TELEVISION

Goes on Broadcast Schedule

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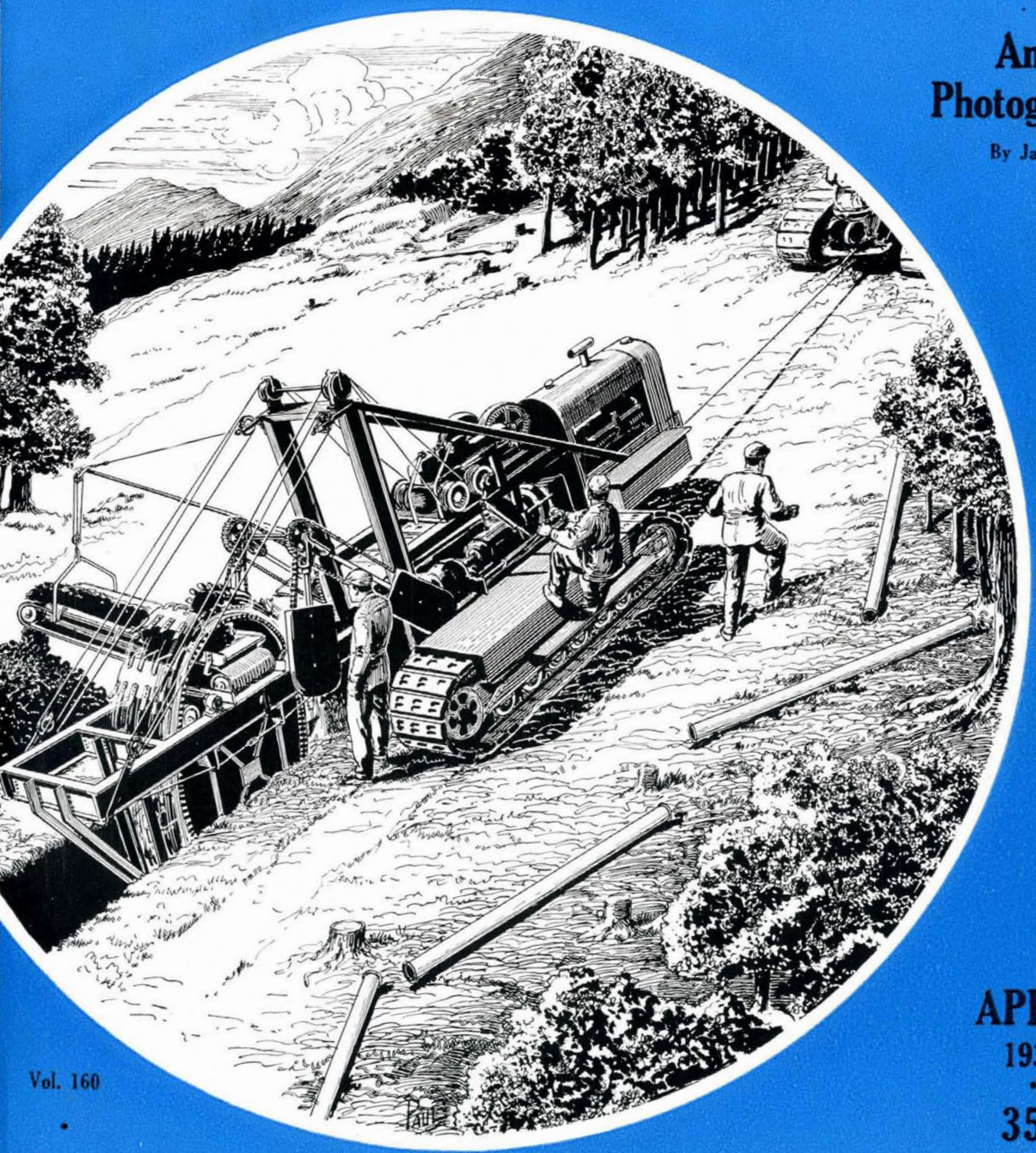

Vol. 160

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No. 4

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1939

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Stepping Stone To The Future—

Since science touches and influences our lives hundreds, thousands of times daily, we can be best prepared for the future, can best profit by the achievements of science which will continue to influence and change our lives, our businesses, and our whole economic scheme by carefully following current progress. Understandable, thorough, and authoritative discussions of trends and how they will affect us are presented by experts in many fields of pure and applied science in each monthly issue of:

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■

Authoritative Noted scientists and experts in many fields of endeavor write for each monthly issue. Authors are carefully chosen both for their intimate knowledge of their subjects and for their ability to write "humanized science" articles. In addition to the office staff headed by Orson D. Munn, a staff of contributing editors assists in checking and cross-checking every fact. This list of contributing editors reads like a "Who's Who" of top men in Science and Industry, and includes Directors of Research of several gigantic industrial organizations, the editor of the *Journal of the American Medical Association*, a noted naval captain, a number of famous university professors, and others. These men are, in effect, continually "in conference" with the office staff.

■

Understandable Second only to wide general interest, in importance, is the style of Scientific American articles. They *must* be written so that the layman can easily understand them. This is assured by the care with which the editors select authors and material. The editors attend scientific and industrial meetings, make periodical survey trips, and get suggestions as to both authors and material by reading each month thousands of publications—scientific, technical, and trade magazines, and institutional, industrial, and governmental bulletins. The result is a clear, straightforward presentation of editorial matter that is a happy compromise between the too-popular and the too-technical. Sensational writing is avoided; and facts take precedence over futuristic, illogical predictions.

■

Readers Thinking people—progressive industrialists, educators, ambitious laymen, thousands of industrial executives, technicians, research engineers, scientists, alert men who lead the nation and mold its industrial future—these are the present readers of Scientific American. Many of them laid the groundwork for their careers by reading this journal regularly, and continue to read it for its inspiration.

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NINETY-FIFTH YEAR • ORSON D. MUNN, Editor

CONTENTS • APRIL • 1939

IN digging trenches for pipelines which will transport oil, as described in the article starting on page 212 of this issue, a ditching machine is employed. As our front cover illustration shows, this machine frequently is used on such steep slopes that even the crawler-mounted machines are incapable of negotiating them under their own power. To help them up the slopes a cable is run to a winch mounted on a tractor which is securely anchored to a tree.

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50 YEARS AGO IN . . .

SCIENTIFIC AMERICAN

(Condensed From Issues of April, 1889)

EMPLOYMENT—"Frequently one sees appalling computations of the vast number of workmen who are constantly thrown out of employment by new mechanical inventions that take the place of human hands. But along with the displacement of hand labor there has gone a replacement, in consequence of the increased production that always follows a cheaper process of manufacture. . . . It must be admitted that though mechanical inventions have put a great many persons out of work, they have also put a great many more persons into work."

UNDERGROUND WIRES—"The work of removing the aerial telegraph, telephone, and electric supply lines in this city, with a view

to forcing the electrical supply companies to use the subway system in such streets as contain it, has been vigorously prosecuted during the past week. . . . A very impressive feature of the operations is the comparative darkness to which the city in these parts is relegated at night. The gas lamps are quite unable to supply sufficient light for the people, who have now been accustomed to electric illumination. It is to be hoped that the electric light companies will make every effort to start their lamps anew and give the many centennial visitors a good illustration of subway electric supply and illumination."

BLACK SNOW—"At Aitken, Minn., on April 2, at 4:45 o'clock, it became so dark that lights were necessary in business houses, and the air was filled with snow that was as black and dirty as though it had been trampled into the earth. Six ounces of snow and one-fourth ounce of dirt and sand were found in the bottom of a dish. The dirt is very fine, something like emery, and contains particles that have a metallic luster. This dirty snow fell to the depth of half an inch. The atmosphere at the time presented a peculiar greenish tinge."

TRANSATLANTIC—"The new and magnificent ocean steamer *City of Paris* arrived at this port on the 11th inst., on her first trip, having made the voyage from Queenstown in the remarkably quick time of 7 days, 11 hours, 39 minutes. It is believed her speed will be increased after a few more voyages have been made and her machinery becomes a little worn. As it was, the vessel made 498 miles as her fastest single day's run."

NIAGARA—"There have been recently two very heavy falls of rock at Niagara Falls. At first a mass of rock fell from the Horseshoe Falls, and twenty-four hours later another mass was precipitated into the abyss below. . . . The result of the displacement is a change in the shape of the fall. Formerly the Canadian portion of the fall could be described as a horseshoe; but the breaking away of rocks in the center some years ago made it V-shaped. Now that a further displacement has occurred, the fall has returned to its old condition."

DIAMOND—"The 'Julius Pam' diamond, which is valued at from 15,000 to 20,000 pounds, has arrived in London from Kimberley. It weighs 241½ carats, or fully 90 carats more than that other beauty, the Porter-Rhodes diamond, and was found in the New Jagersfontein United Mine. . . . The only larger diamond in existence is the Imperial, but it is said to be inferior in quality to the 'Julius Pam.'"

ELECTRICITY—"Professor Elisha Gray remarks that electrical science has made a greater advance in the last twenty years than in all the 6000 historic years preceding. More is discovered in one day now than in a thousand years of the middle ages. We find all sorts of work for electricity to do. We make it carry our messages, drive our engine, ring our door bell, and scare the burglar; we take it as a medicine, light our gas with it, see by it, hear from it, talk with it, and now we are beginning to teach it to write."

TELEPHONES—"In probably no country in the world has the telephone come into more general use than in Sweden. Not only can Stockholm boast the most perfect telephonic arrangements of any capital, in addition to the largest percentage of telephone subscribers, but the east coast and the west coast will soon be in telephonic communication, a line between Stockholm and Gothenburg being in course of erection."

RECTIFIER—"A device which may be of considerable value is described by M. Neyreneuf in the *Journal de Physique* as an electric valve, by means of which the current can be sent in one direction, but not in the other. With a voltameter constructed of two aluminum electrodes, dilute acid as electrolyte, and an alternating current, he found that pure hydrogen was evolved at both electrodes, but on making up an arrangement with one electrode of aluminum and one of mercury, the current was found to pass in one direction only."

SWAY—"The oscillation of high structures in storm winds is a much observed fact, and has probably been the cause of many failures in high chimneys by collapse or permanent set out of plumb by excessive pressure from the rocking motion set up in gales of wind. . . . The Eiffel tower will no doubt be affected to a marked degree by high winds. Although its form of structure is of the least area to the force of the wind, its form and elastic material favor large oscillation in storm winds."

