded The Goodyear Tire & Rubber Company and currently is in process of production in its Akron factories, for the Columbia Construction Company, Inc., of Redding. The complete system will be twice as long as the largest ever built previously.

The Columbia job will require approximately 20 miles of 36-inch wide, six-ply, long staple cotton, rubber-covered belting, weighing approximately 1,500,000 pounds. It will be installed in 26 endless, vulcanized-on-the-job units for a continuous haul of sand and gravel up to six-inch cobble from the Columbia Company's gravel pits at Redding to the working area for the Shasta Dam at Coram. Shasta Dam is being constructed as part of the federal flood control project for the Great Central Valley of California, to harness the waters of the Sacramento River.

Roughly following the general contour of the rolling desert intervening between Redding and Coram, the belt-conveyor will begin its haul at an elevation of 490 feet, carry through a pass at a maximum altitude of 1450 feet and make delivery to its extreme northern terminal at an elevation of 650 feet. Installation is scheduled to be completed by March 1, 1940 and the system placed in operation by April 1, 1940.

The conveyor system will be erected on wooden bents varying in height above the ground from four to 90 feet and will require the use of 12,500 steel troughing idlers. The 26 terminals, at which links of the system overlap, will be of combination steel and wood construction. Dumping from one unit to another at the 25 transfer points will employ the use of steel chutes.

The 26 links of the system each will be motivated with 200 horsepower electric motors, except the three most northern units which will generate power because they are down-grade, or lowering conveyors. The component weight of the material on the slope makes these belts self operating.

Capacity of the system will be 1100 tons per hour while conveying at a speed of 550 feet per minute. Material in transit will be on the conveyor one hour and 40 minutes between extremities. Four years of operation will be required to meet the total requirements of the dam construction project, estimated at 10,000,000 tons.

## Labels Printed on Glass

BEAUTY is combined with utility in the new Anigraphic Process for printing labels on glass. With this process, existing product labels may be duplicated with exact fidelity of detail and color combinations, or they may be applied without a background so that the contents of the container will show through the label. Anigraphed labels may be washed and are resistant to ordinary solvents and abrasion.

The new process is similar to lithography and is applied with a press directly to the surface of the container in one, two, three, or four colors in perfect register at one operation. When the container is placed in an oven, a moderate temperature fixes the ink, and the container is then ready to use.

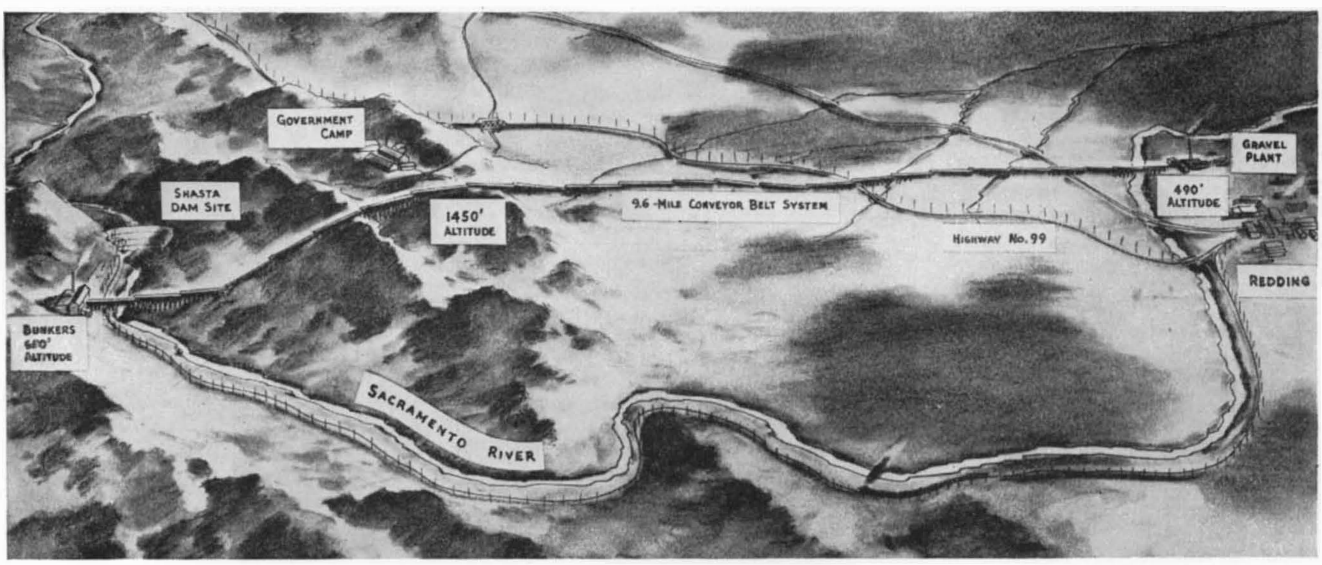
**RAZOR BLADES**

**A SINGLE ton of high-carbon. cold-rolled strip steel will produce a million safety razor blades.**

## New Division of Living World Proposed

THE old classical division of the world of living things into the plant and animal kingdoms should be revised. Dr. Herbert F. Copeland of Sacramento Junior College recently told a Botanical Society of America meeting.

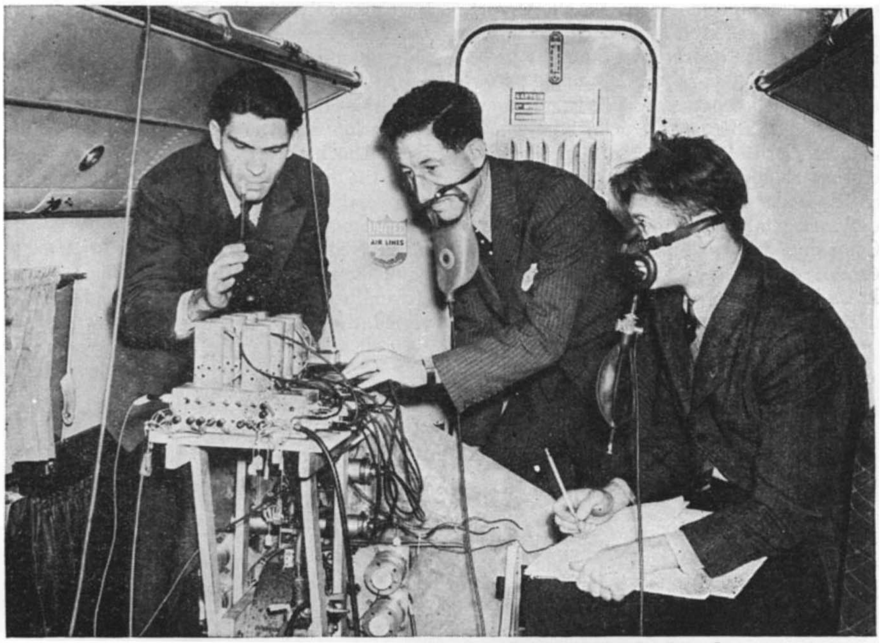
Proposals put forward by Dr. Copeland included the setting up of two new "king-




Artist's sketch of the long conveyor belt being installed at Shasta Dam, California doms." One, including bacteria and certain other lower forms known as the blue-green algae, he would call the Monera, a term coined in the 19th Century by the German biologist Haeckel. The second, to include fungi and the red and brown algae, he would entitle the Protista.—*Science Service.*

## Photographing Mesotrons At High Altitude

IT is interesting to note one of the services which superchargers are rendering in scientific research. A Douglas DC-3 transport airplane, operated by United Airlines, equipped with supercharged Pratt & Whitney engines, recently and unwittingly broke the world's altitude record for the type of aircraft by flying to a height of 28,900 feet. It carried two scientists of the University of Chicago, engaged in photographing mesotrons, the heavy radioactive components of cosmic rays. The plane remained aloft for three hours and a half with the outside temperature at 30 degrees below zero, Fahrenheit. The two scientists used 800 pounds of equipment; photographic plates were exposed at the highest point of the flight. As can be seen from our photograph, occupants were quite comfortable without overcoats, but had to wear oxygen masks.


Equipment for photographing cosmic rays at high altitudes

The flight was part of the cosmic-ray investigations being carried on by Dr. Arthur H. Compton, Nobel prize winner, who maintained contact with the plane by radio.—*A. K.*

## Operating the Turbo Supercharger

WRITING in the *Air Corps News Letter,* Captain Donald J. Keirn presents some interesting thoughts on the airplane supercharger and its operation. While the airplane supercharger is at least 20 years old, it has so far been installed on only a comparatively small number of Army planes, and only a minority of Air Corps officers are familiar with its operations. Yet the supercharger today is extremely simple because an automatic regulator maintains sea-level pressure in the air supplied to the carbureter up to the "critical" altitude of 25,000 feet. The pilot merely sets the turbo regulator control to the desired pressure on a manifold gage, and then controls the engine by means of the throttle in quite conventional fashion.

Essentially, the turbo supercharger is a gas turbine coupled directly to a centrifugal air compressor. The gases in the exhaust manifold of the engine are well above atmospheric pressure (even at sea-level) and have a tremendously high temperature. Thus they contain a tremendous amount of energy. The exhaust gases expand to three or four times their original volume and down to the atmospheric pressure of the altitude at which the engine is operating. In so doing, they attain a tremendous velocity and this high velocity drives the turbine at 20,000 revolutions per minute. The centrifugal compressor coupled to the turbine compresses the rarefied air of high altitude and the power of the engine is thereby maintained.

Why is there the "critical" altitude mentioned above? Because the power of the exhaust gases remains practically constant. The gage reading of the centrifugal compressor becomes very low at 25,000 feet. With constant power and decreasing load, the turbo supercharger would revolve at a dangerously high speed and, to prevent this overspeeding, some of the exhaust gas must be by-passed, and less power given to the turbine. Then the compressor receives less power, the incoming gas is not brought up to sea-level pressure, and so, beyond the critical point, the power of the engine, constant hitherto, begins to drop off fairly rapidly. — *A. K.*

## Airline Feeder System

THE airmail pick up system recently described in Scientific American is one means of extending the benefits of air transport to small cities and towns. Airline feeder systems is another. Therefore, it is gratifying to learn that Airline Feeder System, Inc. (with Richard T. Crane as president, and Bernt Balchen, noted pilot-explorer, as consultant) is applying to the Civil Aeronautics Authority for a Certificate of Convenience and Necessity permitting operation with airmail, passengers, and express to serve 34 cities in 15 eastern, northern, and southern states on a route of 2906 miles. Many of these cities—Bridgeport, Elmira, Syracuse, Knoxville, and so on—have hitherto not enjoyed air service. The new airline is so laid as not to duplicate existing services and to feed into the main airlines. Nothing will be more helpful to the extension of American air transport facilities.—*A. K.*

## Smoke Jumpers

WE recently described the experiments to be made by the Forest Service of the Department of Agriculture in dropping fire fighters by parachute. These experiments, conducted in the Chelan National Forest, Washington, have proved entirely successful and the "smoke jumpers" will be of inestimable value in preserving our forests. The latest account of these tests yields interesting information.

The forest fighting 'chutes are 30 feet in diameter (much bigger than the ordinary 'chute) and descend at only 12 feet per second. With this slow rate of descent, and flaps which permit the 'chute to be guided, a jumper can select his landing spot comfortably. Even at altitudes of 8000 feet, where the thinner air gives less support, there is very little hazard in landing. Parachute jumpers who had been fearful of the prospect of landing among tree branches were surprised to find that trees, located close together, acted somewhat as springs to cushion the landing and are preferable to hard, rough ground. Rips and tears seldom occur in the silk canopy, and there were no instances of a canopy catching, then slipping, and finally dropping through the trees. In other words, either the jumper comes straight through to the ground, or he is held securely suspended as shown in one of our photographs.

The standard type parachute-harness


Photo by U.S. Forest Service

**Parachute jumper wearing protective suit and helmet, and carrying 'chute and coil of landing rope**

Photo by U.S. Forest Service

**A "smoke jumper" preparing to disengage himself from his parachute harness and descend to the ground**

proved a handicap in tree landing. When a man hangs suspended from the crown of a tree, the pressure on the leg and chest straps of an ordinary harness is so great that he is unable to unsnap the connections and get free. Therefore, the harness has been made so that it can be detached from the shroud lines. When a man is caught in the trees, he detaches himself from the 'chute and reaches the ground by a rope which he carries.—*A. K.*

## Shoulder Safety Belts

RECORDS of accidents suffered by Air Corps pilots recently revealed a larger number of injuries to the head and face than to other parts of the body. The reason is that the lap-type safety belt prevents the lower part of the body from being thrown forward; in case of a crash, the upper part of the trunk and the head are unrestrained and jack-knifed forward and the head strikes the instrument panel or other structural parts of the airplane. To meet this situation, the Matériel Division of the Army Air Corps has developed a shoulder-type safety belt.

In appearance, the shoulder safety belt resembles a pair of suspenders. The front ends are latched to the standard lap-type safety belt; the back ends are anchored to the airplane seat. The shoulder belt can be loosened or tightened separately from the lap belt, but, when desired, lap and shoulder belts can be released simultaneously.

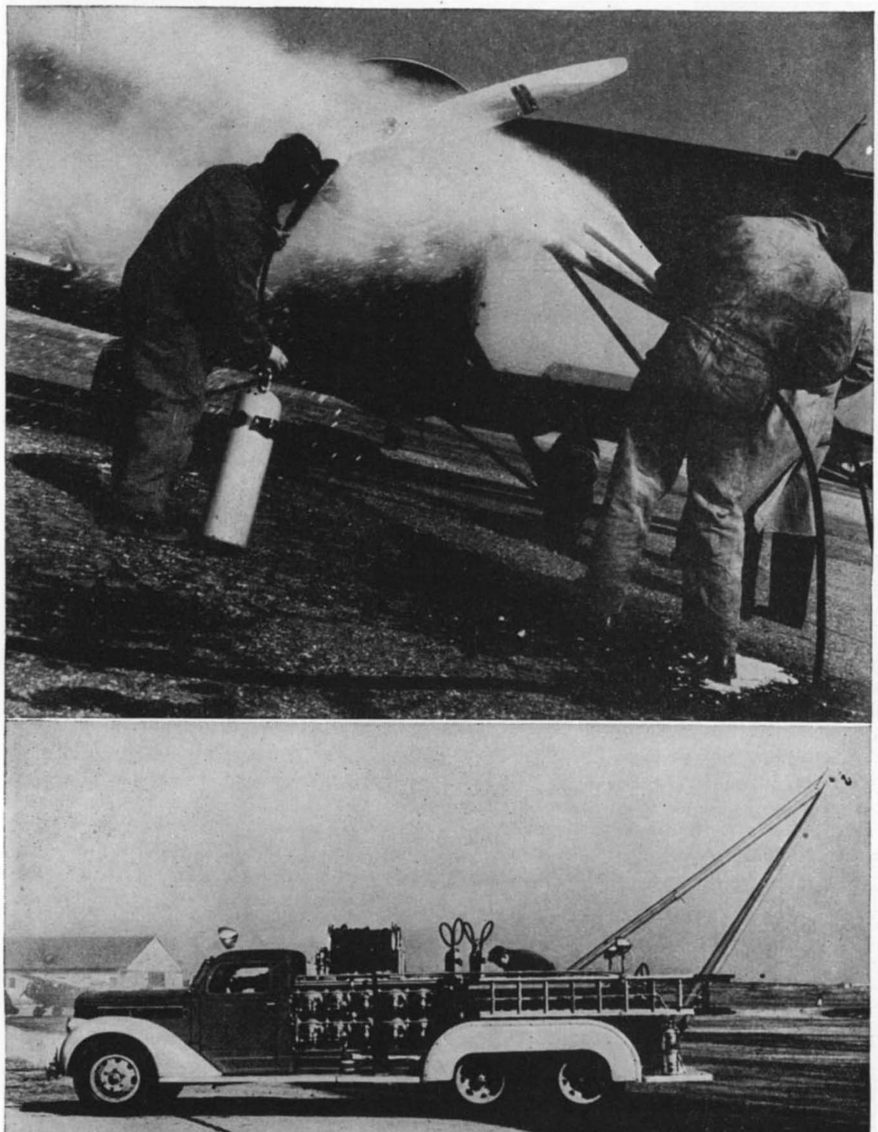
Laboratory tests have proved more than satisfactory. The pilot's adjustable seat, with pilot in it, was suspended in a horizontal position from an overhead beam. Through a trip mechanism, the seat could be dropped a predetermined distance and abruptly stopped in its fall by means of a chain suspension. An accelerometer measured the number of "g's" developed. Due to the hazardous character of the task, or because he weighs a convenient 200 pounds, it was Captain Harry G. Armstrong, Director of the Physiological Research Laboratory at Wright Field, who was the human guinea pig. In a number of drops he felt the slight cutting action from the edges of the lap belt but experienced no pain or discomfort. On the basis of these tests, it is estimated that an enormous impact deceleration of 30 times gravity would cause no injury to the pilot. If service tests are as favorable as experimental tests, the shoulder belt will become standard Air Corps equipment, with added safety for our pilots.— *A. K.*