TEAK—"So indestructible by wear or decay is the African teak wood that vessels built of it have lasted fully one hundred years, to be then broken up only on account of their antique mould or defective sailing qualities."

AND NOW FOR THE FUTURE

¶Safety factors in air transportation that have been made possible by scientific research.

¶Treacherous waters are being battled by engineers bent on saving Niagara Falls, by R. G. Skerrett.

¶Animals, man's benefactors in many ways, can also be carriers of serious diseases, by William Wolf.

¶Mechanization of lumbering operations speeds production, by Andrew R. Boone.

¶Strange behavior of liquid helium puzzles pure science research workers, by Prof. Thomas H. Osgood.

OUR POINT OF VIEW

More Tax Diversion

EACH year the 10 percent excise tax on sporting arms and ammunition, levied under the Pittman-Robertson Act, is supposed to be ear-marked for use by the various states for wildlife restoration. Because it would assist restoration or restocking of game, sportsmen have not looked upon the Act with disfavor.

It appears now, however, that somebody in Washington has had a brilliant idea: diversion to other uses of more than two thirds of the revenue obtained under this Act. Reliable estimates of this revenue place the full amount at $3,250,000. Yet the recommendation for the appropriation to the states, when recently presented to the 76th Congress, was just $1,000,000. Where is the other two and a quarter million? Going to build a post office for some tank town, or some other political extravagance?

To us, this attempted expropriation of moneys for other than their legal purpose is reprehensible in the extreme, and we therefore repeat here and wish to emphasize statements in the report of the House Committee on Wildlife Restoration:

"The Committee is of the opinion that by proper administration and intelligent co-operation the Pittman-Robertson Act can be made the beginning of a national wildlife program, which if carried out to the fullest extent possible under the law can prove as beneficial to wildlife restoration and management as the Federal Aid Highway Act has been to the State highway systems of this country.

"And it is our earnest recommendation to the Congress that the present excise tax on arms and ammunition be continued and that the full amount of the tax so realized be appropriated in the future for use under the provisions of this act."
—*F. D. M.*

Who Profits Most?

TIME and time again this page has pointed out the necessity for retaining the profit motive in the patent system of the United States. So have, also, many other authorities on patents and inventions. Yet we have before us the spectacle of a Congressional Committee, supposedly impartially investigating monopolies, indicating by many of its questions to witnesses an attitude prejudicial to the taking of a profit from an invention by the developer. Were this belief in the "guilt" of inventors confined strictly to the Committee, no great harm would be done; but, unfortunately, the members are, ex officio, authorities on this subject and their words have the force of propaganda to sway the unthinking portion of our citizenry. Already, newspaper reports of their investigations of several industries have aggravated the too general, erroneous feeling that industrial patent holders are not to be trusted.

As a recent witness for the "defense" before this Committee, Dr. Vannevar Bush, president of the Carnegie Institution, was most effective. Taking from his pocket a little strip of metal about an inch and a half long, he explained that one company had spent $100,000 to develop it. Warmed by the heat of his hand, it performed with a snap; it is a thermostat for use in electric irons and other appliances. At this enormous cost, it goes without saying that no individual or company would have developed it without the assurance that the patent law permitted a profit on its manufacture and sale. It is equally obvious that research of the kind that made it possible would be quickly and entirely abandoned by corporations should the present 17-year patent period be sharply cut or if general licensing of patents were compulsory under the law.

This seemingly simple yet costly development is but one of thousands made every year, also at great cost, in the interest of the public's comfort, convenience, and general well-being. It is the people who benefit, even though the developer does make a profit for a few years. It is the people who must understand this fact and, knowing that the greatest profit is theirs, take a determined stand against unstudied modifications of the present patent system.—*F. D. M.*

Resources

A RECENT plea by the Administration for a survey of the natural resources of the nation strikes a responsive chord in the editorial heart of Scientific American. But at the same time it creates a feeling of apprehension that will not down. We have always been in sympathy with efforts directed toward conservation of lumber, coal, metals, and so on; we have given active editorial support to further the cause of those striving intelligently to this end. But we have seen the results of all too many governmental surveys—a new bureau set up, millions of dollars spent in field work and for endless reports that might well have been written in the reference room of a public library. And then silence.

It is not too naive, we hope, to cling to a straw of optimism and to dare to look forward to the time when a lavishly endowed government bureau will produce a plan that can be handed to the people of the nation to serve as a guide to coordinated conservation. It must be admitted that such a guide, if properly prepared by competent specialists, would be of tremendous value to industry, agriculture, and the public as a whole.

We do feel, however, that the same end can be reached—more economically, more efficiently, and in the same length of time—by those whose best interests will be served in the long run by the application of conservation principles that are well known today. This statement is made in no spirit of laissez-faire, but rather from a knowledge of how industry in general is meeting and solving its own problems to its own and the public's advantage. Some scandal mongers and mud slingers to the contrary, this nation is no longer ruled by robber barons whose only aim is to despoil for their own benefit, and the devil take the hindmost. Modern industrialists realize full well that our natural resources are not unlimited; that they profit most when they apply conservation tactics to the full. Modern agriculturists are working along the same lines. The public is on the receiving end and is reaping the benefits. And these benefits are accruing with a minimum of drain on the national treasury, a fact that will not be true if the Administration goes too far in its laudable but perhaps misguided efforts to study the whole problem of conservation. The money so spent might better be left in the hands of those who would apply it to practical methods of conservation rather than to the formulation of theories that make fine reading but are lacking in value when put to test.

It may help to clinch our argument if we cite a generalized example of conservation practiced for the much-kicked-around profit motive. Years ago far-seeing lumbermen came to realize that stands of timber were not inexhaustible, that they could not ruthlessly cut down trees and leave the countryside a barren waste. They found that indiscriminate logging was not the profitable way and that it would interfere with future gain. So, just as any sensible business man would do for his own protection, they began to plan their operations on a conservative basis. Selective logging and tree-planting programs were inaugurated and, as these practices are applied more and more, we have little to fear for the future of this important industry that is tapping but at the same time replacing one of our important natural resources.
—*A. P. P.*

Personalities in Science

EDWIN POWELL HUBBLE

TO Dr. Edwin Hubble, of the Mount Wilson Observatory, in California, recently was awarded the Bruce Gold Medal of the Astronomical Society of the Pacific, "for distinguished services to astronomy." Within the past decade Dr. Hubble has become an astronomer of outstanding world recognition.

On the occasion of the presentation of the medal Dr. Harold D. Babcock, president of the Society, gave an account of his career and accomplishments, a part of which is quoted from the Society's *Publications*.

"Dr. Hubble was born at Marshfield, Missouri, November 20, 1889. His undergraduate studies, emphasizing mathematics and astronomy, were completed in 1910 at the University of Chicago, where, against spirited competition, he won a Rhodes Scholarship, a recognition of his promise for the future. The ensuing three years of study at Oxford, centered in the field of law, were followed by the degree of Master of Arts in 1913. On his return to the United States he was admitted to the Bar, but he soon found that his strongest interests remained in science. He resumed the study of astronomy at Chicago, became, in 1914, an Assistant at the Yerkes Observatory and a pupil of Professor Frost, and in 1917 received the degree of Ph.D.

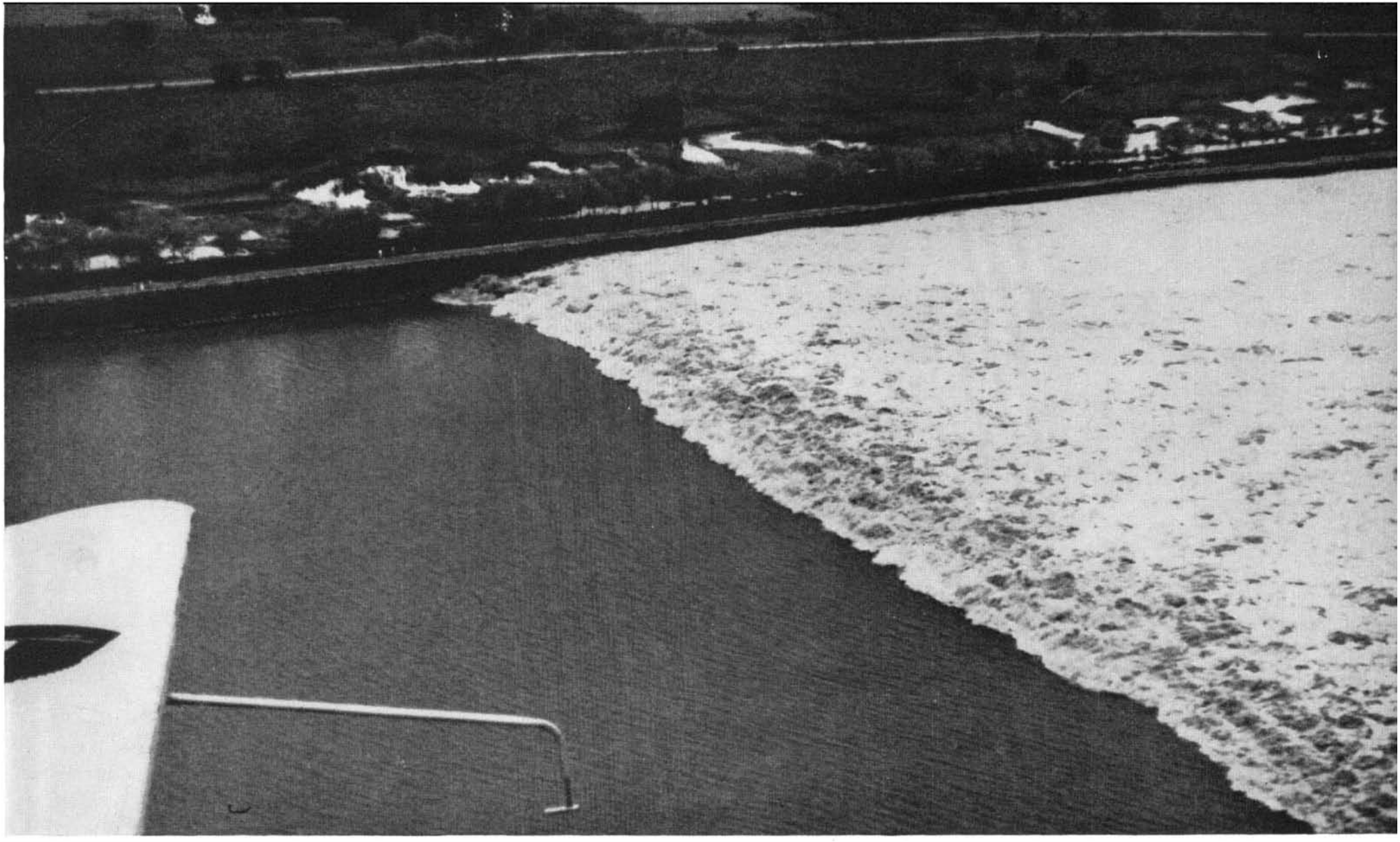
"Enlisting in the infantry that same fateful year, he served until 1919 in France, was mustered out with the rank of major, and immediately joined the staff of the Mount Wilson Observatory. Here he rapidly made a place for himself in his chosen field, as testified by his receiving the $1000 prize of the American Association for the Advancement of Science in 1925, his election to membership in the National Academy of Sciences in 1927, his selection as Halley Lecturer at Oxford University in 1934—a rare distinction for any non-British astronomer—and the award to him of the Barnard Medal in 1935.