## Fire-Fighting at North Beach

THE magnificent North Beach Airport, La Guardia Field, has been splendidly described and illustrated in the daily press. There is one item of the equipment, however, which has passed relatively unnoticed —the fire-fighting crash truck. Safety measures at North Beach are so complete that crashes should be rare, yet they must be anticipated. A huge and speedy truck, designed and built by Walter Kidde & Company, carries hundreds of pounds of carbon dioxide which is ejected through hoses in the form of gas to smother, within a few seconds, gasoline or oil flames following a crash. The principle of smothering fire with carbon dioxide gas has been well tried in electrical generating plants, cargo ships, and other industrial applications. Rushing out of high pressure cylinders, it dilutes the atmospheric oxygen and chokes off combustion. The same gas is used in the fire-fighting equipment now carried on practically every airplane. In such installations, fire in the engine compartment automatically releases the heavy carbon dioxide.—*A. K.*

## A Curtiss Navy Scout

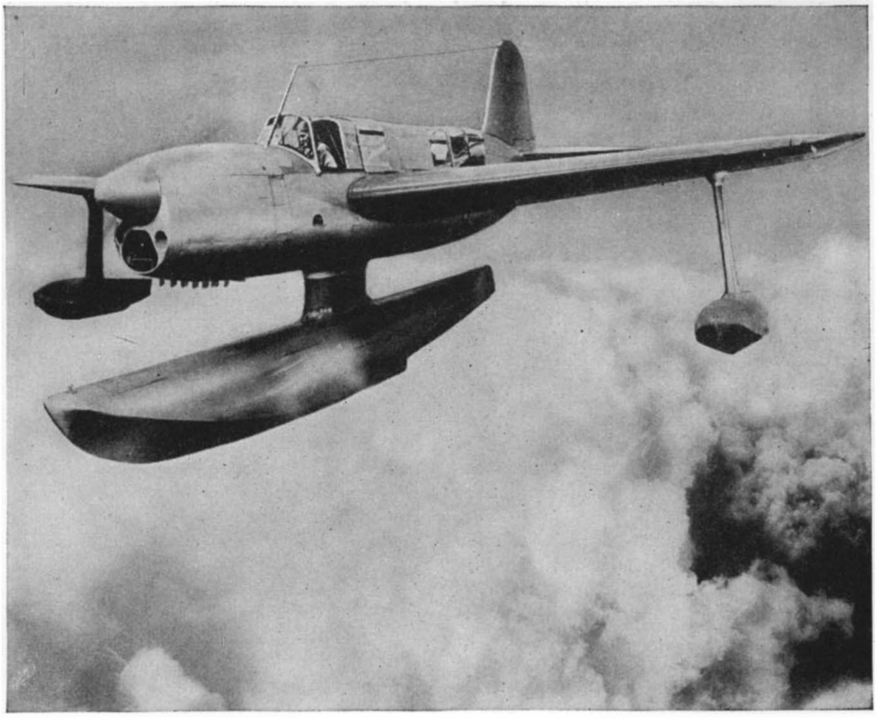
THE XSO3C-1, a two-seater scout and observation plane built for the Navy by Curtiss-Wright, has passed its tests in excellent fashion and has attracted favorable attention. It is equipped with the 12-cylinder Fairchild Ranger "V" engine, which is inverted and air-cooled. But a short while ago, the radial air-cooled engine seemed to have displaced every other type. Now the fine Ranger engine is being put into service in a number of ships. One of our photographs reveals some of the reasons for revived interest in the in-line air-cooled type; the nose of the fuselage is beautifully streamlined, and, with the cylinders inverted, the pilot has a splendid view ahead.



**Fighting a plane fire with $CO_2$ and *(bottom)* new airport fire-fighting truck**

In spite of the moderate power of the Ranger (in the light of modern standards), the Curtiss machine has high performance and long range, for a seaplane of the observation variety. The central main float is braced to the streamlined fuselage by a single cantilever strut. The tip floats, which provide lateral stability in the water, are also supported with a minimum of bracing. In addition to fine lines everywhere, a "mid-wing" is employed, that is a wing which is placed neither at the top of the fuselage nor at the bottom. The "mid-wing" involves some difficulty in the "carry through" of the loads between the wings on each side, but also provides the best aerodynamic solution.

While the experimental aircraft is a seaplane, the float system is interchangeable with a landing gear. Such observation machines are now aboard Navy battleships and cruisers.—*A. K.*

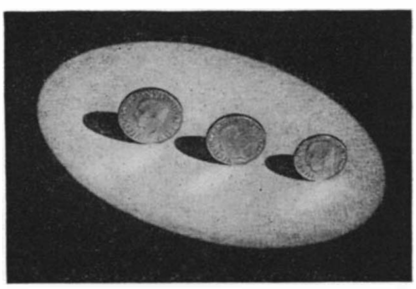


High performance and long range are features of the XSO3C-1 Navy scout

## Stainless Steel Coins

PROPER acknowledgement and thanks should be due from the Italian Government to one of our readers, Mr. John H. Pearce of Seattle, Washington. Mr. Pearce suggested back in 1932—and we published his suggestion in full—that stainless steel coins should prove far more satisfactory, for a great number of reasons, than coins of other metals usually used. Among other advantages of the stainless metal, our article said that it would be as cheap as, or cheaper than, the copper that now goes into our cent, that it would not corrode no matter how long it is hoarded in the child's bank or handled with perspiring hands, that it would wear longer because it is harder, and that it would leave no disagreeable odor on the hands.

So far as our records show, Mr. Pearce's suggestion was the first such ever made, and now the Italian Government's use of



stainless steel to make coins is the first such use. Several new Italian coins made of the metal include the following pieces: 20 and 50 centissimos, and the 1 and 2 lire pieces. The special type of stainless steel used contains 22 percent chromium, 12 percent nickel, and a small amount of molybdenum.

## Pruning Tools Spread Sycamore Disease

THE disease of the London plane tree and native sycamore, now a killing epidemic in Philadelphia and Baltimore, can be introduced into even very small wounds in healthy trees, by pruning tools, according to tests by Dr. J. M. Walter of the Division of Forest Pathology, Bureau of Plant Industry. The London plane, commonly called a sycamore in this country, differs from most trees in that it grows well in cities. The plane-tree disease was first noticed in Philadelphia, and has been found in New Jersey, Washington, Virginia, North Carolina, West Virginia, and Mississippi.

Doctor Walter urges special care—by tree surgeons and others pruning and caring for trees—in the careful disinfection of tools before they are used again on healthy trees. Wash the tools in alcohol, he says. While the disease occurs in the large cities chiefly on the London plane tree, it has been found elsewhere in smaller towns on the American sycamore.

Small samples of living or recently killed wood taken from suspected trees and showing brownish, reddish, or bluish black discoloration may be sent to the Laboratory of Forest Pathology, Morristown, New Jersey, for determination of the disease.

**AIR CONDITIONING**

**MORE than 2000 industrial air conditioning installations are not only improving the health and efficiency of employees but are also increasing production, reducing loss by rejections, and eliminating dirt and abnormal moisture in many manufactured products.**

## Aluminum Film Prevents Silicosis

IDENTIFICATION of a film which, by covering quartz particles, prevents silicosis, was recently reported by L. H. Germer and K. H. Storks of the Bell Telephone Laboratories in *Industrial and Engineering Chemistry*.

The protective film is hydrated oxide of aluminum, and is so thin that no way exists of making it visible. Its identity was discovered by electron diffraction analysis, in which a beam of electrons was passed through the film specimen and the resulting diffraction pattern recorded on a photographic plate. Features of the pattern were then examined to identify the material composing the film.

Silicosis develops rather quickly in rabbits exposed to air containing moderate concentrations of quartz particles finer than one two-thousandth of a centimeter, but it is completely prevented if aluminum powder is also present in the air to the extent of about 1 percent by weight of the quartz powder. The aluminum forms, in the lungs, a protective film upon the surface of silica particles which prevents them from dissolving, and thus prevents toxic effects.

"The seriousness of silicosis in the mining and foundry industries indicates the importance of identification of this film," it is declared. "The smallness of the silica particles and the very small amount of aluminum which is sufficient to cover them with a protective film make it evident that this film is extremely thin. It is estimated that a film 250 Angstrom units, or one forty-thousandth of a millimeter, thick will certainly prevent solution of silica and toxic effects. The minimum thickness of film which will prevent solution is probably very many times less than this figure."

## Snow Photos From Air

BOMBS of carbon-black powder, dropped on the snow from the map-making planes of the third Antarctic Expedition, will permit faster and more accurate overlapping of aerial photographs necessary in claiming rights to Antarctic areas by the United States. A large quantity of uncompressed carbon-black powder to be used for that purpose has been donated to the Expedition by the Continental Carbon Company.

Both the plane carried atop the roof of the huge Snow Cruiser and the planes based at "Little America" will carry the black-powder bombs on their aerial survey flights. Every few miles, just prior to taking a photograph, the planes will release a powder bomb which makes a big black splotch

**on the snow. When the photographs of** the barren wastes are developed, the black spots on the pictures will provide an accurate and quick method of piecing them together to form the aerial map.

Spotting of the ice and snow fields in this manner is necessary because there are practically no landmarks to identify a particular area—nothing but endless wastes of perpetual whiteness.

## Street Lighting Evaluator

DEVELOPMENT of an ingenious instrument which, for the first time, enables safety authorities quickly, conveniently, and accurately to evaluate the effectiveness of street lighting systems has just been announced by General Electric's lamp department at Nela Park.

Its significance derives from its relation to the 5000 lives that are annually lost in traffic accidents merely because motorists could not see safely. Experts to whom the new instrument has been shown hail it as an effective tool for diagnosing street lighting systems and prescribing the means of affording adequate visibility.

The new street lighting evaluator serves as a traveling laboratory. It "sees" and promptly records the true brightness of pavement, brightness of objects on and near the roadway, and the interference with seeing caused by the glare from the lighting system. These are the three factors that determine how quickly and clearly and certainly a driver can see. It permits the safety official to determine visibility values without having to step out of his car.

One of the evaluator's several parts, mounted on the hood of an automobile and extending beyond the radiator, resembles a stubby spring-board. A second part, above the windshield, looks like the loud speaker of a public address system. A third element, on the driver's seat, resembles a portable radio.

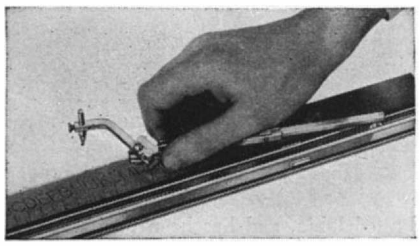
What appears to be a spring-board actually is a miniature strip of street. The pavement is similar in tone and texture to the surface of the roadway in question. On it are typical obstacles. Its position above the headlamps of approaching cars makes it possible for the investigator to proceed with an appraisal at any time without waiting until traffic has disappeared.

What first might be taken to be a loud speaker above the windshield is really a glare collector which measures the total glare from all street lamps, within the driver's field of view, and the loss of vision resulting therefrom.

What looks like a portable radio on the driver's seat is an "operator's control box" provided with dials and selector switches. It automatically records on a card the measurements of the three factors (brightness of pavement, objects, and interference with seeing caused by glare from the system). Only a few moments are required for the operator to compute the net visibility at a given location.

## Rapid Lettering Set

A FAST, accurate, versatile and economical lettering set has been announced by the Eugene Dietzgen Company. An outstanding feature of the Edco "Spee-Dee" lettering set is that with a single guide, it is possible to produce eight differ-



**Neat, accurate lettering may be produced with this new device**

ent types of lettering simply by changing the setting of the tracer and the pen arm.

Each lettering outfit has six different weights of pen points from extra light to extra bold, thus making 48 different weights and styles of type available. Letters are formed in one continuous movement without shifting the guide, because each character on the guide is complete and in alphabetical order. Each guide has upper and lower case letters, numerals, and characters. Proper positioning and spacing of letters are made easy by the spacing markers. The guide is precision-built of special, durable plastic material.

## Naval Construction

OUR naval building program, off to so late a start in the opinion of many of us, now seems to be making such rapid strides that in the next few years we will approach reasonably close to an adequate Navy. Latest figures on construction of naval vessels in this country are appropriate just now when attention is centered upon the extent of our defense forces.

On October 1, 1939 four of our new battleships were already under construction and contracts awarded for four more. Probably the *North Carolina* will be the first to be launched some time this spring. Two aircraft carriers are under construction, one of them having been launched last April. Six light cruisers have been authorized but contracts have been let for only four of them, and construction has begun on none. Three submarines have been launched of the nine under construction, and eight more have been authorized but not begun. Nine destroyers have been launched among the 28 now under construction, while seven more have been authorized but not begun. We are also building tenders, minesweepers, a repair ship, fleet tugs, mine layers, and sub chasers, totalling 19 vessels, about half of which are under construction or have been launched and one has not been contracted for.

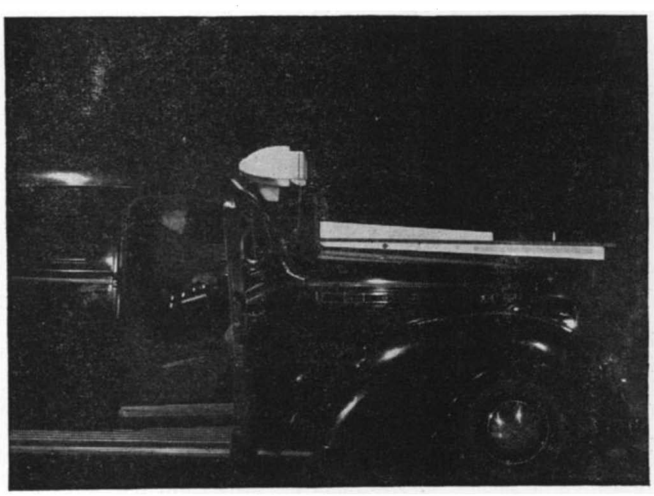
### FORESTS

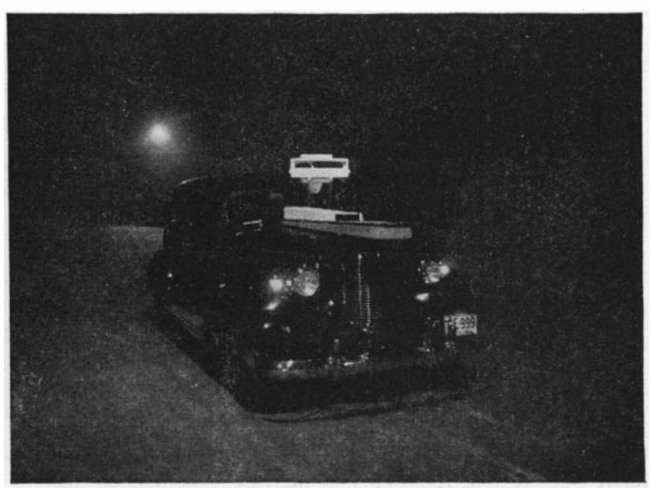
**FOR a number of years prior to the war, Germany was overcutting her forests by 50 percent. That country produces normally only about two thirds of its annual wood requirements, and the present war is, therefore, expected to cut so deeply into German forests that it will take years to replenish them.**

## Motor Noise Finder

AN "industrial stethoscope" for use by acoustic engineers engaged in the diagnosis and checking of running machinery has been announced by Electrical Research Products Inc. Just as a doctor listens to the heart beats of his patient and then charts his condition, so the Recording Frequency Analyzer (as the new device is called) discloses the "sound" condition of motors undergoing test, and records the results on a graph automatically.