"Even before he received his degree, Hubble showed evidence of his skill as an observer. On taking up his researches at Mount Wilson, he boldly attacked the vast problem of determining the scale on which is constructed that part of creation within the range of observation. Aided by the best equipment thus far available for the purpose, he has been able to establish new outposts of knowledge through the application of accepted methods and of new developments in technique.

"Dr. Hubble was the first to establish a reliable scale of distances for objects observable with the 100-inch reflector and farther away than the Magellanic Clouds. He has brought within the domain of the measurable a sphere of radius 500 million light-years. The volume of space now subject to exploration is a thousand million times as great as that amenable to quantitative discussion only 20 years ago."

After describing Dr. Hubble's researches on the Andromeda Nebula, made prior to 1929, which provided "almost conclusive evidence in support of the island universe hypothesis"—observations which "alone would attract the interest and respect of all astronomers"—Dr. Babcock refers in summary to the cosmological significance of his observations in general. "They certainly have reacted strongly upon the thinking of the greatest theoretical physicists and astronomers, have stirred the depths of philosophical speculation, and, perhaps more important than anything else, have clearly shown the need for still greater instrumental power. It is not an overstatement to say that the convincing data assembled by him with the 100-inch telescope have been a powerful argument for the construction of the 200-inch reflector."

Dr. Hubble is the author of a recent book, "The Realm of the Nebulae," embodying in semi-popular form the results of his researches in the subject of his specialty.



A MAGNIFICENT TIDAL FRONT IN A CHINESE RIVER

BY rising more rapidly in the seas than they can flow into adjacent land channels without producing an uncommonly steep front, the tides in a few suitably situated places on the earth produce bores, especially when sun and moon conspire to produce maximum rises. A bore (old Scandinavian word meaning "wave") occurs in the narrowing Bay of Fundy, also in several English rivers. The bore shown above is a heavy one which occurs at flood tide in extreme eastern China, near Hangchow, on the Tsientang. The bore rushes up the river at quite considerable speed, raising the water level many feet, mainly at the steeply sloping face. The standing figures on the distant bank give the scale. The fury of this thundering "wall" of swift, turbulent water is awe-inspiring and the natives never tire of witnessing it.

In a television studio. *Left:* Directing a scene on a "live" stage. Two cameras are used to introduce variety in the angles of view. *Right:* Another stage setting showing, in the foreground, the latest type of lighting equipment used in television studio work

HERE COMES TELEVISION!

Will Serve Entertainment Needs . . . Technical Equipment Has Limitations . . . Standards Laid Down to Prevent Obsolescence of Receivers

By O. B. HANSON
Vice President and Chief Engineer
National Broadcasting Company

FOR years people who knew of my connection with television have been asking: "When do we get it?" Whenever the temptation to predict grew strong within me, I would mentally turn the pages of old magazines—"Television Comes to the Home" (1928), "Television Gets Ready for Business" (1930), and so on—then mutter a few incomprehensible phrases and let it go at that. Now I am in happier circumstances. Broadcasting of regular television programs to the metropolitan area of New York will start in April. The same time has been chosen for marketing the first commercial receivers. Together, the two events mark the real beginning of American television.

It is probable that the average intelligent reader, having scanned a few magazine articles and news stories about television, has arrived only at the point of confusion. Perplexing questions pop into existence, speculation arises, and nobody seems very certain of anything about television. Television is bound to have profound effects on our social order. It will affect existing industries, create at least one new one. Some day it may encroach on other entertainment and educational media. Perhaps it will cause a change in the styles of presentation that will be used in other media.

JUST prior to the arrival of scheduled television programs on the American scene, we present the accompanying article to give a comprehensive view of the situation as it stands today. Written by Mr. Hanson at our request, it clears up many misconceptions about the subject.—*The Editor.*

Will there be national television networks? What about the movies and television? Who will appear on the television screen and what will the programs be like? And what is television and how does it work?

Let me begin with the last question. A convenient definition of television is "the transmission of scenes or images in motion, by electrical communication methods." Broadly, it is a radio medium designed for the entertainment and education of the home audience. The television system which has gained widest acceptance is entirely electronic, without a single moving mechanical part. Its bright, moving images are in black and white, filled with interesting detail and without a trace of flicker. The transmission apparatus, although almost infinitely complex in design, is entirely reliable. In a recent demonstration at Washington, D. C., in which the NBC mobile television units were the transmitting station, not one minute was lost in more than 30 hours on the air through equipment failure. I assume that the commercial receivers soon to be marketed will also be reliable and simple in operation.

MY description of television's apparatus will naturally veer toward the technical. And since I am most familiar with the NBC equipment, I shall use it as an example. Our apparatus embodies the RCA all-electronic system of television. In the camera, fitted with a photographic lens system, the light image is focused on a photo-sensitive mosaic inside the Iconoscope, a highly evacuated tube shaped somewhat like a dipper. The photo image is here registered and its light values converted to electrical potentials. We have here a "picture in voltages," which, to be useful, must be analyzed, taken off the mosaic, amplified, and broadcast.

The analysis, or "scanning," is accomplished by a beam of electrons originating in the neck of the Iconoscope and focused on the mosaic to the fineness of a pin point by an electrostatic lens. The beam is drawn across the mosaic, by horizontal and vertical deflection coils, in a predetermined pattern of 441 lines at the rate of 30 frames a second. Actually the rate of scanning is 60 half-frames, or "fields," per second. Interlacing—scanning of the odd lines dur-

Mobile television unit consisting of two trucks that carry all equipment necessary for relaying television programs from remote points to the main transmitter located some miles away

ing the first field, followed by the even-numbered lines in the second—completely eliminates flicker.

In so scanning the mosaic, the electron beam neutralizes the charge that has accumulated on each element of the mosaic. In so doing, the beam sets a current flowing in the circuit; in aggregate, these impulses constitute the vision ("video") signal. They are amplified many times and sent to the transmitter either by radio relay or coaxial cable, where they modulate the station's ultra high frequency carrier before being broadcast over a specially designed wide-band-pass antenna system.

At the receiver, after again being amplified, the video signal modulates the electron beam in the neck of a large funnel-shaped vacuum tube called the Kinescope. The modulated beam is drawn over a fluorescent screen of zinc sulfide at the large, or screen, end of the tube in the predetermined pattern of 441 lines, 30 times a second. And since the light values created in the fluorescent screen vary directly with the intensity of the electron beam, a replica of the original image is produced. Viewing is either direct from the end of the tube or by reflection in a mirror.

This is the system we shall use in inaugurating our television program service in the New York area. We are confident that with the inevitable technical improvements that will develop once a television service gets well under way, the system will serve the needs of the American people.

Our technical facilities at W2XBS include studios for both live talent and film programs, and a mobile television station for outside pick-ups. This latter should be of great assistance to us in presenting programs from athletic stadia, parades, and sidewalk interviews, and all types of outdoor news events, in addition to floor shows from popular night clubs and hotel grill rooms. We shall use either our present mobile station, or one similar to it, in televising the next Presidential Inauguration in Washington, D. C.

Mr. Hanson, author of the accompanying article, with one of Iconoscope tubes used in transmission

Our studio for live talent programs is fitted with three Iconoscope camera-chains for multiple camera pick-up of performances. This assures the variety of shots necessary in the pictorial art. Switching from one camera to another is done in the studio control room by means of push-buttons. Several projectors and cameras are located in the film studio.

All technical equipment has its limitations. Television apparatus offers no exception. Our camera's depth of focus still leaves something to be desired, although improvements are constantly being made in this respect. Likewise, the spectral response of the Iconoscope is not equivalent to that of the human eye, though its range is considerably greater, since it extends into the infra-red frequencies.

In a more practical sense, television service at present is limited to a few transmitting stations. NBC has been broadcasting intermittently with the RCA all-electronic system of television since June, 1936. Several other stations employing the electronic system, however, will soon be broadcasting. One other station is licensed in New York City, another in nearby New Jersey and two others upstate. Bridgeport, Connecticut, will be the location of a sixth eastern station. Most of these will be isolated stations, although I believe the two in upstate New York will be interconnected by radio relay.

THIS brings us squarely against the problem of television networks. If television is to fulfill even a small part of its promise it must create networks. Spontaneity will be the life blood of television, and it cannot deliver news events to viewers in many cities, while they are still happening, without building networks. Eventually, I am sure, the country will be covered with such networks in much the same manner as radio networks reach into all parts of the United States today. Economic considerations also make the creation of such networks imperative, but technical and cost problems still limit our progress in this direction. Most circuits comprising our national sound radio networks cannot transmit sound frequencies beyond 5000 cycles. Good television demands circuits capable of transmitting a band of frequencies from 30 to 4,000,000 cycles per second for the video signal alone.