The equipment employs frequency analysis by the "sweep" method, using a small drive-motor to actuate the frequency dial which sweeps the whole range of frequencies from 30 to 10,000 cycles per second. With this motor is synchronized another

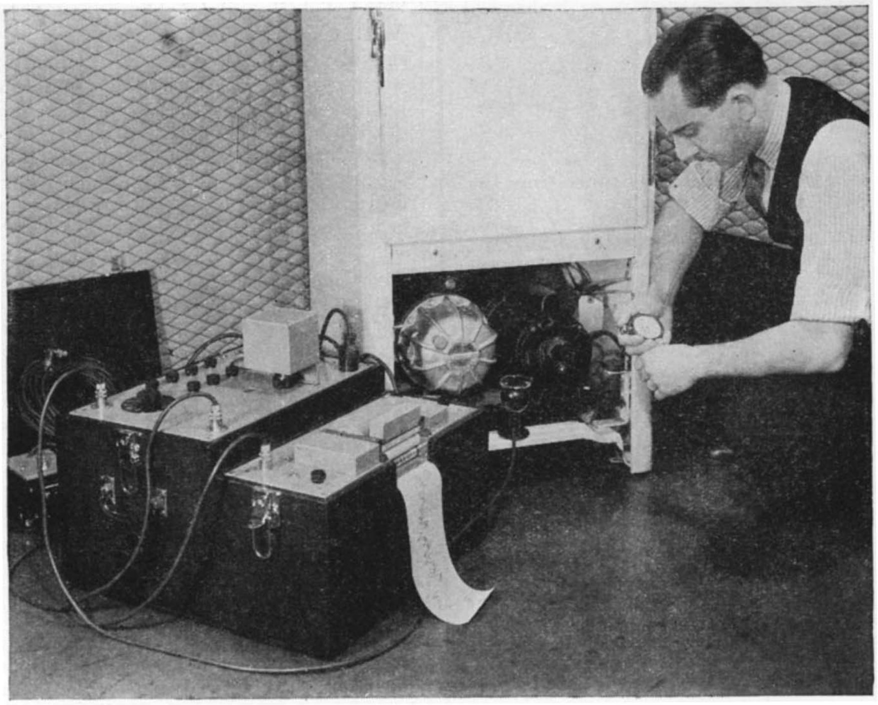




**Two views of street lighting evaluator equipment, showing glare collector and miniature street**

motor driving a band of graph paper on which a stylus traces the sound level at each frequency passed. Sharpness of frequency selection from the great variety of sound that the microphone picks up from a whirring machine is assured by crystal filters.

Thus the acoustic engineer has a completely plotted and permanent chart of the sound levels at various frequencies. Having tested both good and defective machines in this manner, the engineer knows the eccentric sound peaks at certain frequencies which are symptoms of the defects most chronic to the type of machine tested. He may then recommend that the manufacturer install one of the recently announced Industrial Noise Analyzers (or electrical "tin ears") which, set to the particular frequency which betrays the defect, becomes a watch-dog against its recurrence.

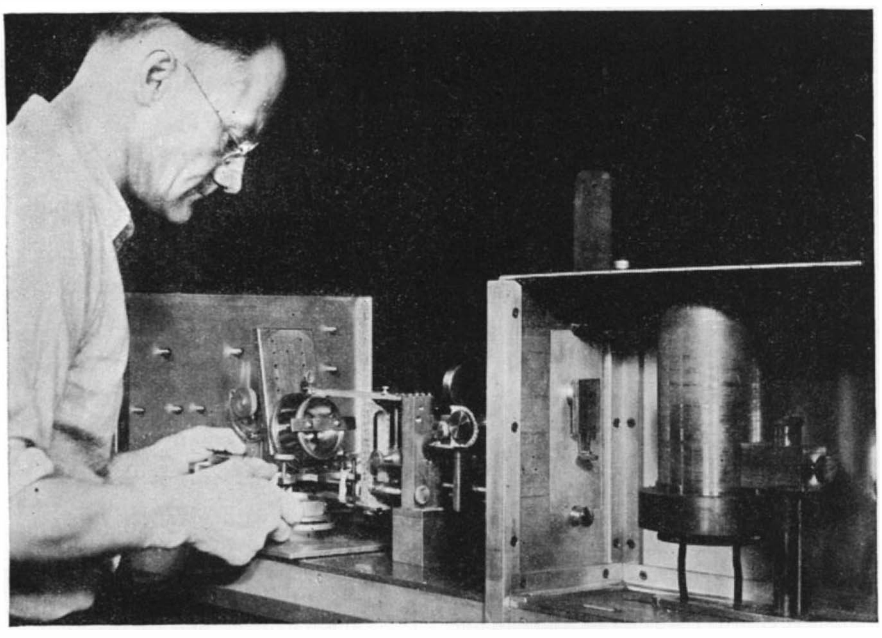


Testing refrigerator unit with recently announced "industrial stethoscope"

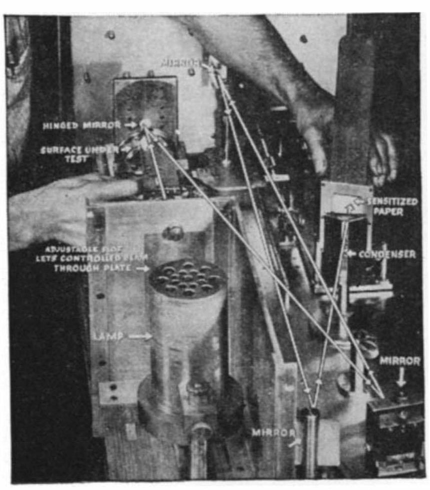
## One Millionth of an Inch

ACCURACY to one millionth of an inch is the answer of roller bearings to the ravages of friction. And it's done with mirrors.

Using a machine so delicate that it must be kept in an air-conditioned room, The Timken Roller Bearing Company has achieved a new super-finishing process on the metal raceways in which rollers revolve that eliminates irregularities not even visible with a microscope.



*Above:* Equipment for measuring surface roughness to one millionth of an inch. *Below:* Path of light ray that makes measurements possible




Reduced to its fundamentals, this instrument consists of a light beam reflected between a series of mirrors, the first of which is hinged and changes its vertical angle as the specimen is drawn along under it. This is accomplished by mounting this mirror on a bell crank lever pivoted in the center, with a diamond point on one arm and the mirror on the other.

As this diamond point makes contact with the specimen surface, any minute irregularity moves the mirror system. This movement is transferred by the mirror deflecting the beam of light. The deflection of the beam is accentuated in reflecting off each mirror. Finally the beam runs through a condenser which reduces it to pin point size and focuses it on a revolving cylinder of sensitized photographic paper.

When the paper is developed, irregularities of a millionth of an inch show up like saw teeth. The machine is so sensitive that if the specimen is .000025 of an inch off level, it will show up as an error of 1/8 inch on the sensitized paper.

The direct result of profilograph studies has been a new type of surface finishing. Hence, honing machines were developed. This consists of fine abrasives being held lightly against a piece of work, with the abrasive and the work moving in several opposing directions. Honing has unquestionably lengthened the already long serviceable life of precision bearings by practically eliminating internal friction.

### TRAIN SPEEDS

**THAT the United States has made amazing progress in the speeding up of passenger trains in recent years can be seen from the fact that, in 1932, American mile-a-minute daily runs totalled only 2022 miles, while today, they have reached 48,247 miles. American railroads also operate 4415 miles at 70 miles or more per hour, and 1012 miles at 75 miles or more per hour.**

## Infra-Red Spectroscopy in Industrial Research

IN recent years a new method of analysis of organic compounds has been put into practical application. It has been found possible to use infra-red, or heat, radiation to "finger print" complex organic molecules for identification and analysis. This method applies only to molecules and is not to be confused with the well established spectrum analysis of the elements which utilizes the visible and ultra-violet light given off by atoms.

The infra-red radiation, sometimes called "black light," used for this purpose is invisible and must be picked up by a very sensitive heat detector, the thermopile, which can "feel" and measure a rise in temperature of only a hundred millionth of a degree.

An instrument known as an infra-red spectrometer does the actual "finger printing" of the molecules. This instrument, the heart of which is a one-pound prism of rock salt, automatically separates the radiation into its various wavelengths and records their intensities. A sample of the organic compound under investigation is placed in the path of a beam of infra-red radiation, and the radiation which passes through is measured and recorded by the spectrometer.

It has been found that after passing through any given organic compound, the infra-red radiation will have lost a certain set of its wavelengths, resulting in what is called an absorption pattern. The key to the whole matter is that no two different organic compounds have ever been found to have identical absorption patterns.

This fact makes possible the rapid identification of an unknown compound simply by comparing its absorption pattern with the patterns of known compounds. The task is ended when a perfect match is found. A more important use of the method is the identification of compounds which are present as impurities in other compounds. This type of chemical problem has been dealt with very successfully by the new method in a large number of cases.

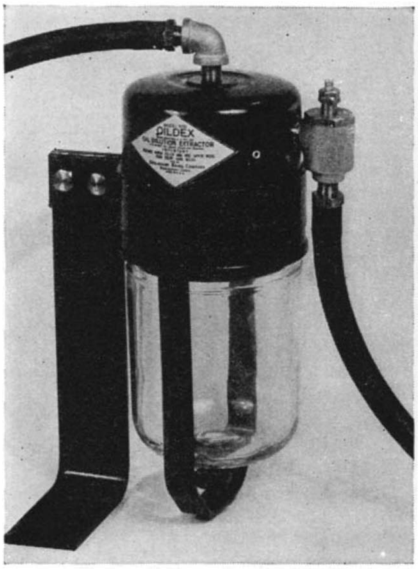
Perhaps even more important is the fact that accurate quantitative determination of the amount of impurity in a compound can be made with the infra-red spectrometer. Amounts of impurity in organic compounds as small as 0.01 percent have been detected and measured. Furthermore, a not inconsiderable item to the chemist is that only a few drops of the sample are needed for the analysis and even these few drops can be returned unharmed afterward.

### OILDEX AND FILTREX

EXCLUSIVE manufacturing and sales rights for the production and distribution of an oil dilution extractor and an improved type oil filter, companion motor products designed to effect oil and gasoline savings and reduce motor maintenance cost, have been acquired by Bridgeport Brass Company. Both products are patented and will be sold under the copyrighted names of "Oildex" and "Filtrex."

Claiming that the oil dilution extractor is the only device of its kind on the market today, where dilution extraction and filtration are accomplished, the company declares that the use of this product in combination with the oil filter, in addition to providing substantial oil savings, has shown consistent gasoline savings of from 5 to 20 percent, depending on the condition of the motor when the installation is made, and reduction in motor maintenance cost by as much as 50 percent.

Both the oil dilution extractor and the oil filter are for installation on the automobile and can easily be installed by a competent mechanic in a short time. The Oildex, for example, has an inlet and outlet tube; the inlet line is connected to the crankcase at some point above the oil level. If the car is



Oil dilution extractor for use on automobiles, with connecting lines

equipped with a breather pipe, the inlet tube is connected by means of an adapter and the line is run from the adapter to the oil dilution extractor where the volatile gases are filtered and are sucked by vacuum into the intake manifold connected to the extractor by another tube. The oil filter is installed in accord with accepted practice.

**AUTO TAXES**

AFTER an automobile is built, tax collectors, during its lifetime, collect $4 for every $1 that was paid to workmen for building the car.

## Pigment Research Improves Paints

FORMULAS for exterior white and light-tinted paints with improved durability, better hiding power, and greater freedom from dirt collection, have been developed for various climates as the result of an extensive research program conducted by the Krebs Pigment & Color Corporation.

Recent developments in house paint technology have dealt primarily with the production of improved titanium pigments and the methods of incorporating them most advantageously into exterior paints. Titanium dioxide is a comparatively new paint pigment which was at first confined to use in white paints.

According to the findings of this research program, white and light-tinted house paints containing titanium pigments properly combined with other pigments, have exhibited properties far superior to those of any of the older type paints.

As titanium dioxide is several times as opaque as any other paint pigment, paints incorporating it have better hiding power, and are of a clearer, more brilliant white. Because paints containing titanium dioxide tend to fail by chalking rather than by cracking or checking, they are inherently "self-cleaning," and make an easier and more satisfactory surface for repainting. With formulas varied according to climate, they are also slower to show paint failure.

A recent achievement is a specially processed titanium dioxide, developed by Krebs, which makes practical the use of this pigment in a full line of light-tinted house paints. This new pigment overcomes the tendency of tinted shades to fade when made with pure titanium dioxide, and is more chalk resistant. In addition, paints made with it have exceptional durability and hiding power.

## SEALED HEADLAMPS FOR OLDER CARS

DEVELOPMENT of two new all-glass sealed headlamps, designed expressly for use on front bumpers of cars made prior to those equipped regularly with sealed lights—some twenty million in all—was announced recently by General Electric's lamp department, Nela Park. The new lamps will be made available early in February. One of each is to be installed on a car bumper as shown in one of our illustrations.

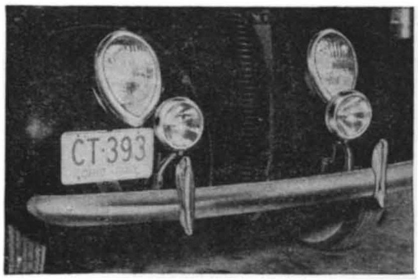
The new sealed lamps are designed to supplement present headlighting of older cars. Proper use of the new all-glass units, according to automotive lighting engineers, will give motorists headlighting approximating that provided by 1940 cars which are equipped with the popular "Sealed Beam" headlamp systems.

Like the all-glass Sealed Beam lamps on many of the latest models, each of the two new sealed lamps consists of a high-efficiency light source, a hard-glass reflector mirrored on its inner surface, and a special lens—all parts hermetically sealed into a single unit.

One of the new lamps, called the "sealed driving lamp," produces a symmetrical beam of about 35,000 candlepower and, like the "country beam" from Sealed Beam lamps, has a moderate amount of light above the horizontal. This beam is intended to supplement the light from upper beams of cars of 1939 and older.

The other new sealed unit, called the "sealed passing lamp," is equipped with a lens especially designed to supplement light from the lower or "meeting beam" from old-style headlamps. It provides a wealth of illumination along the right side of the roadway without creating glare for approaching drivers. The beam, rated at 35,000 candlepower, is similar to the "traffic beam" from Sealed Beam headlamps. Its light distribution is said to be "asymmetrical," the

Side view of new sealed headlamp for older cars, showing also the connection block on rear of lamp




How sealed headlamps are mounted on the front bumper of older cars

illumination being spread to the right only.

Nela Park engineers recommend that the sealed driving lamp be wired in such manner as to come on with the upper beam of the regular headlamps. The passing lamp should be wired to come on with the lower beam of the regular headlamps. Each lamp should be wired through a switch clamped to the dash to permit the driver to turn them off when the car is being driven on lighted city streets.

### FLOWERS

LARGE quantities of roses and other cut flowers are shipped from Pacific Coast to Atlantic Coast cities in refrigerator cars attached to fast passenger trains.

## No Petroleum Shortage

EVER since that eventful day in 1859 when Colonel Edwin L. Drake and "Uncle Billy" Smith discovered that petroleum could be brought from the earth by drilling, persons throughout the nation have expressed the belief that petroleum resources soon would be exhausted. Even during years when the industry had a surplus rather than a deficiency of oil, revivals of these alarms were heard. Today, despite the fact that proved oil reserves are conceded to be well over 100 percent greater than estimates of a decade and a half ago, alarmists not only insist that they soon will be exhausted but in some instances have charged the industry with unnecessary waste and an unwillingness to co-operate in conservation.

As a result of the frequent charges of waste, the American Petroleum Institute, in 1925, made a thorough study of the industry and conservatively reported the known future oil reserves as 5,321,000,000 barrels. During the next 10 years 8,692,000,000 barrels were produced; yet authorities agree that today we have future proved reserves of some 17,000,000,000 barrels—more than three and one half times the estimates of the mid-twenties!

But that is not all! During the past few years science, technology, and the inventive mind of man have so widened our horizon that those most familiar with the subject believe that reserves still to be located and developed are much greater than ever estimated.

The last 10 years rightfully may be termed "a decade of advancement." Engineering advancements have resulted in improved production methods by which increased recovery is possible. In addition, better engineering practices and geological advancements have permitted more accurate determinations of the location and the quan-


See our other advertisement on page 125

tity of oil in the earth and the industry is vitally concerned in securing the greatest recovery from every pool.

While means of increasing the recovery of oil fields were being developed, better refining methods for increasing recoveries of the most valuable oil fractions were found. Thus, today it is possible to give assurance that known reserves, plus the development of those certain to be located at a future date, plus substitutes, should they ever be required, are ample to meet every demand.

Any discussion of the future adequacy of petroleum products should begin with the probable future demand. This is dependent on the nation's probable gain in population, the increase in the number of motor cars, and the requirements for petroleum products by industry and in the home.

To make a fair analysis of what is to come during the next several decades, one first must consider the probable increase in population from 122,000,000 to an estimated 146,000,000. During this same span, the number of passenger vehicles is expected to increase from 25,000,000 to some 31,000,000 and the number of motor trucks and buses will step from 4,300,000 to some 6,000,000. In other words, the anticipated number of motor vehicles in 1960 will be 37,100,000 as compared to 29,500,000 today.

From this, one might hastily conclude that the consumption of petroleum products for use in motor vehicles will skyrocket within the next few years. Such, however, will not be the case. According to reliable authorities, the annual motor fuel consumption per vehicle operated in the United States has decreased from an all time high of 721 gallons in 1937 to 704 gallons in 1938. This reduction in gasoline consumption is a result of the trend to lighter vehicles powered by more efficient engines, and automotive engineers predict that future advancements will reduce the per-vehicle consumption of gasoline to the neighborhood of 670 gallons in 1960.