Two methods are available. The coaxial cable, a concentric conductor capable of passing the wide band of frequencies used in television, is apparently the new art's equivalent of the wire circuit used to interconnect sound broadcasting transmitters. One such experimental circuit, connecting New York and Philadelphia, is already in existence, although some modification of it would be necessary if we were to transmit 441-line images over it. Its cost, I understand, was about $5000 a mile. The other possibility for networking is the use of automatic beamed micro-wave radio relays which, in tests, have given us reason to suppose that they will be at least an important element in the final answer to television networking questions. Neither

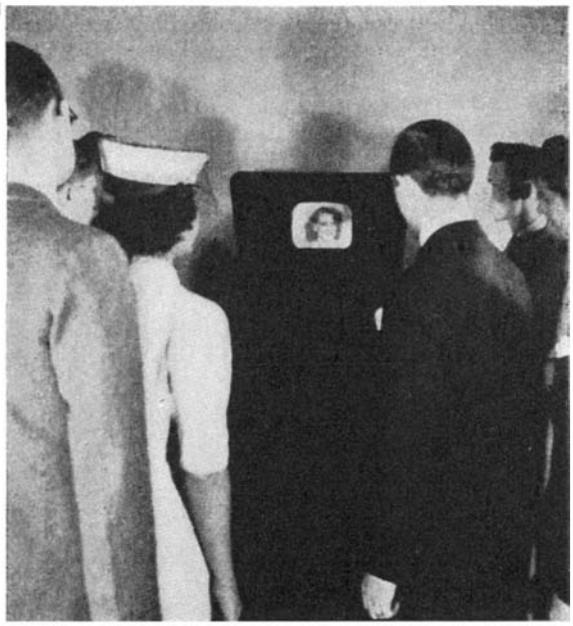
of these is in existence in any practical sense, nor is either likely to be available for any national network for some years to come. However, the availability of a limited micro-wave network along the eastern seaboard is a distinct possibility before the Presidential Inauguration of 1941. The probabilities are that, for at least a decade, television will be confined to more or less isolated stations located in the larger centers of population, and serving perhaps a little more than 50 percent of our population.

Another very practical limitation is found in the frequencies used in television. Because of the necessity of transmitting a vast amount of information within an exceedingly short time, the developers of television had to turn to the ultra-high frequencies—waves between ten meters and one meter in length. This brought some decided advantages; it also brought some disadvantages, the chief of which is the fact that the range of high-quality reception is practically limited by the visual horizon as seen from the transmitting antenna. The NBC transmitter, with its antenna on the very top of the Empire State Building, highest building in the world, reaches out about 55 miles, although pictures have been received up to a distance of 100 miles. Perhaps when we have learned more about tube design and can obtain greater power output than the present 30,000 watts peak we shall extend our service range. That is a matter for the future to decide.

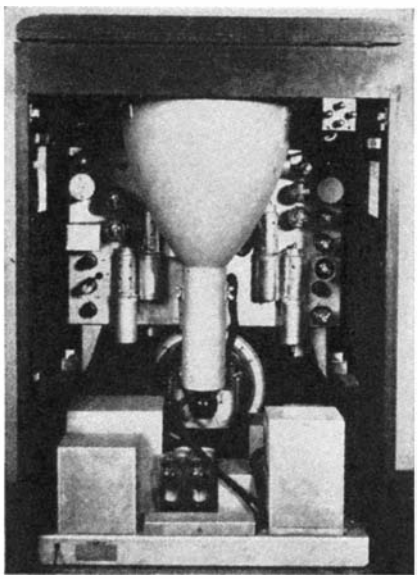
ON the other hand, within the service range an excellent signal is laid down. Ordinary static is not present on these frequencies but man-made static, such as is created by diathermy apparatus, electric razors, and faulty automobile ignition systems produce interference that is detrimental to television reception. Future laws may require the installation of suppressors on all electrical equipment radiating energy that interferes with television and all other communications service on the ultra-high frequency bands.

I have emphasized some of the problems of ultra-high frequency transmission. I hope that I have not given the impression that they are of such gravity as to ruin television's chances of success. In my own home, about 46 miles from the Empire State tower transmitter, I enjoy the reception of excellent images. I am quite sure that everyone within the metropolitan area of New York who invests in a receiver and has it properly installed will also enjoy a unique type of entertainment.

This brings up the question of the type of entertainment television will probably offer in the near future. Today's television, as I have indicated, is capable of broadcasting studio productions by live talent, motion picture film, and outdoor programs relayed by a mobile television station. A single production, in fact, might embrace all three types. In the past we have successfully combined action in our live talent studio at Radio City, films of outdoor scenes and still pictures from a projection room, and special effects from yet a third studio into one production.



Right: A television receiver of the type that will be available for home reception of sight and sound by radio. The image is viewed in a slanting mirror in the lid of the receiver. *Below:* Rear of the receiver, showing the funnel shaped shield of the cathode-ray tube (Kinescope) that makes images visible



The NBC television program staff, under the direction of Thomas H. Hutchinson, has been experimenting for two years and more with numerous types of material. Some, conspicuously successful in other media, have been found to be dismal failures in television. Others were found to have television qualities; all needed adaptation. What is required is a rather fast pace, an ease of performance, and a certain spontaneity that registers well in television. Up to the present we have found no accurate yardstick that will measure in advance the success of any given act or performer on television.

During the experimental period, Hutchinson's staff has put on a variety of plays, motion pictures of all types, educational material, vaudeville and night-club entertainment, orchestras, and what-not. Magicians, jugglers, trained dogs, a scientist showing the microscopic life in a drop of water, a book reviewer, legitimate actors and educators have tried their talents on the new art. The individual items have run all the way from an individual turn of ten minutes or so to dramas and fashion shows of 35 minutes or more. We have put on sidewalk interviews, both day and night, picked up a floor show in a nearby cafe, and televised the graceful gyrations of skaters on an outdoor rink. We have covered a spectacular fire.

These are beginnings only, but I believe they offer promise that television programming will develop into something both highly interesting and informative. Certainly no other medium will be able to compete with television in furnishing programs of news events. Television will be on the spot and will flash the scene into the home while it is still happening; when the program begins neither the engineer behind the camera nor the viewer at his receiver will know what the outcome will be.

But what about television's effect on the motion-picture industry? The motion picture, like all theatrical entertainment, is of mass appeal; an audience must be present in large numbers to get fullest enjoyment from one of the theater's spectacles. Much of the appeal, therefore, is social; going to the theater or the motion-picture house is a social event. The wife wishes to dress and get away from the home scene for a few hours, to mingle with hundreds of others motivated by the same impulse. It is not likely that television, or any other medium that enters the home will ever

(*Please turn to page* 251)

Quicker Than the Eye

Demand for Better Steel Has Made Necessary More Careful Control of Processes . . . Photo-Electric Cell Measures Temperatures Accurately

By ROBERT B. SOSMAN, Ph.D., Sc.D.
Research Laboratory, United States Steel Corporation

THE human eye is a pretty good pyrometer. In estimating temperatures that are high enough to bring about the emission of light, the eye has served the steelmaker effectively for at least 3000 years. Only within the past decade or two has it really begun to be taxed beyond its capacity as an aid in steelmaking.

Considered as a pyrometer, or as a camera, or merely as a means of getting about in the world, the human eye has two serious weaknesses: it is slow, and it is easily fatigued.

Everyone who has dabbled in amateur magic and sleight-of-hand knows how easy it is to make quick movements that the eye cannot follow. Many steelmaking operations are now so fast that it is impossible to follow them visually, at any rate to the extent that one could say afterwards that this or that part of the steel was too hot or too cold.

As for fatigue, look at a bright light or toward a window, and note how the outline persists after the eyes are closed. Or stare at an intermittent colored sign and note the complementary color that appears momentarily as the lights go out. These effects are but momentary, but they can be cumulative; who has not felt the depressing effect of overexposure to bright sunlight or to the flickering movie screen? Modern steelmaking processes, at least those that are operating continuously, can no longer be controlled by casual and occasional inspection. They have to be watched, persistently, and the human eye just can't take it.

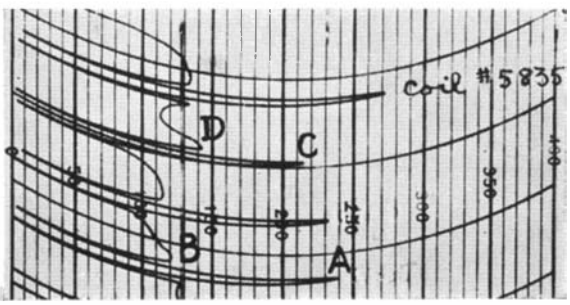
At this point the photo-electric cell steps into the breach and provides an eye that is in some respects as sensitive and also as discriminating as our own, but at the same time is much quicker and much less subject to fatigue.

Two types of photo-electric cell have found use in pyrometry. One of these is the cesium vacuum cell, requiring an applied voltage, familiar to all amateur and professional experimenters with electron tubes. The other is the type used in large numbers by camera enthusiasts in their exposure meters. This is the Photronic or barrier-layer cell, a self-generative type of photo-electric cell which requires no applied voltage.

In the cesium cell the external voltage is supplied by a storage battery or rectifier; when light falls on the cell the variations of current in the circuit can be used to indicate and record the temperature of the hot surface from which the light came. In the self-generative type of cell, a metallic plate is coated with a mixture of selenium and other substances. This layer in turn is coated with a layer of vaporized metal so thin that it is transparent. One electrical connection is made to this layer and the other to the metal plate. If a meter is placed in the circuit and the light from a hot object is allowed to fall on the cell, the current in the circuit will be in proportion to the light intensity and again we have a means for indicating and recording the temperature of the surface from which the light came.

An application of the cesium photo-electric cell to the steel mill is in the so-called "Optimatic" pyrometer, mounted to read the temperature of the fast-traveling strip of metal in a modern hot strip mill. This mill takes a hot slab of steel and converts it at steadily increasing speed into a ribbon hundreds of feet long and several feet wide, which is later cut into sheets for tin cans, automobile fenders, and innumerable other uses. So much depends upon proper temperature in the strip, as well as proper speed, roll pressure, and tension, that the estimation of temperature by the unaided eye is no longer dependable.

The Optimatic pyrometer has a matched pair of cells, but does not use the pair in quite the same way as we use our own pair of eyes. It looks down on the hot surface of the strip with just one eye, while it cocks the other eye toward an incandescent lamp. Through the operation of a set of electron tubes the current in the lamp is caused to change until the lamp matches in brightness the hot surface, and the lamp current thus serves as a measure of the temperature. All this takes place much quicker than I can tell about it, and the record of temperature is made within a fraction of a second after the pyrometer sees the steel.



Above, in circle: Photronic photo cell mounted above a roll table in the strip mill at Fairfield Works of the Tennessee Coal, Iron, and Railroad Company. *Right:* A sample of slab-temperature record made by a Photronic pyrometer on a strip mill

In the Research Laboratory of the United States Steel Corporation we have preferred to depend upon the Photronic type of cell, and in this way eliminate some of the troubles incident

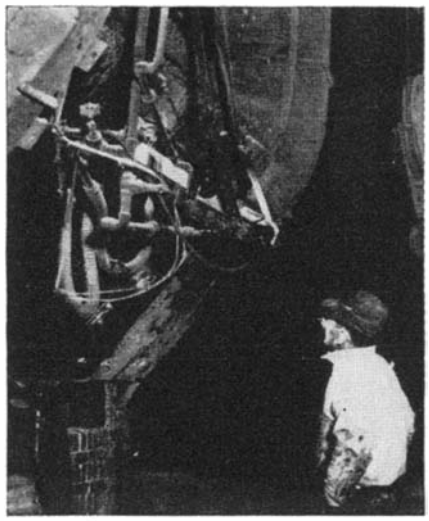
to the use of a rectifier such as is necessary for the cesium cell. In one application, a Photronic eye, carefully water-jacketed to protect it from damage by heat, looks down upon the roll table along which the hot slabs for the strip mill begin their journey. When it is first seen by the pyrometer, the slab has already been given a squeezing and cleansing that gets rid of the coating of scale formed upon it in the heating-furnace. The slab is thus left with a clean, glowing surface whose temperature is instantly recorded by the electric eye.

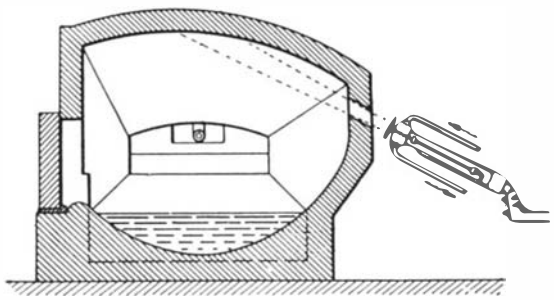
One of the illustrations shows a portion of the automatic record made by the pyrometer on a moving strip of paper. At the point A, the slab has just passed under the eye or receiver and has flashed its temperature, but was in sight for such a short time that it made only this single record of temperature. After several passes back and forth through the first set of rolls, however, it had lengthened out so much that it reached clear back again under the pyrometer and made a second record, B. This time the greater part of it passed back under the pyrometer as the strip emerged from the rolls, then went forward again through the last pass, thus doubling its appearance on the record. If its temperature had been uniform and had not changed during this brief interval, it would have drawn a vertical straight line, but the surface is, of course, cooling all the time and if uniform from end to end should make an inclined straight line. If hotter at the rear end, on the other hand, it should make a "V". This was actually the case with the second following slab, registered at C, when it came back to make its longer record, at D. These variations are nearly or quite invisible to the human eye but they tell men in charge of the heating and rolling a good deal more than they would tell you or me.

ANOTHER application of the photoelectric pyrometer, this time one in which absence of fatigue rather than quickness is its most valuable characteristic, is found in the so-called pyrometric roof control in the open-hearth furnace. This is a furnace into which cold scrap steel is loaded through wide front doors, to be melted down by a flame of gas, oil, or tar. After the steel is melted, liquid cast iron from the blast furnace is poured in, and the mixture is then held for several hours while refining takes place. In the refining action, the impurities are burned out of the material and absorbed by the slag on top of the metal, leaving only pure iron behind.

The limiting factor in the speed of such a furnace is the melting temperature of the roof and walls. These are usually built of silica brick made from sandstone or quartzite, the white rock that forms the high ridges of central Pennsylvania. These silica brick melt sharply at 3142 degrees, Fahrenheit, just as sharply as a piece of ice melts at 32 degrees, Fahrenheit.

In the presence of the vapor of iron and iron oxide that is present in the open-hearth furnace, silica brick melts at a temperature lower than this; in fact, very close to 3000 degrees, Fahrenheit. The furnaceman dare not let his roof pass this temperature else it begins dripping into the molten steel below, forming "icicles" like those seen along a roof gutter during a thaw. It is important that he get the furnace as hot as possible to gain speed in the process, yet he cannot stand in front of the furnace peering through the wicket of the furnace door, for not only has he other duties to perform but his eyes would soon be so fatigued by the brilliance, even though protected by his colored glasses, that he would be unable to judge accurately the temperature of the roof. His usual former practice, therefore, has always been to play safe and stay well below the melting temperature of his roof, even though he lost time thereby, because melting a roof is a very expensive accident.





Above: **A roof-control photoelectric pyrometer mounted in the back wall of an open-hearth furnace.** *Left:* **Diagrammatic cross-section of one of these furnaces, showing how the pyrometer is placed. A constant flow of water, indicated by the arrows, cools the pyrometer**

With the electric eye always on the job, however, he can attend to his other duties and no longer be concerned about getting dangerously near the melting temperature. The pyrometer can be connected to an automatic controller which will shut off a part of the fuel the moment the roof temperature reaches the limit which has previously been set on the controller. Then, about one half minute later, when the temperature has dropped back through the prescribed range of action of the controller, the fuel will again be automatically turned on.

In the open-hearth furnace, the pyrometer is arranged to sight through an opening in the back wall of the furnace upon the middle point of the inside surface of the roof. A record made by one of the automatic controllers shows that the temperature had repeatedly gone just above 3000 degrees but had been instantly pulled back by cutting off fuel, only to come up again a short time later. This really effective service, independent of human judgment, makes work possible at the highest temperature without danger of destroying the furnace.

The pyrometer, mounted in the rear of the furnace, is protected by a steel jacket through which water constantly circulates, for it is uncomfortably hot in the vicinity and the electric eye is almost as sensitive as the human body to temperatures above 100 degrees. Constant circulation of cold water, however, keeps it in prime working condition for weeks or months at a time.

It need hardly be said that these devices have their little idiosyncrasies which have to be learned by experience. For example, if you stood in front of an opening in the furnace wall as long as the pyrometer is expected to stand there, you would probably be stung now and then by a flying particle of molten steel or slag. These particles are projected up by the vigorous boiling that occurs in the steel bath, and occasionally one will fly on such a trajectory that it comes straight out through the opening. It will not do to try to protect the pyrometer by a shutter or screen, as that would cut off the necessary light from reaching the automatic eye. A piece of glass would stop the particle but the particle would stay where it stopped and the accumulation would gradually cut off the view. We want a screen which is transparent and always on the job to catch the particles, but one which will throw them away as soon as they are caught. A jet of air is the ideal screen for this job. It stops none of the light but it deflects the flying particle and renders it harmless.

THE MOTORIST

A modern oil tanker, the S. S. *J. W. Van Dyke*, at night. Note the well-protected passageway down the center of the deck

OIL is found in widely scattered areas, with the richest deposits often hundreds and even thousands of miles from the great consuming centers. From the days of the earliest oil wells, therefore, the development of efficient and economical transportation from the wells to the consumer has been one of the major problems of the industry. The fact that the American motorist pays close to the world's lowest price for gasoline is to a considerable degree due to the success of the oil industry in adapting the various forms of land and sea carriers to the transportation of its products.

During the earliest days of the industry, the output of the wells was barreled and carried by wagons to the small local refineries and from there to the nearest railroad siding. Except for some slight competition from canal and river carriers, the teamsters and the railroads enjoyed a monopoly on the haulage of petroleum. Today, the teamsters have disappeared. The railroads, on the other hand, continue to be an important factor, deriving a revenue of $250,000,000 annually from the crude and refined products shipped by the petroleum industry. Their days of preëminence, however, are past. By far the greater part of the output of the wells is now transported by pipe lines, oil tankers, and motor tank-trucks.

Within the continental borders of the United States there are approximately 345,000 active oil wells, located in 22 states. Fifty-five thousand miles of pipe line gather the day's supply from the wells and carry it to the gathering stations on the trunk pipe lines. From the gathering stations, the oil flows through 60,000 miles of trunk line to 437 operating refineries in 28 states and to marine terminals at coastal points.

From the marine terminals, the crude oil is shipped by tankers to refineries in the United States which are not linked by pipe line to the oil fields, and to ports throughout the world. From the refineries, the refined products are shipped by tankers overseas, and to distribution terminals in the United States by inland waterways, rail, and more than 5000 miles of pipe line. Forty thousand motor tank-trucks carry the refined products from the distribution terminals to the nation's 200,000 filling stations.

TODAY, approximately 75 percent of all the oil produced in the United States is moved by water carriers at some stage of its passage from the well to the consumer. Practically all shipments to points along the Atlantic and Pacific coasts are made entirely by water. From these receiving points on the two coasts, oil barges and river tank-ships carry petroleum products through 30,000 to 45,000 miles of waterways to inland destinations. During a single month, tankers have unloaded as much as 45,000,000 barrels of crude oil, gasoline, and other petroleum products at United States ports.

The United States leads all nations in its contribution to the world's total of 1655 oil tankers of 1000 gross tons or over. As of June 30, 1938, there were 418 tankers aggregating 2,759,642 gross tons under American registry, not including the oil barges and other craft of less than 1000 gross tons which constitute a big majority of the oil carriers that ply our inland waterways. Tankers constitute about one third of American merchant marine tonnage. Petroleum and its products provide nearly one third of all water-borne tonnage in American world trade.

Ocean transportation of petroleum has progressed a long way since the first ship to carry a cargo of oil on the high seas sailed for England from Philadelphia in 1861. The vessel was the 224-ton brig, the *Elizabeth Watts*, and she carried her cargo in barrels. It was not until 1869 that the first oil ship fitted with iron tanks appeared. The name of this pioneer tanker was the *Charles*, a sailing vessel of 774 tons with 59 tanks. Prior to this, the oil had been shipped in barrels, or entire holds of the vessels in the trade had been used as single tanks. The first steam tanker appeared in 1878, and by 1885 more than 1000 ships with a capacity of from 2500 to 14,000 barrels of oil were transporting American petroleum products to United States and foreign ports.

Ever since the first tank-fitted ships appeared, the trend has been towards larger, faster, more efficient vessels. It is this search for speed and economy in tanker operation that is directly responsible for the introduction of welding in the construction of the larger vessels during recent years. Welding makes it possible, without sacrificing strength, to reduce materially the hull weight which must be moved by the ship's propelling machinery, while the smooth, welded hull offers less opportunity for surface corrosion.