In addition to motor fuel, the barrel of crude of 20 years hence will continue to be drawn upon for domestic demands of kerosene, lubricants, marine and Diesel fuels, heating oils, and other uses. Weighing the probable crude supplies from domestic sources against expected demands, it is estimated that the peak will be reached in about 10 years when 1,109,800,000 barrels will be required. By 1960, it is believed that this demand will drop to in the neighborhood of 1,071,000,000 barrels—a figure which closely approximates that of today's crude-oil production.

In any fair discussion of the subject, one must bear in mind that refinery improvements already in operation and those which will come as a result of unending research in refinery technology and operation will increase the yield of gasoline obtainable from a barrel of crude. Conservative estimates for 1960 indicate that nearly 60 percent of the crude will be converted into motor fuel as compared with slightly over 40 percent, the recent average for the industry.

Because of the discoveries which have been made and which will continue to be made in the finding, production, and refining of crude, it is quite evident that a shortage of petroleum is remote. Known reserves of today are well over 100 percent greater than estimates of 1925. Properly managed, as in most instances they are today, these reserves, together with new discoveries, are sufficient to relieve any doubt that a shortage of petroleum is imminent.—*The Orange Disc* Magazine.

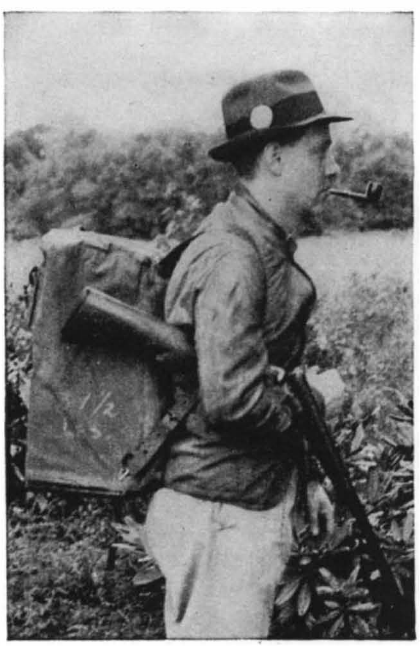
## ALUMINUM ROOFS

A STUDY of the performance of aluminum finishes as applied to metals and other surfaces has convinced engineers that this metal would so resist intense sunlight and oxidation that it should make a highly suitable roofing material. Hence the Paraffine Companies, Inc., have developed a new roofing called Alumi-Shield which takes advantage of the well-known characteristics of aluminum. It has high reflective properties and provides good insulation at a much lower cost than do other comparable metals. This new roofing consists of prepared asphalt roll roofing surfaced with metallic aluminum.

## PORTABLE PACK WATER FILTER

A GROUP of men—campers, hunters, explorers, engineers—far from a municipal water supply, can now purify their own drinking water, wherever they

*Above:* Operating pump of portable water filter. *Below:* The entire unit may be carried on the back



may be located, with the new Seitz Portable Pack Filter. Packed for transportation on the back of a man, the equipment weighs between 30 and 40 pounds. The unit is completely self-contained with a hand pump that will supply up to five or six gallons of potable water per minute. Easy pumping will supply one or two gallons per minute.

All parts of the filter are built of aluminum coated with a special water-repelling Bakelite lacquer to prevent oxidation. The hand pump which supplies the water is positive acting; that is, needs no priming. It provides a suction lift of at least 10 to 15 feet.

## Moles, Birthmarks and Cancer

THE common mole, skin-colored or a little darker, "rarely, if ever, terminates in cancer," and blood-vessel birthmarks and the dark brown, warty, hairy birthmarks are also relatively innocent of cancerous tendencies, Dr. Eugene F. Traub, of New York City, declared at the recent meeting of the American Academy of Dermatology and Syphilology.

"The smooth, dark brown or dark blue marks, devoid of hair, are the ones that are most dangerous. It is from this type that melanoma (serious skin cancer) often develops," he said.

Skin cancers, Dr. Traub emphasized, are easy for the doctor to diagnose and generally can be cured by X-ray or radium treatment or surgical operation.—*Science Service.*

## Dwarf Apple Trees

A DWARF apple tree that will not grow taller than a man can reach and which will bear fruit the first or second year after it is planted is now a practical accomplishment and should meet an increasing demand among amateur gardeners and home owners, says Dr. H. B. Tukey, horticulturist at the State Experiment Station at Geneva, New York, who cites the many inquiries received at the Station as an indication of the mounting interest in trees of this type as ornamentals and novelties for the home garden.

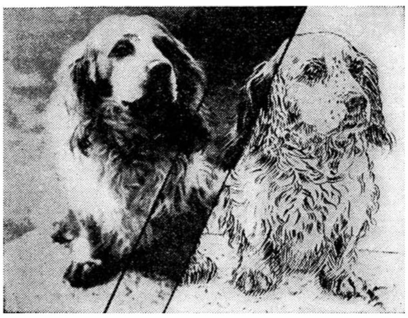
"Fortunately," says Dr. Tukey, "tests made at the Experiment Station have now progressed to the point where we can give direct answers to such questions as 'How soon will dwarf trees come into bearing?,' 'How big will they get?,' 'What kind of fruit will they bear?,' 'What varieties shall I use?,' 'What special care must I give them?'

"The trees which are now becoming available are true dwarfs and are produced by budding the desired variety on a rootstock known to nurserymen as 'Malling IX'. These trees are especially well suited for training to special shapes; many varieties will bear the first year and the rest the second year; and while they should not be regarded as trees to produce the family supply of apples, they make exceedingly attractive ornamentals and often the bloom alone is sufficient to repay the planter for his time and labor."

Dwarf trees should be regarded as garden plants and will require much the same careful handling as do other garden plants, says Dr. Tukey, who concludes that, "for the amateur gardener and small home owner, however, they are exceptional, useful, and interesting novelties."

## Photographic Drawing

MANY years ago a considerable proportion of the illustrations used in newspapers were made by drawing over photographs and then removing the photograph from beneath the drawn lines by means of chemicals. Thus, while the process is not new, it has now been made available for



From photo to drawing

extremely easy operation by the layman in a small kit recently produced by Chas. M. Higgins & Co., Inc. This inexpensive kit contains the necessary chemicals, a bottle of brown India ink and one of black India ink, mixing bottles, brush, a pen, and even a sample photograph on which to experiment.

This kit is not, however, wholly a hobbyist's outfit. It can be made use of by editors who wish to make from a photograph a line cut instead of a more expensive half-tone. An architect, in preparing for alterations in a house, may draw part of the house on an old photograph and then sketch in the desired changes. Other uses may suggest themselves to readers.

## Stainproof Paint

INTERIOR house painters are plagued with the problem of old stains showing through new coats of paint. Only too often it is necessary to put several coats of paint over such stains, with the possibility that the stain will later make its way through these coats and show up again. Staincure is a new paint made to solve this problem. It is a ready mixed, white, flat, sealing paint with extremely high hiding power. It is, furthermore, quick drying.

The manufacturers claim that Staincure is an excellent primer for use as a one-coat finish on such products as fabricated doors, windows and sash, and the like. In such use it prevents pitch and sap stains from bleeding through.

## Four-Lane Road "Jacked" Apart

HOW a four-lane highway that was "jacked" apart to make a divided roadway reduced fatal accidents by more than 83 percent, was described recently by Arnold H. Vey, traffic engineer of the State of New Jersey.

New Jersey took a popular four-lane highway and split it down the middle, moving separate concrete slabs sideways. Two roadways, separated by a dividing center strip, thus resulted.

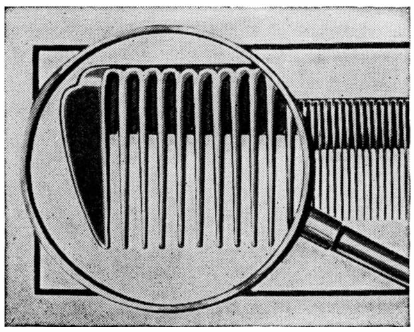
A study of accident figures on this road in 1933-34, before the division, and for 1937-38, after the division, showed that fatal accidents dropped 83.3 percent. Nonfatal accidents decreased 48.5 percent and accidents involving property damage were cut 17.6 percent. The reduction for accidents of all kinds was 40.4 percent.

Particularly valuable was the new divided highway at night, for accidents were then decreased by 47.2 percent while during the day they dropped only 31.4 percent.

The cost for the unique jacking job was $50,000 per mile, Mr. Vey reported. By applying National Safety Council figures to the reduction in accidents, it was found that the saving in accident costs are sufficient to pay for the conversion in slightly over three years.—*Science Service.*

## Self Cleaning Comb

WHAT is said to be the first basic improvement in combs in 4000 years, a new one, called Komatic, has been placed on the market. In this comb the backbone



has been pushed completely to one side so that the teeth slots go all the way to the back edge. Its self-cleaning characteristic is said to be due to the fact that this side backbone gives a sharp edge on one side and there are no pockets in which hairs or lint may collect.

## Problem: The Chord and Arc

HERE is another of Lieutenant-Commander Kaplan's headaches for those—and there are a lot of them—who really enjoy headaches and claim the problems don't make heads ache hard enough.

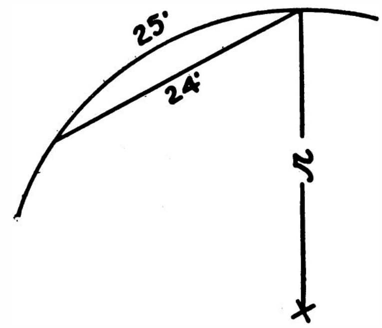
Find the radius $r$ of the circle in which a 24′ chord subtends a 25′ arc.

For those who find the problem too elementary, the additional one is offered to deduce a series which defines the radius $r$ *explicitly* in terms of the chord $c$ and the arc $a$—a series, that is, which will permit numerical computation of $r$ by direct substitution of the known values of $c$ and $a$.

In transmitting the above problem, Commander Kaplan underlined the word "explicitly" in red ink, and then stated in his letter that the emphasis was put on the word in order to forestall a deluge of series which define the unknown radius implicitly.

Well, that ought to be explicit enough, speaking explicitly!

Address any correspondence regarding

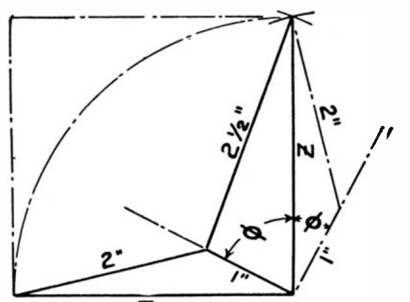



this problem to Lieutenant-Commander Leonard Kaplan, in care of Scientific American, 24 West 40 St., New York, N. Y., to whom it will be forwarded unopened.

## Solution to the Problem of the Square

LAST month we suggested that you try to construct by graphical means 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. Here we have our solution.

Referring to the illustration it will be easy to follow the construction. First lay off




one inch lengths, measured from the vertex, along the sides of a right angle. From these points as centers, swing arcs with 2- and 2½-inch radii. The line connecting the intersection of these arcs and the vertex of the right angle is one side of the square.

To determine the length of a side, we have the following expressions derived from the cosine law:

$$25/4 = Z^2 + 1 - 2Z\cos\theta$$
$$4 = Z^2 + 1 - 2Z\cos\Phi$$

where Z is the unknown side of the square, and θ and Φ are respectively the angles opposite the 2½- and 2-inch sides in the triangles shown in the graphical construction. The equations may be rewritten as

$$4Z^2 - 21 = 8Z\cos\theta$$
$$4Z^2 - 12 = 8Z\sin\theta$$

Squaring each side and adding gives

$$32\,Z^4 - 328\,Z^2 + 585 = 0$$

Solving as a quadratic in $Z^2$, we have

$$Z^2 = \frac{328 \pm \sqrt{(328)^2 - (4)(32)(585)}}{64}$$
$$= \tfrac{1}{8}\left(41 \pm \sqrt{511}\right)$$

and so Z = 2.8197 or 1.5164 inches. The first of these two values is the correct answer, the latter being the length of a side of a square with the three corners at the given distances from a point *outside* the square.

# 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.

## Old Sights—New Sights

HAD the flintlock muskets of our Colonial troops, entrenched on Bunker Hill in June, 1775, been equipped with modern sights, that famous command "Don't shoot until you can see the whites of their eyes" might have had an even more devastating and a considerably earlier effect on the Redcoats storming the American ramparts. Actually, sights, so-called, were in evidence on firearms as early as 1475, but it remained for Maurice, of Orange, to make his mark in history in 1598 by designating muskets with sights for the army of the Netherlands.

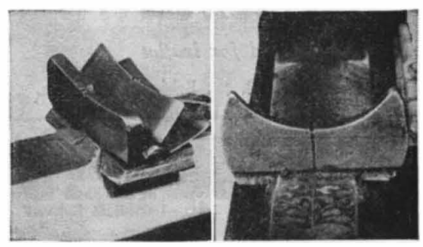
Although development of "iron" sights for hunting rifles has advanced apace during the past 60 years to the point where scientific details and data are legion, the great-great-grandfathers of many of our present day sights are to be found on ancient weapons of European make. Why the early arms were so equipped is something of a puzzle, for, after all, about the best a would-be marksman could do with one of those early guns was to point and hope. Without rifling, which was the case with many early guns, a true aim as we know it today was almost a miracle.

In examining some of the antique firearms in the possession of The International Studio Art Corporation, formerly a part of the William Randolph Hearst collection, the other day, we came across the early antecedents of the "buckhorn" sight, the peep sight, the folding leaf sight, the telescope sight, and finally, the interchangeable disks with varying sizes of apertures, which the Merit Gunsight Company has recently modernized even further through the manufacture of an iris type disk which offers 12 different apertures by means of a click adjustment.

The fore-runner of the buckhorn sight was found on a matchlock arquebus of 1583, originally made for Francis II, Duke of Saxe Lauenberg. Incidentally, this weapon is considered one of the finest antiques of this type and is valued at about $5000. The ancestor of the folding leaf rear sight came to light on a Hungarian wheel-lock arquebus made by Johann Stiffter in 1682. Stiffter is recognized as one of the finest of early gunsmiths, and this sight consists of three leaves, offering various stages of elevation.

On a matchlock arquebus of probable Dutch origin in the late 17th Century, we discovered the several times great-grandpappy of the 'scope. It has no magnification, of course, and is merely an octagonal metal tube 1¾ inches long with a 3/8 inch diameter at the butt end, tapered to a 5/32 inch opening at the fore end. Nevertheless, here is an early adaptation of the 'scope principle, wherein the shooter sighted through a small cylindrical tube for the purpose of bettering his aim.

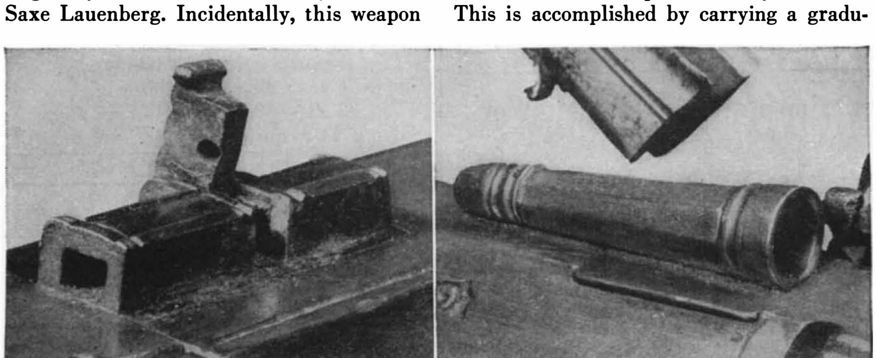
The peep sight we examined was startling, to say the least. It took the form of a four-legged metal lizard, lying on the top of the barrel, with open mouth gaping directly into the shooter's eye. However, the lizard



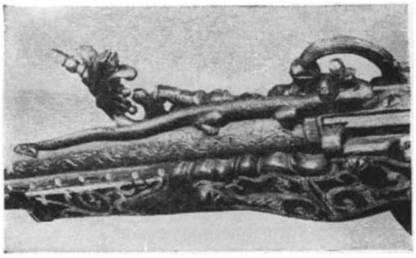
*Left:* Folding leaf sight of 1682. *Right:* Ancestor of buckhorn sight.

has a hole through the top of its head, and when one peers through this physical defect, he sights along the gun over a crude bead fore sight and hopes his aim will be bettered. This combination matchlock and wheel-lock gun was of Oriental origin, 1650.