One of the first all electrically welded, self-propelled vessels to be built in the United States was the *White Flash*, a tanker 201 feet 2 inches over-all, with a capacity of 7500 barrels of oil. The *White Flash* was delivered in 1931, but it was not until 1936 that the same construction method was applied to the larger type of ocean oil-carrier. In 1936, The Atlantic Refining Company placed with the Sun Shipbuilding and Dry Dock Company an order for a tanker of 18,500 tons dead weight, in which the entire tank space extending from the engine room bulkhead to the forward end of the tank space was to be of welded construction. The vessel was commissioned in February, 1938, and is now on the Philadelphia-Texas Gulf Coast run. A sister ship, built for the same company in the same shipyard, was completed and placed in service on the same run in August, 1938.

The two new tankers—the *J. W. Van Dyke* and the *Robert H. Colley*—are the world's largest welded ships and illustrate in graphic fashion the remarkable development that has taken place in the construction of oil-carrying vessels since the first tank ships appeared nearly 70 years ago. The new tankers have an

GETS HIS OIL

Oil, Gasoline Distribution Relies On Science For Aid . . . Problem Has Inspired Unique Developments . . . Pipe Lines, Huge Tank Ships, Trucks

over-all length of 541 feet 5 inches. The capacity of each is 156,000 barrels, or 6,552,000 gallons—enough gasoline to supply the average requirements of 10,000 motorists for a full year.

Turbo-electric engines developing 5000 horsepower give the ships a speed of 13.25 knots, enabling them to make the trip between Philadelphia and Texas Gulf ports in six days. Three 300-horsepower discharge pumps, driven by 2300-volt explosion-proof motors, give each of the vessels a rated maximum discharge capacity of 630,000 gallons an hour. With adequate shore pumping equipment, each can be loaded in approximately eight hours.

At some loading points, particularly on the Pacific Coast, where shallow water or lack of harbor facilities make it impossible for tankers to tie up to the docks, oil carriers take on their cargoes through submarine pipe and hose lines that may run a full mile out into the ocean. The vessel is brought into position, anchored, and made fast to buoys anchored to the ocean bed. The submarine hose is hauled aboard and attached to one of the tanker's intake pipes. Orders are given by submarine telephone when it is time to begin pumping in the oil. When the loading is completed the hose is cast off, made fast to a buoy to mark its location, and the tanker sets out to sea.

Radio telephone communication between refineries located at tide-water and their tugs operating in the harbor is a recent development that speeds the handling of tanker cargoes. The tug-to-shore radio 'phone communication often saves many hours when a tug that has left the docks is needed in a hurry at some point in the harbor, and it is frequently possible to keep the tugs operating efficiently in thick weather that would otherwise slow them down or put a stop to their activities.

Just as the modern oil tanker is a skilful adaptation of the cargo ship to the transportation of a particular type of cargo, so the oil pipe-line is an equally skilful and efficient adaptation of a medium used for centuries for the transportation of water. For practically all liquids available in large volume, pipe lines provide the most economical form of land transportation that has ever been devised. The cost of transporting petroleum products by pipe line is approximately half the cost of rail transportation.

Since the construction, in 1875, of a pipe line from Oil City, Pennsylvania, to Pittsburgh to transport crude oil, the pipe-line system has spread out over most of the United States, but so unobtrusive and unspectacular has the growth of the system been that few are aware of the enormous, complex transportation network that lies beneath the surface of the country. Thousands pass over the lines every day without a thought for the millions of gallons of oil flowing beneath them.

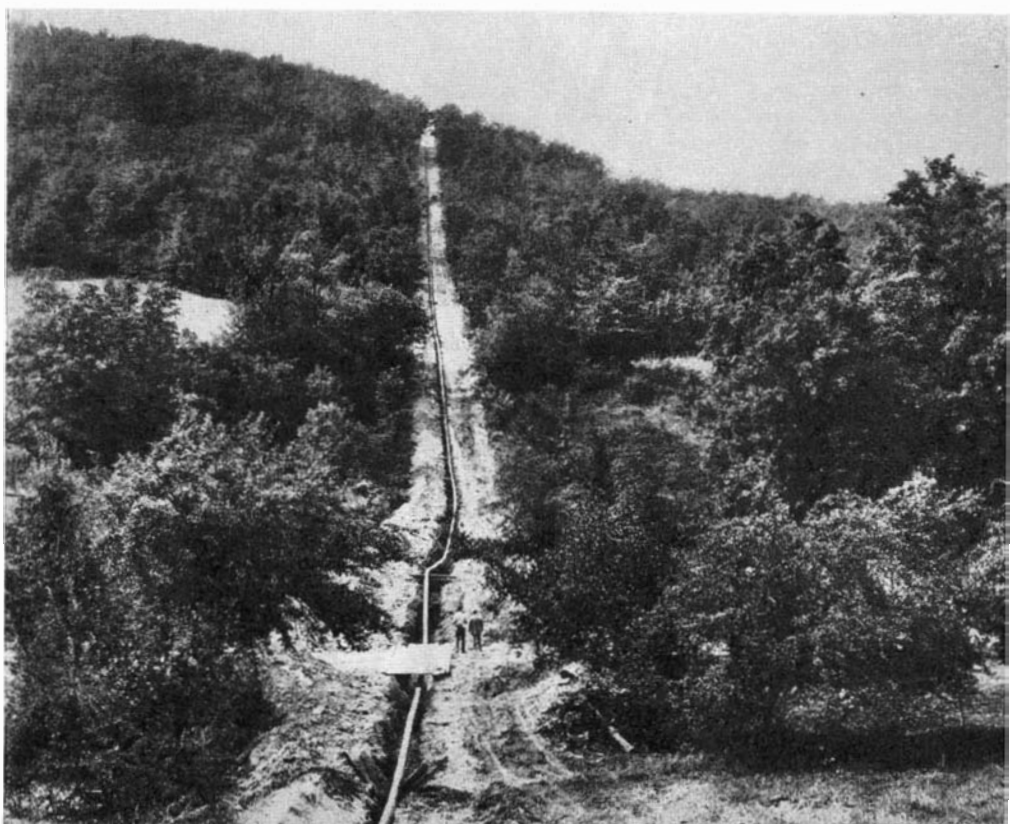
THERE is not one of the 345,000 active oil wells in the United States that does not have an outlet for its production through a pipe line. When new oil fields have been opened up, pipe lines have always been prompt in providing the new areas with facilities for volume shipment, even in the most remote places. Soon after the discovery of the East Texas field, the greatest source of oil yet uncovered, 17 trunk lines, capable of moving 1,000,000 barrels a day, were built to serve the new field. During the past year more than 1,215,000,000 barrels of crude oil, and 75,000,000 barrels of gasoline were moved in interstate transportation by the nation's pipe line system. So enormous is the system that it is estimated that more than 5,000,000 barrels of crude oil and gasoline could be moved in 24 hours.

In planning the construction of a pipe line the first problem that must be solved is to find the route between the points to be connected that will permit the speediest and least expensive construction, and the most efficient operation after the pipe has been laid. Conditions of topography, drainage, and rights of way are all factors that must be considered, but the route must follow a comparatively straight line, for a route laid out to avoid all the difficulties of the terrain would probably be so circuitous as to make the cost prohibitive.

Aerial photographic surveying is a comparatively recent development that is proving an invaluable aid to the location engineer. The aerial photographic maps show the engineer all of the surface details in the horizontal plane, and with stereoscopic devices, similar in principle to the old-fashioned stereoscope that used to be standard home equipment, he can obtain a three-dimensional effect that shows all the details of elevation changes.

Such aerial surveys enable the engineer to plot a route across average country in his own office, with the assurance that few, if any, changes will be ne-

Pipe lines to carry oil and gasoline—many thousands of miles of them—spread like spider webs radiating out from the various oil fields to all parts of country. Here, one is being installed



Ditching machine anchored to a tractor and cutting a trench for an oil pipe line on a steep slope

cessary when the route is staked out on the ground. In extremely rough country, alternate routes can be plotted on the photographic map, with selection subject to a one-party ground check, whereas without the photographic map it would be necessary to put half a dozen surveying parties in the field to cover the possibilities of as many different routes.

In spite of all the study devoted to the selection of the best available route, nature frequently presents obstacles that test the skill and ingenuity of the construction engineers. A recently completed 225-mile line from Williamsport, Pennsylvania, to Rochester and Buffalo, New York, had to cross three rivers—the Chemung, the Genesee, and the Susquehanna—and frequent swamp areas. Precipitous, rocky hills and deep valleys, often heavily timbered, not only made difficult the transportation of pipe and other supplies, but placed tremendous strains on trucks, tractors, ditchers, and other machines.

Even after trees had been felled, the stumps blasted out of the ground, and a roadway cleared by a machine known as a bull-dozer, trucks were frequently unable to negotiate the steep slopes and the pipe had to be backstrung from the nearest accessible spot. The procedure was to weld the pipe into one continuous section and push it down the incline to the next relatively level spot where it could be welded to the section beginning at that point.

Many of the precipitous slopes even defeated the crawler-mounted machines capable of pulling 15 tons or more of deadweight up surprisingly steep grades. To help them up the slopes it was necessary to haul them with a wire cable from a winch-equipped tractor anchored to a tree some distance up the hill. A machine used to back-fill the ditches after the laying of the pipe, and admiringly referred to by the workers as "Popeye," somersaulted 15 feet through the air on one of the slopes, but was quickly repaired and returned to duty.

Each of the river crossings presented its own problems. In the case of the Chemung crossing, which was not very wide or deep, a machine known as a trench hoe was mounted on two large timber runners and pulled across the river bottom by two winch-equipped tractors anchored on the far bank, digging a five-foot trench as it went. A barge fitted with an inclined runway was used to lay the pipe across the 1000-foot Susquehanna crossing. The lengths of pipe were welded together on the runway and allowed to settle into the river-bottom ditch as the barge was winched across.

ALTHOUGH virtually every technique in the pipe-line builder's manual had to be employed at one time or another to overcome the obstacles set up by nature, the crews employed on the job established some remarkable records for speed. On some of the less difficult stretches, as much as 25,000 feet of line was laid in a single day. The whole 225-mile line was completed in four months from the start of construction.