One requirement of the modern rear peep sight for target use is an arrangement for an eye cup, or a series of eye cups, so that different sizes of apertures may be used. This is accomplished by carrying a gradu-



*Left:* Variable aperture peep sight made in 1746. Either rectangular or round opening may be used. *Right:* Fore-runner of the telescopic sight (17th Century)

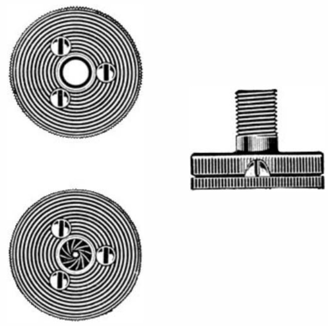


A hole through the top of the lizard's head serves as a peep sight

ated group of eye cups or through the use of the Merit iris-shutter disk. But on a rifle of 1746 we found a sort of pre-historic application of this variegated disk idea in a small metal box, fastened lengthwise of the top of the barrel. The shooter could sight through a rectangular opening 1/4 by 3/8 inches, or he could drop a hinged block of metal into a slot in the metal box and utilize the round aperture 1/16 inch in diameter which had been bored in the hinged block.

While the first practical peep sight was made by the Lyman Gun Sight Corporation in 1807, which, with only minor improvements, is still known as "Lyman No. 1," this device for improvement of target shooting did not receive much impetus until after the Civil War and the concurrent European military struggles. It was not until 1911, however, that Col. Townsend Whelan, in collaboration with other authorities and the Lyman people, worked out the first practical micrometer receiver sight, permitting minute adjustment for windage and elevation.

It remained for Ralph Albertson, of the Merit Gunsight Company, to bring about one of the latest developments in rear peep sights. Albertson, a Californian, says he used to "get a big kick" out of hunting the western jack-rabbits on the run with a .22 auto-loading rifle. Not having the desired



*Left:* Variable aperture Merit sight closed and open. *Right:* Side view

success at this with conventional open sights, he built a special peep sight and equipped it with a series of eye disks of varying apertures. While these disks were interchangeable without changing zero on the rifle, Albertson decided it was a nuisance to carry a pocketful of accessories, together with canteen, lunch, and gun. So, having had many years experience in fine tool and die making, he set about to produce a peep sight equipped with an iris shutter, operating on the same principle as the diaphragm of a camera.

After several years of experimentation, the Merit iris shutter of today not only answers the problem of variation of sensitivity of individual eyes to light, but also obviates the necessity of carrying a series of disks providing different apertures for different conditions. Merit disks are made for use on Lyman, Redfield, Pacific, Vaver, Marble-Goss, Remington, Savage, Winchester, Stevens, and any other sights using 7/32-40 thread for disk mounting and taking a disk 1/2 of an inch or larger in diameter.

## Gun Collectors, Please Note—

When we started chatting about antique firearms in the December 1939 issue, we had no idea that we would uncover so many would-be amateur gun collectors among our readers. To those of you who have written for information, we hope the replies have been helpful. To those of you who haven't written and would like to, we say again that our mail box is of very generous proportions. And, to those of our readers who have already established themselves as collectors of old guns, may we suggest that for the benefit of the many neophytes who aspire to reach your status you drop us a line, giving any suggestions you may have which might be helpful in starting a collection of antique firearms?

There are, of course, two primary factors in establishing collections of any items, be they weapons or scrap iron; learn to know the various types or specimens together with their values, and, advertise yourself. For the first, there are books, current periodicals, catalogs of amateur and professional collectors, and association with fellow addicts. For the second, Charles Edward Chapel summed it up nicely when, in his book, "Gun Collecting," he wrote, "—to start building a gun collection, look in old attics and barns, visit the junk shops and second-hand dealers, tell your friends and relatives you are a gun collector, and write to all the gun dealers for their price lists and catalogs."

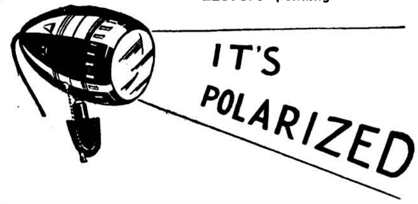
We can furnish you with lists of books and periodicals, tell you where to write for catalogs, and provide you with names of associations of amateur collectors. We may be able to answer questions concerning ancient firearms, as we have access to several sources of information, and we'll be more than glad to act as a sort of clearing house between those collectors who have obtained a start and those who thus far have only the idea and the ambition. May we hear from you "old timers"? Perhaps some of the newer collectors would like to effect trades or make purchases.

## Pot-Shots

### AT THINGS NEW

Winchester Repeating Arms Co. offers Model 75, a new five-shot, box-type magazine, bolt-action sporting rifle, chambered for .22 Long Rifle rim-fire cartridges only, and equipped with same receiver, bolt-action, and speed lock as the well known Winchester 75 target rifle. The new 75's barrel is tapered with forged front sight ramp and is shorter, being 24 inches, as compared to 28 inches in the target gun. Walnut stock is equipped with sling-swivel bows. It has shotgun butt, with steel butt plate, checkered pistol grip and forearm, and stock dimensions are: length of pull, 13½ inches; drop at comb 1 9/16 inches, at heel 2 9/16 inches. Standard model weighs approximately 6¼ pounds.











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

## Positive-Negative Design

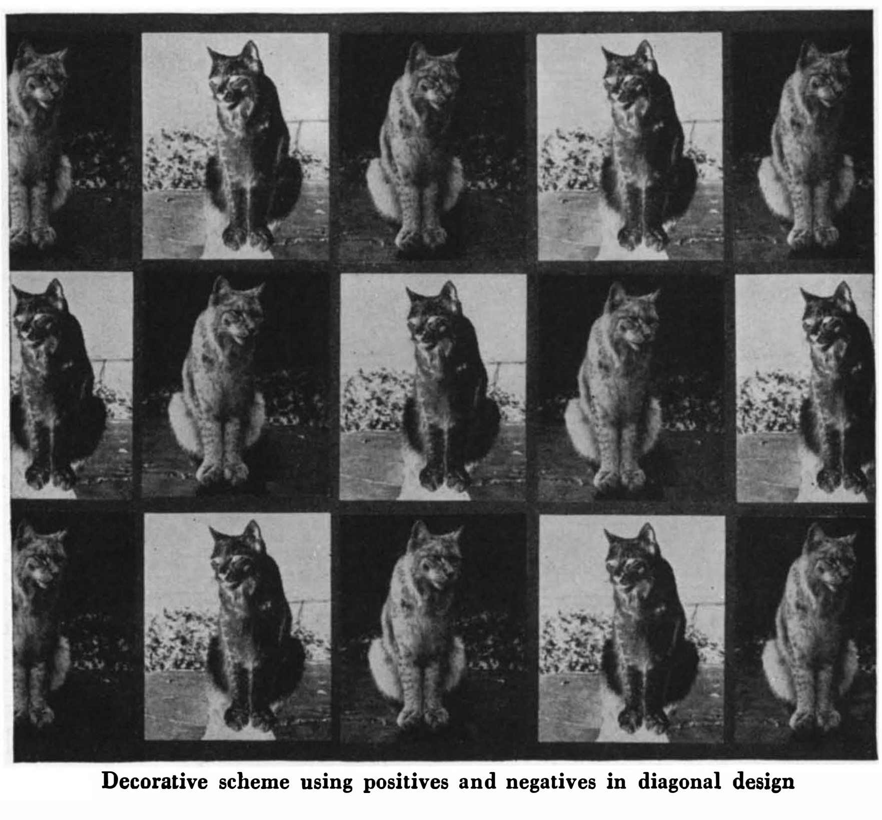
As everybody knows, paper negatives may be made from paper positives (prints) in exactly the same way as photographic prints are made from regular film negatives, either by contact printing or by projection in an enlarger. We shall not now take up the subject of making prints by the paper negative process, as our sole purpose is to show how photographic designs either for murals or less ambitious uses may be achieved by utilizing in the decorative scheme both the positive and the negative print.

The subject chosen for the design here illustrated is that of a lynx photographed between two bars of its cage in a New York zoo. The pose of the subject—looking toward one side of the picture rather than straight ahead—suggested the possibility of a design in which a number of prints would be made by enlargement, followed by the making of an equal number projected in reverse. This latter would have necessitated projecting the negative image with the "glass" or back side toward the easel instead of the normal emulsion-to-easel position. Thus, when mounted, lynx would face lynx all through the pattern. However, this did not seem to offer much promise as it suggested the possibility of dull monotony.

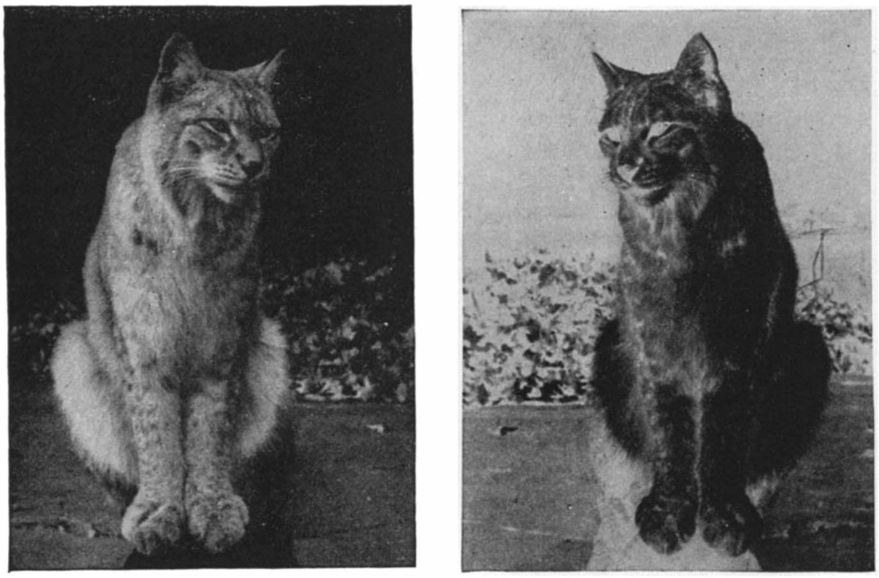
The next thought was to make positive lynx face negative lynx, in this way retaining the original idea yet varying the visual appeal by alternating the tonal appearance of the positive with the distinctively different negative print. The result, we believe, has justified the means.

For the purpose of our illustration, we used the dimensions 3 by 2½ inches for the print, but the size you select, should you decide to do something along these lines, would depend on the purpose to which you intend to put the design. The larger the space you will want to cover the greater will be the size of the print. It is suggested, however, that the smaller these prints are, for any given space area, the better will be the general pattern effect. A large number of small prints will be more effective than a smaller number of larger prints. In the latter case the observer will be so taken up with studying the individual prints that he will fail to get an impression of the pattern as a whole.

After the required number of prints had been made up, washed and dried, one of the prints was selected for making the paper negatives by means of contact printing. We say one of the prints; actually *any* one of the prints was as good as the next one for this purpose, since one of the important things to look out for in this type of work is that all the prints should be uniform in



Decorative scheme using positives and negatives in diagonal design



**Positive *(left)* and negative prints used in the wall decoration, slightly reduced**

appearance—exposed and developed for exactly the same length of time. The positive prints had been exposed "bleed" fashion, that is, without showing any white borders, to exactly the required dimensions, so when contact paper negatives were made, they were exact duplicates of the positives in their outside dimensions.

The mounting of the positives and negatives proved to be the most fascinating part of the job. Desiring a black background we used a sheet of black bristol board, which was ideal for the purpose. We allowed a quarter of an inch from top and side and ruled these off in pencil to provide a guide for starting the mounting of the pictures from the top horizontal row and the extreme left-hand vertical row. From there on we spaced the prints about ⅛ of an inch apart. Incidentally, a few extra positives and negatives were printed as a precaution against possible spoilage. The edges were lined up as nearly as possible to maintain the ⅛-inch separation throughout. However, in a hand-made proposition of this kind exactness is not to be expected nor is its lack of much consequence. Reasonable exactness is all that one can hope for.

The arrangement of the prints is very simple: positive faces negative throughout. Positives and negatives run diagonally through the pattern, but no positive is ever strictly adjacent, that is, above or below or to either side of a positive; and the same holds for the negatives. This may be seen by studying the reduced reproduction shown here.

If a small area is to be covered, we would suggest making all the necessary prints and negatives directly. In the case of a larger area, however, it may prove labor-saving to make a small panel, copy it and from this copy make any desired number of prints, which will be joined to cover the designated area.

## Prices Come Down

PRICES of imported cameras naturally soared when war was declared, due to difficulties of obtaining adequate supplies. Now, however, according to Burleigh Brooks, well-known importer of cameras, several large shipments have been received from abroad and prices of his line of equipment have been reduced to points approximating those in effect before September 5. In some cases, the new prices are even lower than before that date. The lines affected by this readjustment include Rollei, Dolly, Foth-Derby, and Bee-Bee cameras, as well as Schneider lenses.

## High Contrast Subjects

ON those occasions when pictures are desired or must be taken under lighting conditions not sufficiently well balanced to come within the range of tones capable of being recorded by a film emulsion, it is still possible to make a satisfactory job by proper development. Pictures taken at night outdoors are one type; another type includes subjects involving both dark and very bright objects. An effective method is to develop the negative in a formula from which the hydroquinone has been omitted. This formula is usually referred to as metol developer because of its soft-working qualities and its ability to bring out the shadows in a negative. Hydroquinone, which favors contrast, having been left out, the highlights come up more gradually than they would with the regular metol-hydroquinone combination, thus giving the metol an opportunity to produce full shadow detail without the danger of harsh highlights.

## Counting Seconds

FOR short exposures under the enlarger, it is difficult and somewhat bothersome to watch the darkroom clock. Anything under five seconds duration is hard to follow without holding the clock in the hand. Therefore, most workers when desiring or obliged to make very short exposures in enlarging resort to the "mumbling" system, repeating at an even pace some two-syllable word which, when coupled with the number of the second, takes just about one second to say. One worker will use Lindy 1, Lindy 2, and so on; another will choose a different word. The word used does not matter, of course, just so it does the trick.

## Black Lines and Spots

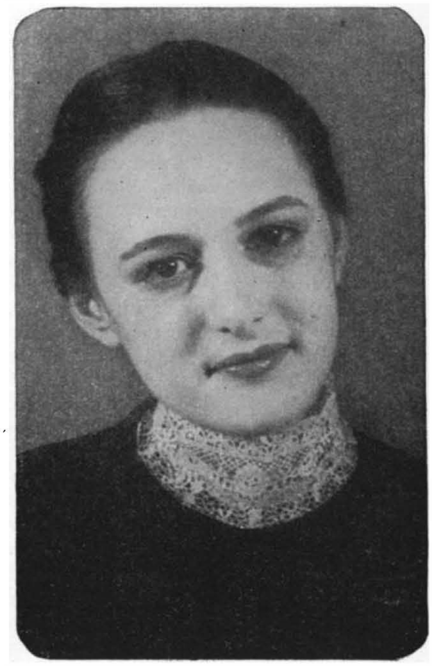
THERE'S more than one way of eliminating those pesky black lines and spots from prints, we learn from *The Gevaert Sensitizer*. As you know, a white area is fairly simple to work on but a black one often appears almost hopeless. What the present suggestion does is to provide a small white area instead of the black line or spot. Make up the following solution:

| | |
|---|---|
| Copper sulphate | 40 grains |
| Potassium bromide | 40 grains |
| Water | 1 ounce |

Apply with a small spotting brush to the black spot or line. The black will gradually disappear, leaving a greenish spot. Now slide the print into a solution of plain hypo and leave it there for 10 minutes. Wash and dry. If the spot is very tiny a little of the copper sulphate solution can be applied with the point of a needle. When the print is dry, fill in the resultant white areas with a fine brush dipped in India ink or black spotting color.

## Amateur Characterization

A CLASS of camera subject matter that is generally overlooked is that of exploiting the histrionic and characterization talents of members of your family and friends. It need not take more than just average ability and imagination to invent a suitable "get-up" for a particular subject, or you may have some idea in mind and



"The Old Maid"

look around for the person who gives promise of fitting into your planned role. An example along these lines is that of "The Old Maid" illustrated here. The young lady used to be in amateur theatricals at one time, so had some idea of the requirements. She put on a dark makeshift jacket, stiffened a piece of old lace to wear around her neck, and made up her face to give an impression of utter plainess. Cocking her head to one side completed the total impression.

## Close-Ups From The Hand

WHEN shooting at such short range as a foot or so, while employing a close-up lens attachment, not only is the focusing very critical, but, after measuring the appropriate distance, not everyone is able to keep the measured distance while holding the camera in the hand. We recently had occasion to use a miniature camera equipped with a supplementary close-up lens. We wanted to use it in the field and did not wish to be bothered with a tripod since the camera was to be used in daylight only. With the lens mount fully drawn out, the distance from lens to object was 15 inches; with the distance scale on infinity, the lens-to-object separation was 11 inches. We solved the difficulty simply by cutting a twig 11 inches long and another 15 inches long. In operation, all we had to do was set one end of the stick near the lens, and the other end next to the small subject, being careful, of course, not to include the stick in the picture.