In many respects, the operation of a pipe line is similar to the operation of a railroad, with its feeder or gathering lines, main trunk lines, terminals, storage yards, switch systems, stations, dispatchers, telephone, and teletype systems. Unlike the freight train, however, the pipe line does not have to move itself as well as its load. The fluid is kept moving through the pipes by pumping stations, usually located about 40 miles apart, although in hilly country, or for heavy and viscous oil, they may be placed at more frequent intervals along the route.

Each station is equipped with pumps powerful enough to send the stream on to the next station, and is provided with storage tanks having a capacity ranging from 10,000 to 50,000 barrels. Frequently three or four different "slugs" or batches, each consisting of from 25,000 to 250,000 barrels, and each consigned to a different destination, will move in succession through the same pipe line. Each "slug" may consist of a different grade of gasoline or other petroleum product. The inter-communicating telephone or teletype system enables the dispatchers to keep the station operators informed of the time when each batch will reach them, and to give the necessary instructions for shunting off the different consignments to the connecting lines that will carry them to their different destinations.

No pick and shovel work is necessary after an oil pipe line is laid; a powerful bull-dozer tractor fills the pipe trench and cleans up the job in short order

VITAMINS FROM OUR OWN FISH

A Local Druggist in a Minnesota Village Finds that there is Opportunity Outside the Crowded Cities and Develops an Industry Where He Lives

By E. J. FORTIER

TODAY, because a young Minnesota pharmacist found experimenting with burbot an interesting diversion, Lake of the Woods fishermen are selling the once-despised fish for the valuable cargo of vitamins A and D they carry in their unusually large livers.

After graduating from the University of Minnesota school of pharmacy in 1929, Theodore Rowell settled in Baudette, Minnesota, near the Canadian border. When not working in his drug store, the young druggist was studying the burbot in his home-made laboratory. (The burbot is the only freshwater member of the cod family.)

Soon after Rowell became interested in burbot and vitamins, an investigational report of the United States Bureau of Fisheries stated that, in experimental rickets, oil made from burbot livers was from three to four times as potent in vitamin D and from four to ten times as potent in vitamin A as good grades of cod-liver oil.

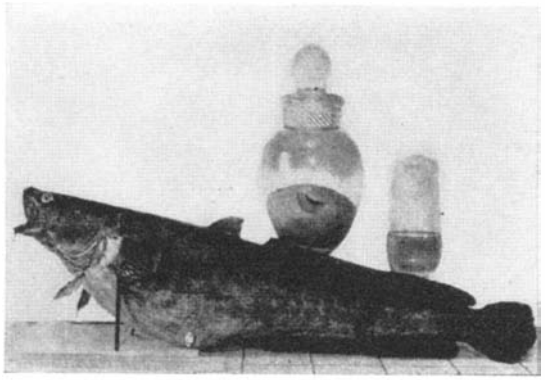
Working in his laboratory, Rowell learned that the liver of the fish made up 10 percent of its body weight and was proportionately about six times larger than livers of other northern freshwater fish. From 1931 to 1933 he worked on different methods of extracting the oil from the liver cells of the fish. After much experimentation he perfected a process that yielded amounts of oil equal to 40 to 60 percent of the liver's weight.

Rowell's next step in producing freshwater vitamins was to evaluate burbot-liver oil as a vitamin-provider. Several litters of silver foxes served as "guinea pigs" for further experiments. For two years all foods containing any amounts of vitamins A and D were eliminated from the feeding chart and burbot-liver oil was substituted. The results were very gratifying.

EVEN better were the results of a study of the anti-rachitic factor in burbot-liver oil recently completed by Dr. Thomas Myers, instructor in pediatrics at the University of Minnesota. In order to test the anti-rachitic value of vitamin D as it occurs in burbot-liver oil, Dr. Myers selected 50 infants from one to two months old from a welfare clinic. Each was given a daily dose of ten drops of burbot oil. Dr. Myers found that, during the observation periods of six months to one year, the children made normal gains and developed satisfactorily in all cases. In no instance did any cases of definite clinical rickets develop.

His experiments had proved to Rowell that burbot-liver oil was six to eight times more potent than good grades of medicinal cod-liver oil. He also found that burbot oil has a very low viscosity and is more rapidly digested and assimilated than most fish-liver oils.

Early in 1935 the young druggist built a small factory near the shore of Lake of the Woods and launched in earnest the production of the new fish-liver oil. Burbot-liver oil was introduced to the medical profession in September 1935,



A rather large burbot. Above it in a jar is a burbot liver proportionate to its size and, at the right in another container, the amount of oil that can be extracted from such a liver

Rowell in his home-made laboratory when burbot provided only a hobby

and soon after was accepted by the council on pharmacy and chemistry of the American Medical Association.

Burbot are caught in the fall and early winter months when they come to shallow shore waters to spawn and feed. Each of 25 to 35 fishing crews on the Lake hires an extra man whose sole job is removing burbot livers. From 40,000 to 50,000 pounds of vitamin-providing fish are caught daily throughout the season.

The general steps in the Rowell process of manufacturing burbot-liver oil are, first, placing the livers in a large steam kettle in which high steam pressure breaks down the oil cells and frees the vitamin-laden fluid. Next, the oil is rendered and decanted and run into a cooling chamber which is kept at a low temperature until all the stearics have been precipitated and strained off. The oil, after being processed, is ready to be bottled and capsuled without being concentrated or blended.

The small factory on Lake of the Woods is the only place in the United States where burbot-liver oil is produced for commercial use. Moreover, the Rowell factory produces the only fish-liver oil of which production is entirely controlled within the United States.

Fishermen are anxious to catch burbot for sale to Rowell not only to supply the new market but also because keeping down the burbot population will conserve game fish on which the ferocious burbot feed.

The amount of burbot available for production of vitamin-rich oil is inestimable. The fish are found in lakes and streams from New England and the Great Lakes region west to the upper Missouri and Columbia River basins, and north to the Arctic Ocean.

Burbot-liver oil has been discussed technically in an investigational report of the Bureau of Fisheries, Washington, D. C., also in *The Journal-Lancet*, Minneapolis, Minnesota.

World's Biggest Meat Market

Famed King Ranch, America's First Planned As Such, Claims Title To Scientific "Firsts" . . . Its Organization Is Tribute To Man And Machine

By W. P. ELLIOTT

MUCH of romance has been written about the famous million-acre King Ranch which spreads its broad tracts through southern Texas until it touches the Gulf shore. Yet romance of the garish western plains variety has little place in this "World's Biggest Meat Market," which each year sends 15,000 to 20,000 head of fine cattle to beef-packing centers of the nation.

Rather, it is a story of patience combined with the ingenious application of scientific data and methods. These alone are responsible for the steady growth, improvement, and prosperity of this vast property. The facts comprise an interesting story—an imperishable tribute to the King and Kleberg men, keen-eyed and keen-minded rancher businessmen who in three generations established and developed the nation's greatest beef-cattle production unit. Robert J. Kleberg, Jr., president and general manager of the King Ranch, Inc., is a grandson of famed Captain Richard King who founded the enterprise in 1852 as the very first planned cattle ranch in the United States. All true cattle-ranching activity in this country grew from King's early work.

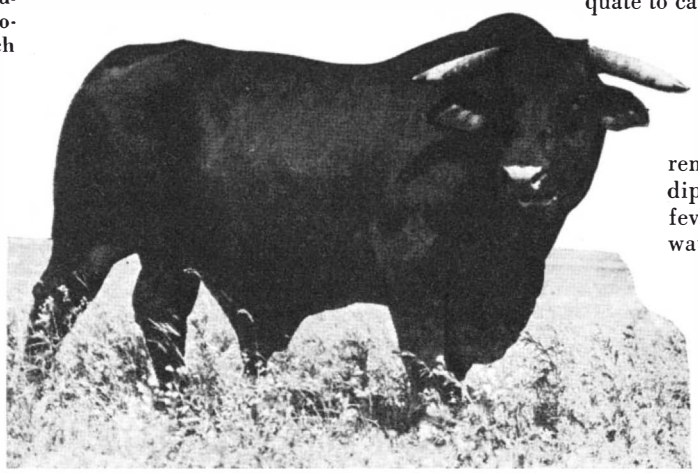
The ranch house which is headquarters for the vast Texas domain that is the King Ranch

The property had and has nothing in common with the general agricultural expansion to the west. Grain farmers spread out from the east, clearing and developing more and more new territory until they had opened a continuous farming country from the east coast to the middle west, but the King Ranch is the result of no growth or westward movement; rather, it was deliberately selected out of the middle of a semi-tropical wilderness, isolated from city and village.

The original purchase consisted of 69,000 acres now known as the Santa Gertrudis division of the ranch. Captain King was aided in his first selection of land by his friend, General Robert E. Lee. Much of the original purchase was in the natural sod of the torrid coastal plains and, even then, stubborn mesquite growth had begun its inroads.

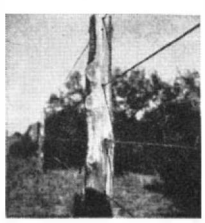
Of course, modern transportation and refrigeration were unknown, so only nonperishable commodities such as tallow and hides could be produced. At Captain King's death, the late Robert J. Kleberg, Sr., who had married the original owner's daughter, became general manager. More land was acquired, although the owners knew that this was not the real answer to the irksome problems which already had begun to manifest themselves. Heavy losses were being suffered because of the deadly fever ticks, screw worms, and many other parasites which externally and internally attacked the great herds of cattle. These were added hazards for, first of all, the range cattle were far out of their climate element. They couldn't stand the extreme heat.

THUS, several decades ago, King Ranch owners summarized their problems and their goal as: 1, To provide dependable supplies of water; 2, To secure adequate transportation to big markets; 3, To eradicate fever-bearing ticks; 4, To develop a breed of cattle able to withstand heat and disease; 5, Land improvement through eliminating standing and running mesquite which threatened the entire ranch, and establishment of a range grass which would thrive despite drought and provide nourishment adequate to carry cattle and bring them to a marketable weight in short time.



The Santa Gertrudis breed, an important scientific contribution to cattle raising: first breed developed in America

To reach this goal meant much scientific study. The King Ranch then began its remarkable series of "firsts" by dipping cattle to eradicate the fever tick. Abundant supplies of water were secured through the initiative of Robert J. Kleberg, Sr., in drilling the first artesian well in South Texas, discovering underground water stocks on which hinged much of the later ranch and farm development of the area. There still, however, was no answer to the heat problem. Many sheds were built to shelter the stock from the broiling sun, but cost and enormity of the project made the method prohibitive.