## 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.*

MANSFIELD SINGLE SOLUTION COLOR TONERS ($1.95 for assorted kit): New kit package includes a bottle of each color—blue, brown, green, and magenta. Ample solution provided to tone hundreds of 8 by 10-inch prints. Procedure: Print to be toned is submerged in diluted toning solution where toning action may be watched; when desired color is reached, print is removed for washing to clear highlights. Manufacturers say: "Amateurs who would like to experiment with toning can secure sample for 10 cents to cover cost of packaging, and so on. Samples of all four colors for 35 cents."

AGFA MEMO SPEEDGUN ($14.50): Designed and fitted for use with Agfa 35mm Memo camera. Similar in design and construction to Mendelsohn Speedgun. Provides accurate synchronization at all camera speeds and with all types flash lamps. Provision made for extension wiring to additional flash lamps; safety catch to prevent accidental exposures; adjustment of both reflector position and synchronizing control for different sizes and makes of flash lamps.

F-R PRECISION RANGE FINDER (black, $5; chromium finish, $5.75): Distance meter for amateur still and movie cameras. Shows in large, luminous field two separate and distinct images when range finder is not in focus. When smaller image is in exact synchronization with larger image through manipulation of micrometer thumbscrew, meter is in exact focus. Works from two feet to infinity.

SPENCER MODEL MK DELINEASCOPES ($22.50 to $58.50): Group includes models using 100-watt, 200-watt, and 300-watt bulbs. Protection from heat provided by adequate ventilation system in 100-watt model; heat-absorbing glass in 200-watt; and fan cooling attachment plus heat-absorbing glass in 300-watt model. Lamphouse cover hinged, permitting easy access to bulb or condensing lenses. Condensing lenses easily removed for cleaning. Also available: Film viewing device for viewing strips of films preparatory to making up individual slides. Fan-cooling unit operated by universal motor for 115-volt alternating or direct current with rheostat to control speed of fan. Spencer projection lens of five-inch focal length, aperture $f/3.6$. Delineascope using 100-watt bulb designed for home use; 200-watt and 300-watt models for small auditoriums and class rooms.

DEJUR-AMSCO CHROME SATIN FINISH RANGE FINDER ($5.50 complete with sling, genuine leather case, and accessory clips): Utilizes superimposition image principle. Has extending viewing eyepiece. Focusing achieved by micrometer ball-bearing adjuster revolving in bronze bearing. Will fit all cameras.

CORD TYPE BRAQUETTE ($1): Framing device adjustable from one inch to 36 inches—"large enough to hang a mural." All aluminum or assorted in black, red or gold.

LAFAYETTE SUPERIOR EASEL ($4.59): Base of steel, with rubber strip bottom. Finish black enamel with chrome trim, except for 11 by 14-inch focusing surface, which is white Lumislite bordered by inch scales. Masking guides easily adjusted and locked, alignment maintained by guide frame at "free" ends.

KODAK CONTROL FOR PHOTOFLOOD LAMPS ($4.50): Designed to prolong life of lamps and assure comfort for subjects while picture is being arranged. Compact metal box less than six inches square. Control accomodates up to six No. 1 Photofloods or up to three No. 2 Photofloods. Plugs into any power line of 100 to 125 volts, either A.C. or D.C.; four sockets provided. Lamps may be burned at about half voltage through use of "dim" switch setting, when heat and glare are greatly reduced. Either left-hand or right-hand group of lights can be turned on or off independently of opposite groups. With control at camera position, photographer can shut off or alter lighting without moving from lamp to lamp.

FOTOCRAFT SLIDE FILE ($3.25): Made of seasoned wood, natural finish. Capacity 80 two by two-inch glass slides. Has self-contained illuminated viewer operated with button switch.

TANKOMETER ($1): New type thermometer designed for use with spiral type reel tanks. Lower end notched to engage reel, thus serving as rotating rod. Thermometer encased in plastic housing for protection against breakage. Scale of stainless steel. Accuracy guaranteed within one half of one degree.

F-R PLASTIC PRINTONGS (58 cents a pair): One red, one black. Sturdy meshing grips prevent slipping; special stops to prevent tongs from slipping into tray.

LAFAYETTE HI-LITE SPOT ($15.89 complete with lamp): Features ample illumination, lightweight, easy adjustment and operation, wide focusing range. Case of unbreakable die-cast aluminum. Mounting of universal yoke type adjustable in all directions. Focusing by dial at rear of case, permitting adjustment of beam through entire range from sharply defined spot to diffused flood-lighting. Fresnel lens of heat-resisting Pyrex; beam concentrator of non-tarnishing chrome-plated aluminum. Pre-focus type bulb used operating at 3200 degrees Kelvin specified for color photography; maintains constant illumination throughout rated life. Illumination said to be equivalent to conventional 500-watt spot. Eight-foot telescoping stand available.

AGFA DARKROOM LAMP AND FILTER OUTFIT ($1.95): Includes Agfa 3¼ by 4¾-inch safelight lamp housing and socket; A3 green filter; A6 yellow-green filter; A7 red filter. Filters, all 3¼ by 4¾ inches, designed to provide maximum visibility with complete safety when correctly used and fitted with standard 10-watt frosted Mazda lamp. Filters for panchromatic and orthochromatic films and for all papers.

WINDSOR EASEL ($7.50): Features: Constant center, with fixed paper stops for 5 by 7, 8 by 10, 11 by 14-inch prints, as well as smaller and intermediate sizes; steel construction throughout, assuring immunity from warping out of alignment; washable in soap and water; white borders from ⅛ to 1¾ inches achieved with smoothly moving masking blades; finished in flint gray, without gloss; baked-on white focusing area measures 11 by 14 inches; rules, with black numbers on contrasting ground, measure both from center of paper outward and from paper corners inward; ribbed rubber strips on easel bottom prevent accidental "skidding."

WABASH SUPER-N-LARGER BULBS (35 cents to $1): New type self-diffusing enlarger bulb. Made of glass scientifically treated on inside by special process to "break up raw filament light rays into soft, diffused light that is distributed evenly and uniformly over entire bulb surface in brilliant, white glow." Five different sizes with wattages ranging from 75 to 500 and lives from 100 to 300 hours.

SUPER OMEGA B enlarger ($77.50 with detachable lens board, no lens): Features: negative size 2¼ by 2¼ inches down to 35mm; adjustable negative carrier, set in bellows, permits use of two- or three-inch lens with same set of double condensers; negative carrier set in turntable to permit rotation in all directions as well as tilting up and down; illumination (A.C. or D.C. operation) 110 volt, 75-watt Mazda photo enlarging lamp No. 211; new type dustless negative carrier; horizontal projection attachment; baseboard laminated hardwood 18 by 32 inches; twin-guide micrometer focusing; counterbalance mechanism comprises strong steel tape on enclosed steel spring. Lenses available ranging in price from $15 to $45.

AGFA HARD RUBBER TRAYS (20 cents each): Size 4 by 6 inches. Made of genuine hard rubber.

ALL-AMERICAN INSTOSCOPE AND INSTOCINE VISUAL-TYPE EXPOSURE METERS: Formerly imported from abroad, now manufactured in the United States, making possible reduction in price to $2.25, including sole leather case. American scale includes American Scheiner as well as Weston Number Speed Ratings. Exposure range from 30 minutes to 1/2000th of a second.

# 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 a number of two-inch squares of 1/8-inch crystal plate glass, and intend constructing filters, using gelatin films and Canada balsam in the usual method of construction. However, I am in the dark regarding certain details of the process: Chemical catalogs list Canada balsam in the following varieties: natural, paper filtered; dissolved in benzol; dissolved in xylol—extra thick neutral. Which shall I use? Should the balsam and glass be warmed? Is light or heavy pressure used in clamping the glass plates? What is the length of the drying period? Is it necessary to seal the edges against moisture? If so, what is used?—R. J. B.**

*A.* Clear—that is, natural—Canada balsam is specified for this purpose. The balsam may be used at ordinary room temperature, but if too thick may be thinned either by adding turpentine or alcohol or, preferably, by heating the balsam slightly in a hot-water bath. Moderate pressure is used for clamping the glass plates. The filter is then put away under pressure. Drying under ordinary temperature will take about two weeks. The edges should be sealed in some way to prevent the entry of moisture. Thin adhesive such as that used in binding two-inch square color slides should serve the purpose.

**Q. In consulting the speed ratings of various films, I notice that the rating for the same film when used in artificial light is usually slower than it is for daylight. Can you tell me the reason for this?—J. L. G.**

*A.* As you probably know, film emulsions are more sensitive to blue than to any other color of the spectrum. Sunlight is rich in blue rays, but tungsten light sources lean towards the red. A comparatively greater exposure is therefore required for the same film used under tungsten lighting conditions to compensate for the illuminant's deficiency in blue. The extent of this deficiency varies with different film emulsions.

**Q. I have a miniature camera which takes 35mm film; this comes in small metal containers. In the course of taking the film out of the container, it becomes scratched; how can this be prevented?—J. W.**

*A.* We presume that you refer to the storage of the negative roll in the metal container. The raw film, as you know, is well wrapped besides having the extra protection of a few sheets of literature around it. So far as the negative roll is concerned, scratching from this cause is easily remedied simply by rolling the film strip up to a measurement reasonably smaller than the inside of the container, and slipping a small rubber band around the rolled strip to prevent it from unfurling in the container.

**Q. With a lead pencil I have drawn a rectangle on the ground glass of my camera to indicate the limits of the exposed area of negatives. Can you suggest a better instrument or material for marking on ground glass—something that will make a darker mark and will adhere well under working conditions?—F. S. D.**

*A.* Lead pencil markings will naturally rub off in a short time. Professionals often mark or rule the ground glass with a sharp instrument. These lines are easily discernible in use. Another way is to use black drawing ink, but the disadvantage of this is that, unless your lines are to indicate the extreme borders of the film dimensions, the black lines might interfere with your image, if you wished to work outside the marked limits.

**Q. Will you please send us a formula for simple photographic emulsion?—J. V. M., Jr.**

*A.* E. J. Wall, in his "The Dictionary of Photography," cites the following Abney formula for an emulsion for rapid plates:

| | |
|---|---|
| Potassium iodide | 5 grains |
| Potassium bromide | 135 grains |
| Nelson's No. 1 Photographic Gelatine | 30 grains |
| Silver nitrate | 175 grains |
| Hard gelatine and No. 1 gelatine (equal parts) | 140 grains |

For details, we suggest consulting Mr. Wall's "Dictionary" as well as his standard work on the subject, "Photographic Emulsions," and Abney's "Instruction in Photography."

**Q. I should like to know where I may find reliable instructions for simple "direct positive development."—S. N.**

*A.* Write to the Eastman Kodak Company, Rochester, New York, for information on the processing of their Positype paper.

# 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.**

## MODERN MIRACLE MEN

*By J. D. Ratcliff*

MEDICINE is the central subject of the first part of this book, which discusses in free, running style, without more technicality than the average layman cares to read for entertainment combined with education, the outstanding developments of medical miracles: pneumonia and its treatments, vitamins, meningitis, and sleeping sickness and the attempts to conquer them and other diseases. The second half is devoted to the revolutionary changes that science is bringing to agriculture. (311 pages, 5¾ by 8½ inches, 15 illustrations.) —$3.10 postpaid.—*A. G. I.*

## HANDBOOK OF PHOTOGRAPHY

*Edited by Keith Henney and Beverly Dudley*

AN attempt has been made—and successfully indeed—to augment in one convenient volume the many books which are now available covering the various aspects of photography. With the help of 23 photographic specialists, the editors have compiled a thorough exposition of the serious aspects of the technique of photographic processes and the scientific basis underlying photography and its applications. This is in every respect a serious textbook that delves deeply into the *whys* and *wherefores* —no picture book in any sense of the word —concerning itself more with technique than with final results. (872 pages, 6¼ by 9¼ inches, numerous line drawings and a few pertinent photographs.)—$7.60 postpaid.—*A. P. P.*

## COMMON OBJECTS OF THE MICROSCOPE

*By the late Rev. J. G. Wood, revised and rewritten by W. J. Ferrier, F. R. E. S.*

IF the reader does not object to its old-fashioned appearance, this book will show him what to do with his microscope: what to look at and where to find it. It is an old book that received much acclaim in its day, now revived and partly furbished for modern use. Heretofore, microscopists have been paying more than the original price to get second-hand copies of the earlier editions. Now it is inexpensive. The diagrams look old-fashioned but they "get there just the same," and the substance of the book is something that does not change. Compass: Elementary optics of the microscope; examination of common objects such as cells, plant parts, algae, desmids and diatoms, insects, blood corpuscles, and a host of others. There are 12 color plates each showing numerous objects, in addition to 28 regular figures. (184 pages, 4¾ by 7¼ inches, illustrated.)—$1.85 postpaid.—*A. G. I.*

## WHAT ENGINEERS DO

*By Walter D. Binger*

WHILE not exactly a guide book to determine the field for future engineers, this book could, nevertheless, be used as such. It is not technical but rather a lucid discussion of many kinds of engineering activities. First, it gives the background of engineering, dating to primitive times, and then, step by step, it carries on to a complete discussion of modern practices. Many clear drawings are included to show processes or tools and equipment that are used. This would be particularly valuable for the youngster who intends to take up some branch of engineering. (304 pages, 5½ by 8¼ inches.)—$2.85 postpaid.—*F. D. M.*

## LOVE AT THE THRESHOLD

*By Frances Bruce Strain*

DATING, romance, and marriage—this is the scope of this work for adolescents. It is a practical book, dealing with the world of today as it is and not merely as some of us wish it were; that is, it assumes that your adolescent is in that world, which will remain as it is, and therefore will have practical problems to meet. It's a book your son or daughter will read and like—not preachy or superior. Part I contains points on dating, what to be like in order to please, and all about different types of girls and men. Part II is on everyday kinds of girls and everyday kinds of men (how to understand and deal with them); also the "one-and-only" stage. Part III is for marriage and is on body mechanisms, fulfillment in marriage, married life, babies in the making. (349 pages, 5½ by 8 inches, 3 illustrations.)—$2.35 postpaid.—*A. G. I.*

## THE STORY OF A FACE

*By Hillary G. Bailey, F.R.P.S.*

"THE Story of a Face" is the story of producing any photographic portrait from the exposure in the camera and all the thinking that goes on before the "click," to the final print. Mr. Bailey considers his book, which is actually a complete treatise on the fundamentals of portraiture in particular and photography in general, a practical formula of procedure. Practical, indeed, it is, with its lucid discussion of such important subjects as lenses, negative and print quality, composition, and full-length portraiture. And, more than this, the book is pervaded by a philosophy and point of view that raises mere fact-recording to that higher level where a fact is only a jumping-off point for individual thinking and interpretation. (127 pages, 7 by 9 inches.)—$2.60 postpaid.—*J. D.*

## PAINTS AND PAINTING

*By G. C. Molleson*

THE purpose of this manual is to present a compilation of useful and practical, rather than technical, information about the formulation, properties, and application of various paints. This material will be of assistance to the purchasing agent, maintenance engineer, manager, property owner, and others interested in or responsible for the maintenance and preservation of buildings, bridges, equipment, and other miscellaneous structures.

Such general information relating to paints and painting has been included as will give the layman or consumer a general and somewhat detailed knowledge concerning those subjects, that will enable him to buy paint suitable for the purpose intended at a reasonable price.

The above, taken from the publisher's blurb, appears to be an accurate characterization of this book. It contains numerous paint formulas. (274 pages, 5 by 7¼ inches, 12 illustrations.)—$2.10 postpaid.—*A. G. I.*

## RUTHERFORD

*By A. S. Eve*

FORMERLY professor of physics at McGill University and a fellow worker with the great Rutherford, Professor Eve is best able to prepare the life and letters of that great and eminent genius. The book is an intimate mirror to Rutherford, his thoughts revealed in it through innumerable letters interlarded with accounts of his life by the author. (451 pages, 6½ by 9½ inches, 23 illustrations.)—$5.10 postpaid.—*A. G. I.*

## GEMS AND GEM MATERIALS

*By Edward Henry Kraus and Chester Baker Slawson*

THIRD and revised edition of the book of identical title, formerly published under the authorship of Kraus and Holden, and widely known as a standard treatise



**FOR OTHER BOOKS YOU WANT, SEE PAGES 106 AND 116**

for study and reference on the forms, properties, formation, occurrence, and characteristics of gems and gem materials. This is no mere book of inspirational writing about gems; on the contrary, it is a meaty, solid, compact, well organized, scientific treatise of textbook type, dealing with gems in most of the aspects which will interest and instruct the practical amateur collector and polisher. It gets down to brass tacks and fundamentals. (287 pages, 6 by 9 inches. 344 figures and 4 fine color plates.)—$3.60 postpaid.—*A. G. I.*

### WHAT'S YOUR ALLERGY?

*By Laurence Farmer, M. D.*

EVERYBODY has at least one allergy. Some allergies are pretty serious but many others are more in the nature of annoyances which are usually unrecognized as allergies; you know something "is biting you" but you just don't think of it as an allergy. This book, written in layman language, tells what allergies are and how they are diagnosed and treated. (234 pages, 5½ by 8 inches, unillustrated.)—$2.10 postpaid.—*A. G. I.*

### MODERN PORTRAITURE

*By Stanley R. Jordan*

ADAPTATION of the technical methods of Hollywood to still portraiture is the basis of Mr. Jordan's latest book for the advanced amateur photographer. In it he presents complete details on all phases of portraiture photography, including equipment, lighting, make-up, posing, and portraits of various types under varying conditions. The large number of illustrations, many with explanatory diagrams, leaves little to the reader's imagination, guiding him through from beginning to end. (199 pages, 6½ by 9 inches.)—$3.10 postpaid.—*A. P. P.*

### MIND EXPLORERS

*By John K. Winkler and Walter Bromberg, M. D.*

SO far as this reviewer recalls, no recent book has so systematically yet at the same time so compactly swept over the field of general psychology as this most readable volume. It starts with phrenology (an early scientific miscarriage), passes to magic and mesmerism, then to Pinal, Todd, Charcot, and Le Maître, on to Galton, to William James, Cattell, Hall, Yerkes, Watson (behaviourism), Freud, and then a few moderns—stating the principles of the psychology of each fully enough to present its main features yet briefly enough to save the reader from becoming lost in the mazes of detail. (378 pages, 5½ by 8½ inches.)—$3.10 postpaid.—*A. G. I.*

### SCIENCE IN YOUR LIFE

*By John Pfeiffer*

SHORT, compact essays on things scientific—heat, molecules, the telephone, hearing, light, X-rays, atoms, lightning, electrons and so on—compose this little book which would interest any man or youth with an inclination toward scientific subjects. Some of the artist's chapter-head sketches are just a bit absurd, particularly one of a "water-driven dynamo." (109 pages, 5 by 8½ inches, illustrated.)—70 cents postpaid.—*A. G. I.*

# TELESCOPTICS

## A Monthly Department for the Amateur Telescope Maker

**Conducted by ALBERT G. INGALLS**

MOST observatory buildings for telescopes fall into two general categories—the conventional dome and the open-topped rectangular building. Examples of each are shown in illustrations on the present page.

The volume of an observatory dome is directly proportional to the cube of the length of the telescope it houses, hence when B. L. Bradley, 235 North High Street, Salem, Oregon, made a 12½″ mirror of *f*/11½, with a 13′ tube (Figure 2), the 20′ dome he built (Figure 1) was a logical sequitur. It is a fine, roomy dome, quite unlike some which leave so little room between walls and telescope that a fat man, or even a skinny one, must become a contortionist in order to get around.

Bradley's dome has a fixed base 7′ high, of reinforced concrete 5″ thick. Rafters are two-by-fours, roofing is 26-gage galvanized iron painted with aluminum. Shutters open a full 6′, running on roller-skate wheels. Dome rolls around on ball-bearing assemblies from wrecked cars.

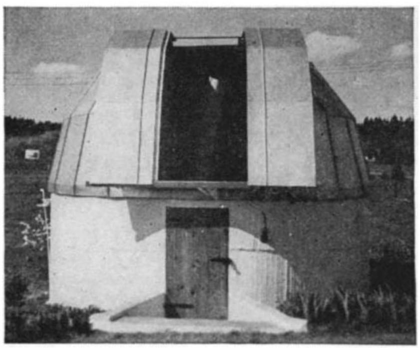


*Figure 1:* **Bradley's big dome**

The telescope stands on a heavy, deep concrete pillar. Its mounting has Timken and New Departure bearings, a closely calibrated declination circle, electric lights, and other trimmings. Tube is 14″ in diameter. Finder is a 6″, *f*/5.5 reflecting telescope. Bradley got the machine work of the mounting done on the well-known "you scratch my back and I'll scratch yours" principle. That is, he made the lads of the Salem High School an 8″ mirror while they did this part of the work for him.

IN winter, the user of a telescope likes a source of warmth to which he may occasionally flee, while in summer he may want to flee from the astronomer's enemy, the mosquito. Frederick C. Holtz, 2150 Wiggins Ave., Springfield, Ill., has worked out a combination, shown in part in Figure 3, which provides for both. "The general appearance," he states, "is that of a garden house with a flat roof. The roof is supported on rails and can be rolled back, giving a clear view of the heavens. This has the added advantage of quickly equalizing the temperatures and does away with the turbulance frequently observed when looking through the slit of the hemispherical type of dome. Many other advantages will also occur to those who have had experience with both types." [There has been many an all-night argument between exponents of the two views; it's like that other problem: which are better—blondes or brunettes?—in final analysis insoluble.—*Ed.*]

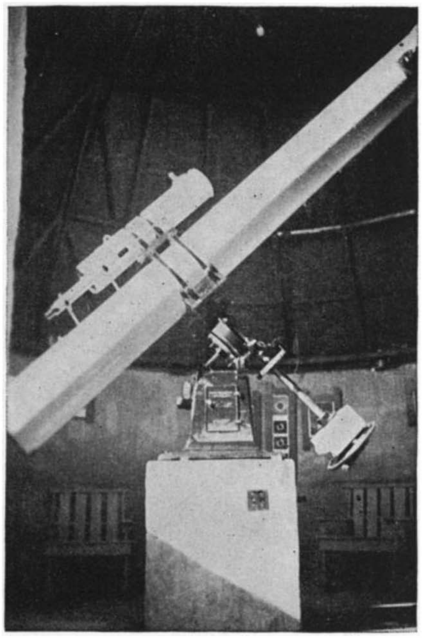


*Figure 2:* **The long-focus reflector**

Continuing, Holtz says: "The portion over which the roof rests when the observatory is in use has been made into a screened-in porch which provides ample room for entertaining guests while they wait their turn to view the celestial wonders. This is augmented by an outdoor fireplace which provides hot dogs and coffee to keep out the cold.

"The telescope (Figure 4) is a 6″ refractor constructed by the writer," Holtz adds, "which ultimately will be replaced by a 20″ reflector—though it must be said for the refractor that its fine definition and many good points could hardly be improved upon. I have made a 3″, a 4″, and this 6″ refractor, also two 8″ reflectors, one with quartz mirror."

Holtz says Steinheil and Conrady are his bibles, likewise Hastings' "Principles in Geometrical Optics," which he calls a wonder of a book.

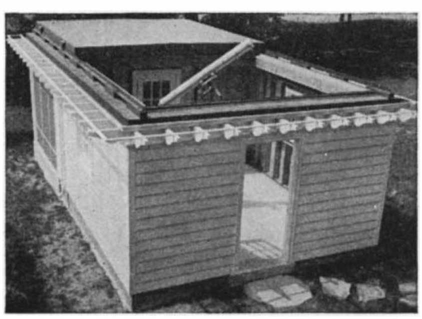


*Figure 3:* **Stars-with-Hot-Dogs, Inc.**

UNCOMMONLY trim workmanship is characteristic of things telescoptical made by D. Everett Taylor, 191 Prospect Street, Willimantic, Connecticut, the author of the chapter on the construction of the metal parts of a refracting telescope in "Amateur Telescope Making—Advanced." Other Taylor jobs—eyepieces, for example—have been described in this department. Now, at our request, Taylor describes one of his recent pieces of workmanship, as follows:

"On page 242, 'ATMA,' Haviland shows a spherometer, and on page250 he recommends a dial-indicating edge or thickness gage. These two items of his are directly responsible for my making the combined spherometer and edge gage shown in three aspects in Figures 5, 6, and 7. For those who aim at a high degree of accuracy in making a lens, this combined instrument demonstrates itself as a necessity instead of 'almost a necessity.' The edge of the thickness gage is for measuring the edge thickness of a lens, while the spherometer gives the sagitta or depth of curve, in decimals of an inch, and is used in connection with the two formulas from page 243, 'ATMA.' The combination gage is made of a 3 5/8″ x 3/8″ brass disk, ¼″ stainless-steel rods, and 1″ x 9/16″ brass rod holder clamps. The Starrett dial gage is graduated to 0.0005″, with a side bezel which simplifies lifting the dial spindle at top. The brass disk is edged, finished on both sides, and a 2″ and a 3″ V-line circle is machined on the face of the disk. These circles are divided into sixths (60° apart), drilled and tapped with 3/16″ x 32 thread. The edge of the disk is also drilled and is tapped with the same size thread, the holes 60° apart and located between or at 30° relative to any hole on the face of the disk. Each rod holder clamp is machined, is drilled for a ¼″ rod, threaded for a screw, then split with a thin hack saw.

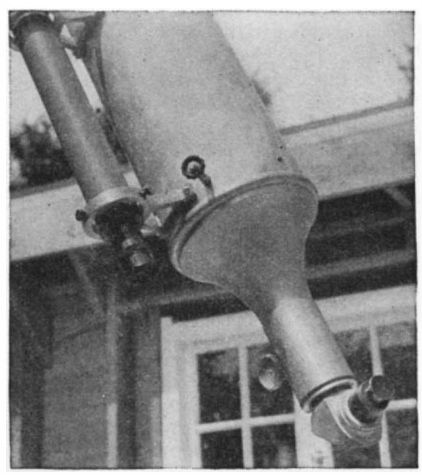


*Figure 4:* **Eye end, 6″ refractor**

"The use of steel balls in the 45° tapered depressions has been abandoned. Steel balls are not sufficiently accurate. A variation of 0.0007″ has been noted in the di-

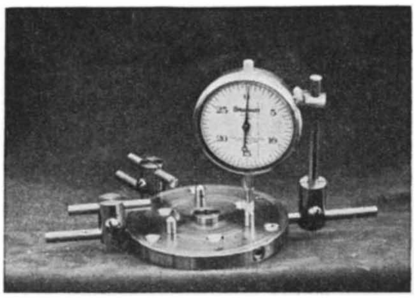


*Figure 5:* Taylor's combined gages

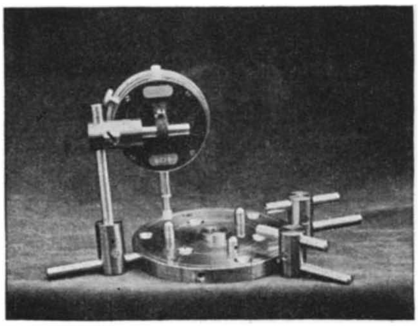


*Figure 6:* Rear aspect of Figure 5

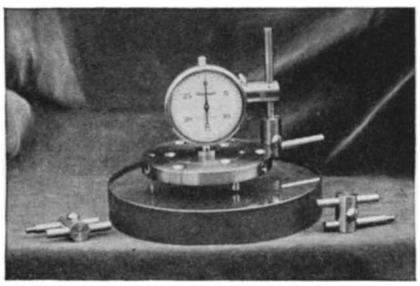


*Figure 7:* The spherometer set-up

ameter of a steel ball. Therefore, the tapered depressions are not required. Three steel posts threaded for the holes in the disk, and having highly polished domes, are used. Each of the radiating rods has one threaded end, while the guide rods have highly polished ends. Used as an edge gage, this device will take lenses from 2" to 6" in diameter.

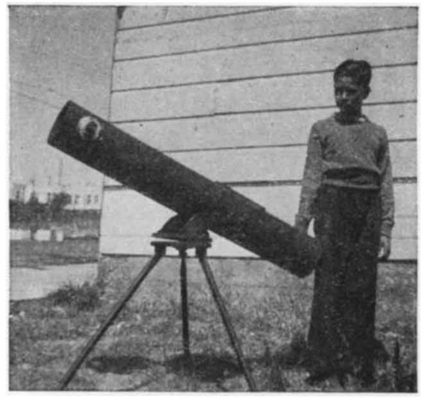
"Figure 7 shows the instrument set up as a spherometer on a 6" optical flat, and adjusted to zero. To use it as a spherometer, three points of contact should be in line. That is, a domed post should be screwed on the under side of the disk, into a hole on a V-line circle at each end of the 2" diameter or 3" diameter, with the spindle of the dial gage passing through the center hole from above, as shown in the photograph. This arrangement locates the three contacts *in line*, thus giving a reading of greater accuracy than would be obtained if three posts were located 120° apart on a circle, with the spindle in the center. It may facilitate in adjusting the spherometer on a flat if, in addition to the three contacts in line, as just described, a third post is screwed into a hole at either side, to steady the instrument while setting the dial. The extra post is to be removed when the spherometer is being used.

"It is doubtful whether a lens can be brought to a complete polish on a machine, without showing some degree of turned edge; which in equal measure would discount the performance of the finished objective if it were not in some manner eliminated. The late world-famous Alvan Clark declared, on the authority of an old lens

## THE BEGINNER'S CORNER

NO thrill an advanced amateur telescope maker is likely ever to receive will out-thrill the one felt by the novice who, after slaving over his first mirror and perhaps wondering all along whether *his* really will perform adequately, as others do, discovers the usual success. Anthony Minski, 36 Chadwick St., Paterson, N. J., describes this thrill in a spontaneous letter mailed immediately after such a first preliminary try-out: "After many trials and tribulations I have at last finished my 6" mirror. I placed the glass, still unsilvered, in its tube and with no little trepidation prepared for the worst. I focused on the Sun and, as I did, the orb became more and more distinct; till at last it stood in all its glory, a clean-cut disk. The sunspots stood out sharply. And then, when it grew dark, I focused on Jupiter, which showed with its tiny satellites in astonishing clarity. Saturn, too, focused beautifully. Then I viewed various stars and these stood out as brilliant points of light, the fainter stars tiny pinpoints in the background. Orion's nebula showed without blur or haze." This man must have fallen asleep that night with a happy smile on his face! One place and another, it happens ten times a night as first telescopes are given first try-outs: this eager anticipation, these dark misgivings, the final jubilation.

BOYS seldom tackle telescope making, and more seldom stick till the finish—it's not juvenile work and it requires more patience than most youngsters possess. Now and then, however, we receive a photograph like the one in these columns, usually from a lad of better-than-average gumption. Rudolf Kohlmeister, 1709 Taraval St., San Francisco, Calif., is the maker of this 6" Newtonian reflector and he writes: "I was 11 when I started it and it took me from Oct. 13, to June 15," Well, Rudolf that is approximately eight months, but we know of instances in which grown men have failed to finish their telescope after eight years, though eight weeks is about average for a man. "The tube," Kohlmeister continues, "is of heavy cardboard wrapped in canvas. The rest is iron scraps and pipe. Grinding and polishing required 54½ hours." A boy of 11 who sticks to anything as long as 54½ hours is likely to get somewhere some day. Your scribe recalls a youngster who similarly stuck, made his telescopes, went through high-school and college, and is now a professional astronomer. That was John W. Evans, of Mills College, Oakland, California.



## TELESCOPTICS

(*Continued from preceding page*)

maker, that the outer 10 percent annulus of a lens should not be allowed to function. Which is the better practice, to grind the turn-down away or to cover it up?

"If Clark's dictum is followed, the required size of glass blank for a lens would be the same in either case. After doing the fussy work required in centering a lens on a mandrel, to grind off a 10 percent annulus would take probably less time than expected. While this grinding would add to the scratch hazard, it would assure a crisp edge and improve an otherwise perfect lens. If the outer 10 percent annulus is to be covered, this should be done with authority and permanence, by machining the inner flange of the cell to the required width or depth.

"It pays handsomely to start with flat, parallel faces on crown and flint blanks. These blanks should be pitched or balsamed into close contact, then precisely edged as a combination, to the desired diameter. By grinding the curves on crown or flint so that the edge thickness does not vary more than 0.0005", the optical center of the lens will automatically be established—and probably with greater accuracy—compared with the result of the tedious conventional practice which depends on reflection and visual judgment."

HAVING purchased a 20½" Pyrex mirror blank, the Springfield (Mass.) Telescope Makers—Carl F. Alsing, president, N. Main St., N. Wilbraham, Mass.—cast about for ways of parallel facing it. One of them owned an old safe for which he had no use because he had nothing to keep in it, and this was converted into a steady support for the grinding spindle. Figure 9 shows the disk on this rough rig while its faces were being ground parallel, as it was 3/8" thicker on one edge than the other, and Figure 8 the 20" by 4½" finished blank with upper face roughed out to approximately the ultimate focal ratio, or 5.5. "We did the edge with the blank pitched to plywood and mounted up grindstone fashion," Alsing states.

IN his new book about the 200" telescope, entitled "The Glass Giant of Palomar," David O. Woodbury discusses the methods used for rotating observatory domes. At Yerkes and Lowell the domes were pulled around by cables wound on a drum. At Mt. Wilson the big dome rests on wheels geared to motors. At Palomar, however, there are two pairs of 5 h.p. motors, one pair of which is shown in Figure 10, a photograph

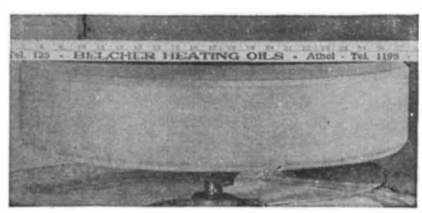



***Figure 8:*** **20" disk ready for fining**

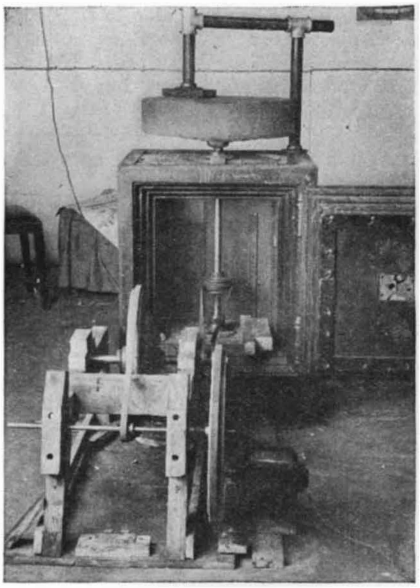


*Figure 9:* **Rough rig for rough work**

by Major Martin D. McAllister of the Municipal University of Wichita, Wichita, Kansas. The vertical drive shafts carry solid rubber truck tires held to the bottom band of the dome by means of springs and friction. As shown in Figure 10, they make contact with the dome through a narrow opening in the top band of the fixed base. This dome drive also acts as a brake or clamp for holding the dome, otherwise the

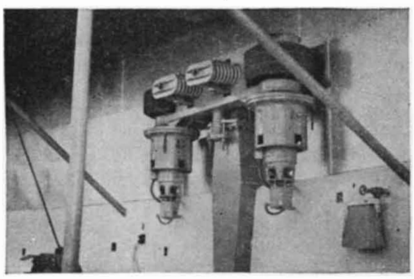


*Figure 10:* **The Palomar dome drive**

unbalanced leverage of the opened shutters with a breeze blowing would turn it, even if it does weigh as much as a 12-car train of passenger cars (1000 tons), for the two rings on which it rotates, made of railroad rails, were ground precisely level.

A MONTH ago we hinted here a few facts about the new Gaviola test for optical surfaces. Before offering a description of it we propose to wait to see how it shakes down in actual practice in the hands of the average worker. Since it deals in amounts about as much smaller than the ordinary Foucault test as the latter deals in amounts smaller than precision machine work, its use obviously will be confined pretty largely to amateurs who have developed high skill. If fine machine work today involves precisions of 1/20,000 of an inch, ordinary mirror work has dealt in precisions of about 1/400,000 of an inch. The Gaviola test deals in precisions of about 1/4,000,000 of an inch. Its user must be expert enough, not alone to perform the measurements, but to control the actual surface in the same degree of precision—all of which hath perhaps a supercilious sound to it. Hence, since the amateur has intellectual curiosity, he will want to know how the new test works, anyway.

## CURRENT BULLETIN BRIEFS

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

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

HIGHWAY TRANSPORTATION REMAKES AMERICA is a 32-page booklet that traces the development of highways from the very beginning down to the present day, and analyzes the many benefits which have accrued to the American people from modern highway transportation. *National Highway Users Conference, National Press Building, Washington, D. C.—Gratis.*

LOOK AND LISTEN, by M. B. Sleeper, is a television handbook for the set builder and service man. Bound with spiral wire, its 96 pages give a complete survey of television reception equipment in its most modern form. An appendix presents a dictionary of television terms. *The Norman W. Henley Publishing Co., 2 West 45th Street, New York City.—$1.00.*

HOW TO TONE PRINTS, by Arthur Hammond, F.R.P.S., is a 72-page paper bound book which gives practical and fundamental instructions for toning photographic prints in various colors. The necessary formulas are included. Several toned photographic illustrations show the results that may be expected. *American Photographic Publishing Company, 353 Newbury Street, Boston, Massachusetts.—50 cents.*

ATLAS SHOP EQUIPMENT is a 72-page illustrated catalog which presents complete information on machine tools and equipment. The latest models of lathes, drill presses, and so on, are described, together with new attachments and accessories. *Atlas Press Company, Dept. 7, Kalamazoo, Michigan.—Gratis.*

INSTRUCTIONS for painting the interior and exterior surfaces of all types of tanks and supporting structures are given in a folder recently made available. Information is included on surface preparation and how to estimate quickly the surface areas and amount of paint required on various jobs. *American Asphalt Paint Company, 43 East Ohio Street, Chicago, Illinois.—Gratis.*

TRAVEL WAYS is a 40-page booklet that lists a multitude of vacation trips by freighter. Its first-page title, "Foreign Lands at Stay-at-Home Prices," sounds the keynote of the whole booklet. It describes freighter traveling, tells of the great values received for every dollar spent. The book is divided into two parts — a complete guide to freighter travel, plus a tour guide to America. The latter includes bus and rail tours. *Harian Publications, 272 Lafayette Street, New York City.—25 cents.*

ENLARGING THE SOLAR WAY is a 23-page booklet that provides essential information for achieving the best possible results with the enlarging process. Contains much practical data of value both to the amateur and the advanced worker. *Burke & James, Inc., 223-225 West Madison Street, Chicago, Illinois.—Gratis.*

THE OBSERVER'S HANDBOOK is an 80-page pocket-size booklet containing an ephemeris of the Sun, data on the planets' position for the whole year 1940 by dates, list of eclipses, data on the sky month by month with four charts, meteor data, double and variable star lists, positions and data for the 259 brightest stars, lists of clusters and nebulae, and other compact data for telescope users. Prepared annually for amateurs by astronomers Chant and Hogg of the David Dunlap Observatory, University of Toronto. *Royal Astronomical Society of Canada, 198 College St., Toronto, Ont., Canada.—25 cents.*

FOOD AND LIFE is the current yearbook of the United States Department of Agriculture under the new policy of making the yearbooks informative and readable. Two-thirds of this 1165-page book deals with animal nutrition — 36 chapters or articles by scientific authorities. The remainder deals with human nutrition. *The Superintendent of Documents, Washington, D. C.—$1.50.*

CURRENT PHOTOGRAPHY, edited by Herbert C. McKay, F.R.P.S., is the newest addition to the field of photographic publications. The magazine is planned in such a way that it appeals not only to the camera enthusiast but to the casual picture taker as well. Information regarding subscriptions may be obtained from *Klein & Goodman, 18 S. 10th Street, Philadelphia, Pennsylvania.*

45,000 WAYS TO WEIGH is a large folded sheet which illustrates a large number of industrial scales, showing the actual applications of many of them. It gives an excellent idea of the many industrial applications of weight measurement for production control. *Toledo Scale Company, Toledo, Ohio.—Gratis.*

RADIO BUYING GUIDE 1940 is an elaborate catalog, thoroughly illustrated, which lists all types of radio and sound equipment. It would be of interest to all radio service men, amateur radio operators, and those who take pride in constructing high-grade radio equipment for pleasure or profit. *Sun Radio Co., 212 Fulton Street, New York City.—Gratis.*

NUTRITIONAL CHARTS is a 36-page booklet which considers the whole field of diet and its relationship to the well-being of the human body. It deals with, for example, quantities of nutrients required per day, a simple diet plan, vitamin data, composition of various foods, and so on. *H. J. Heinz Company, Research Dept., Pittsburg, Pa.—Gratis to medical specialists and students, nutritionists, and dietitians.*

# 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

### Reassuring

MANY of us will be reassured by the implication inherent in a recent decision of a federal court that manure is not an obvious substitute for or equivalent of cereals. The decision was handed down in a suit for infringement of a patent for propagating mushroom spawn. Prior to the invention covered by the patent in suit, mushroom spawn was propagated by placing a culture in a bottle packed with composted manure. The culture was permitted to propagate in the bottle for a period of six weeks or so under predetermined conditions of temperature and humidity. During this period the thread-like mycelium of the culture spread throughout the contents of the bottle. At the end of this period the resultant product was known as mushroom spawn and was planted in properly prepared beds to produce mushrooms.

In the process taught by the patent in suit, cereals such as cracked wheat, whole grain wheat, barley, and rye were substituted for the composted manure and in all other respects the process was carried out in essentially the same manner as the original process. Among other things it was contended by the defendant that the substitution of the cereal for the composted manure did not amount to invention. The Court, however, found that the use of cereals resulted in a decided improvement in the spawn and concluded that the replacement of the manure by a cereal constituted invention.

### Recordings

THE Courts have recognized that interpretive artists have a form of literary property in their renditions. Thus it has been held that where a recording has been made of an orchestra leader's interpretation of a song the recording cannot be broadcast over the radio without the consent of the orchestra leader. This principle of law assumed a peculiar twist in a recent Federal Court decision in a case involving a prominent manufacturer of phonograph records and a well-known orchestra leader. The orchestra leader had entered into a contract with a manufacturer, granting the manufacturer the exclusive rights to manufacture and sell phonograph records of his renditions. The contract specifically prohibited the manufacturer from using the records for radio broadcasts. Thereafter, the orchestra leader authorized radio broadcasting stations to broadcast the recordings which were made pursuant to the agreement.

The manufacturer objected to this use of its records and filed suit against the orchestra leader and a radio broadcasting company to restrain them from using the records in this manner. The Court found that the orchestra leader "because of his unique interpretation of musical selections, had a common law property right in his renditions" and found that the property right in the recorded renditions had been sold to the record manufacturer. Under the circumstances the Court concluded that the record manufacturer was the owner of the recorded renditions and could restrain the orchestra leader and the broadcasting company from broadcasting the recordings.

### Yeast

IN this department in the June 1939 issue, under the title "Experimentation," we referred to a decision of a federal court with regard to a patent for propagating yeast. In that case the patent was declared invalid on the grounds that the process covered therein could not be carried out without further experimentation. The decision has now been reviewed and sustained by the United States Supreme Court.

The patent in suit related to a process for propagating yeast in which the production of alcohol was reduced to a minimum. The patent suggested that the yeast be placed in a relatively dilute wort. Upon the initiation of the process of reproduction, a relatively concentrated wort was added to the original dilute wort over a protracted period of time. The patent did not specify the exact times at which additional concentrated wort was to be added nor did it specify the quantity to be added at these times. The patent did state that the wort should be added "at a rate such that not only the alcohol which may have been formed from the quantity of sugar present in the dilute portion of the wort, but also any alcohol which may be formed from the sugar which is present in the added wort, can be assimilated immediately by the yeast." This description was held by the court to be too vague and indefinite, since both the times and manner in which the solution is to be added may be ascertained solely by experimentation.

### Thermostatic Control

THE difference between a patentable combination and an unpatentable aggregation was considered in a recent suit for patent infringement involving a thermostatically controlled, house heating system. In the patented system, a furnace having an automatic stoker was utilized and a thermostatic control was provided in the room to be heated and also in the furnace. The thermostat in the room was of the usual type intended to cause the operation of the stoker so as to maintain the room temperature within certain predetermined limits. The thermostat in the furnace was intended to cause the operation of the stoker to prevent the fire in the furnace from going out, particularly during warm weather when the thermostat in the room did not cause operation of the stoker at sufficiently frequent intervals to keep the fire going.

It was contended by the defendant that the use of the two thermostats was an aggregation, as distinguished from a patentable combination. The Court considered the law with respect to this question and concluded that "the acid test is whether the old elements work together to accomplish a useful new result." If they do, there is a patentable combination. If they do not, there is merely an unpatentable aggregation. The Court then pointed out that the two thermostats did work together to perform the function of regulation of the room temperature within predetermined limits. The thermostat in the furnace prevented the fire from going out and in that way enabled the furnace to operate in response to the thermostat in the room and thereby preserve the room at the desired temperature. As a result of this co-operation, the Court held that the patent covered a patentable combination.

### Havana

FALSE or misleading branding of merchandise is an unfair method of competition and can be restrained by the Federal Trade Commission. However, an interesting qualification of the power of the Commission to restrain such practices has been recognized by the courts. Thus, where a misleading name has been employed by a manufacturer for a long period of time so as to acquire a secondary meaning quite apart from its original significance, the courts will not require the user of the name immediately to discontinue further use.

This principle is illustrated by a Federal Trade Commission proceedings involving the use of the name "Havana Smokers" on cigars manufactured in the United States from tobacco grown in the United States. The Commission contended that Havana tobacco was regarded as superior tobacco and that the name Havana Smokers would mislead purchasers into believing that the cigars contained Havana tobacco. A Federal Circuit Court of Appeals, reviewing the proceedings, found that the name Havana Smokers had been used by the cigar manufacturers since 1902 and that in all probability the name had acquired a secondary meaning, quite apart from its original significance, indicating to the public that the cigar was the product of the particular manufacturer. In view of this the court was of the opinion that the sudden elimination of the name Havana Smokers might cause confusion among the purchasers of this brand of cigars and concluded that the manufacturer should be allowed a period of two years within which to eliminate the use of the name Havana in connection with the cigars. In this way it will be seen that the public would ultimately be protected against the use of a misleading brand name and that the manufacturer would be permitted a reasonable transition period within which to adopt a new name

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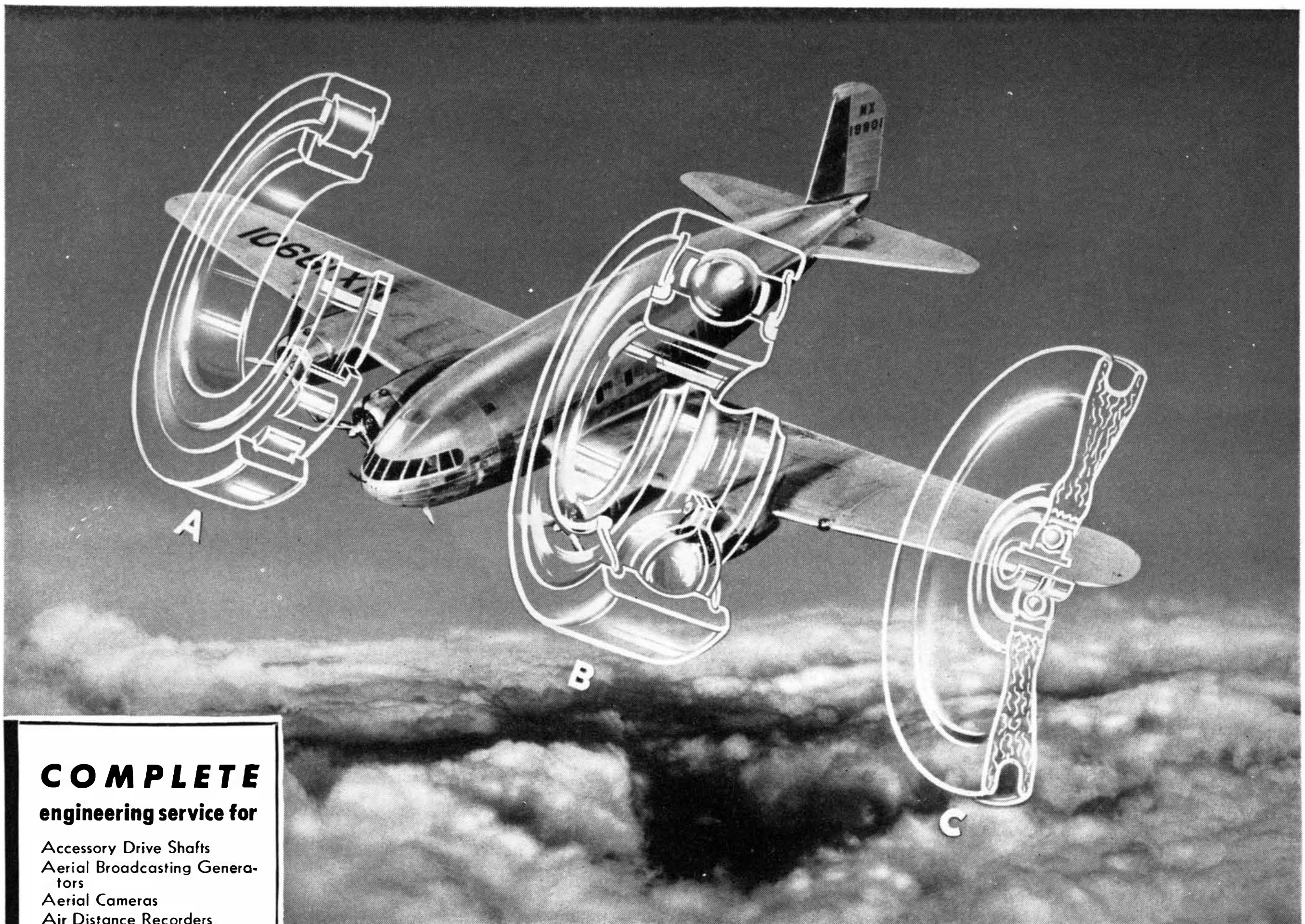


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