A simple yet important innovation: smooth wire fencing instead of barbed wire which often slashes range cattle badly

Then from far-off India came the answer—the Brah-

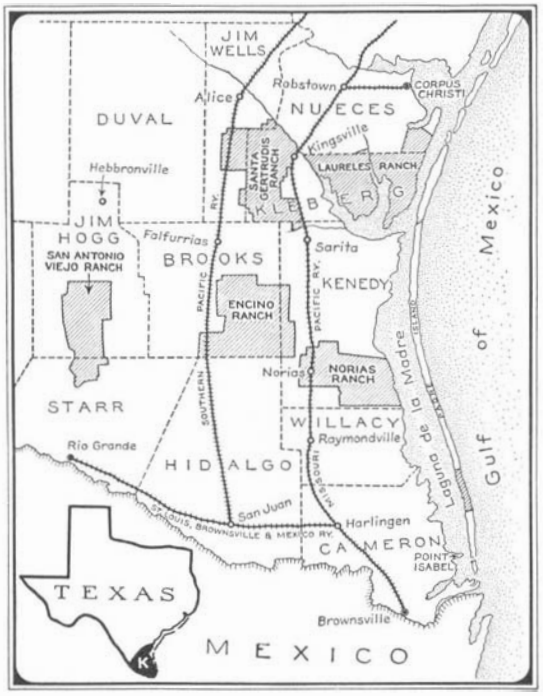
ma bull. Brought to the ranch 18 years ago was a gift bull sired by a Brahma out of a shorthorn cow. This was the foresire of the famous "Santa Gertrudis" breed of cattle. The ranch had begun, long before, to cross-breed shorthorn and Hereford bulls with common range cattle, finally breeding them pure. The cattle were good for feed lots—for someone else to feed and mature—but they had lost their hardiness, their resistance to insect pests and their ability to fatten. The cross-bred Brahma bull, upon its arrival at the ranch, was pastured with 3000 unregistered, pure-bred shorthorn cows, along with other shorthorn bulls. From all the calves therefrom, 60 of the best females and one bull calf were selected as the finest beef calves in the range's history.

Fifty-two Brahma bulls were immediately purchased and the process of selection, line breeding, and inbreeding was scientifically continued. A great sire was developed, and at length, the famous bull, "Santa Gertrudis," was bred, representing near perfection. This great bull is head of the King Ranch herd now.

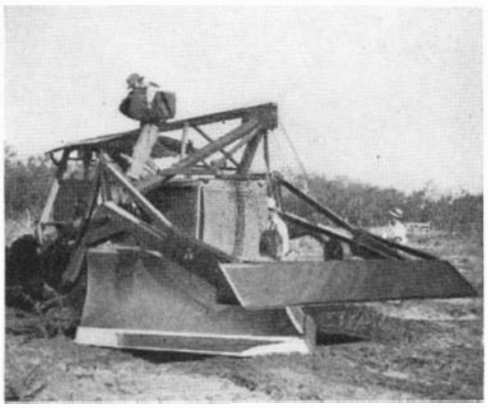
Today, steers of the ranch calf crops average from 100 to 200 pounds heavier at one year of age than Hereford and Durham cattle and are carried to marketable weight in the shortest length of time. They withstand drought well. The obstacles of heat and disease have been decisively licked. The ranch gets credit for one of the most progressive steps in American animal breeding history—a veritable milestone in the cattle industry. It was another "first" for the Klebergs.

The Missouri-Pacific railroad, in 1900, had solved the major transportation problem, so that only one remained—more and better pasture for the rapidly growing herds. In the closing years of his life as a great builder Robert J. Kleberg, Sr., often said that, if he had his work to do over, he would improve the land he owned rather than purchase more and more land for expanding herds. The demon mesquite annually was taking more toll of valuable grazing land. At first, Mexican hand labor was used in an attempt to clear the land. The original owner had given employment to all who came seeking it, but the results were costly and the progress was slow.

In spite of cost and bad times, the ranch management continued to use hand labor, although clearing represented six man days per acre! To feed and employ men liberally was all well and good but it was not getting the job done that had to be done. Young Bob Kleberg then tried wheel tractors equipped with winches to yank out the stubborn mesquite, but with little success. So he put his head in his hands, sharpened up his pencil, and did some serious and scientific thinking, possibly remembering that his father long before had visualized a steam plow in the realization that successful clearing operation would require a machine that could move right along in continuous operation. He sketched a great pushing, ripping, cutting tool which would literally tear the heart out of the mesquite jungle, leaving it clear for the planting of palatable grass food for his herds. What power, however, could pull or push such an implement? The job required not only power but traction—something that could crash through the tangle, push over trunks two feet in diameter, disregarding uneven or soft footing.



The several large ranches comprising the King Ranch holdings. Note section on the island. Inset map of Texas shows (K) general location



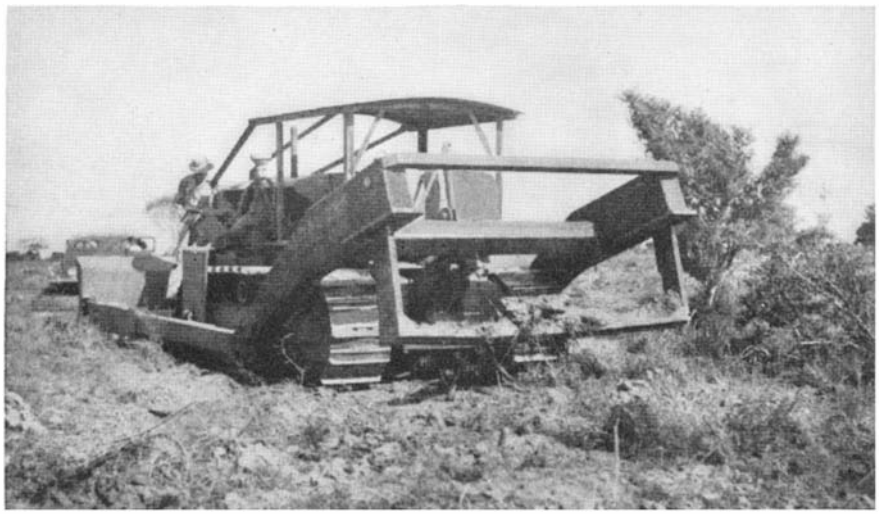
The rancher then thought of the track-type tractor and decided the most powerful model might do the trick. He called upon the distributor at San Antonio who handled "Caterpillar" Diesel track-type tractors. This company and allied manufacturers studied Kleberg's description and sketches and devised what came to be known as the "tree-dozer."

This implement, mounted on the front end of a 95-horsepower Diesel tractor, consists of two independent parts. One is a pusher bar carried ahead of the tractor's nose, arranged so that it will strike the tough mesquite trunk from 1½ to 7 feet above the ground. The other

The "tree-dozer" showing, in small picture, the pusher bar and the heavier cutting edge beneath it. *Below:* The machine rips into large growth with no great effort

part, just below the pusher, resembles a bull-dozer. Three feet high with a heavy, keen cutting edge, the bull-dozer adds the "two" to the "one-two" punch delivered by the unit. Both parts are sturdily mounted and either hydraulically or cable driven by the tractor operator.

In operation, the tractor plunges into heavy mesquite. The pusher bar strikes the trunks first, bending them forward and exposing the roots. The cutting edge below "follows through," striking at the roots of the bent mesquite and quickly gouging out the growth.



The "knife rooter": a powerful tractor draws a heavy ten-foot blade several inches under the surface of the soil to cut off the roots of, and destroy running mesquite

How effective this unit is can best be told by the following data:—The first Diesel track-type tractor and tree-dozer delivered to the ranch has worked 6700 hours and has cleared considerably more than 10,000 acres of hitherto mesquite-tangled land of low economic value which now is seeded in nourishing, hardy Rhodes grass. It is thought that approximately 80 percent of this clearing is permanent or results in 80 percent destruction of brush growth. Use of the tree-dozer is expected to cheapen costs of clearing but it is early to place an exact cost figure because of varying local conditions and size of jobs. The cost of operating the tree-dozer alone on the King Ranch jobs, including low-priced Diesel fuel, lubricating oil, operator's wages, and depreciation has amounted to only approximately $1.40 an acre.

STANDING mesquite, however, is only half the problem. During the last few years, there has been a rapid encroachment of "running" mesquite onto what had been good pasture land. Of small diameter, this energetic native brush of the Texas gulf coast reaches a height of from six inches to four feet. Its tough root system masses to choke out the grass, and the brush often contains more growth underground than above.

Here was a job that also called for power—pulling power—the ingenious rancher concluded, and he proceeded to devise another tool, a heavy ten-foot blade to be drawn eight to ten inches under the ground and parallel to the surface, the blade to be supported by uprights fixed to a heavy bed. Again the tractor distributor and allied equipment makers aided, and the "knife rooter" was born. The implement required plenty of power and again the 95-horsepower Diesel track-type tractor was called upon to pull the tool.

Success again smiled. The outfit was able to destroy two acres of running mesquite an hour. This rooter equipment, used in conjunction with the tree-dozer, results in complete destruction of all brush. The ranch let this job to a contractor who will clear 25,000 acres per year for the next four years. The ranch will continue to clear land with the tree-dozer and seed it to five pounds of home-grown Rhodes grass seed per acre.

And so the last of the King Ranch's major problems was solved. There are other "firsts" to the credit of the ranch, and it may be well to list some of them, for they have contributed immeasurably to southwest ranching: First cattle ranch in the United States. First ranch to kill fever ticks by dipping cattle. First and only ranch in the United States to develop and bring to perfection a distinct breed of cattle. First ranch to provide a range grass that would withstand heat and drought. First to abandon the use of barbed wire and to substitute smooth wire fastened to posts without the use of staples. First to invent the humane and efficient electric prod for handling cattle. First to develop and use the tree-dozer and knife rooter to clear mesquite ridden land.

Kleberg, Jr., has made no secret of his experiments and the results are available to ranchers throughout the world.

Fellow ranchers along the Rio Grande valley are already adopting his land-clearing methods and following his advice in stockbreeding, care and feeding. They are warm in his praise, declaring that he has done more than any other individual to advance cattle ranching, and all in the face of great odds.

King Ranch, Inc., at present consists of five divisions, each under direction of a superintendent and totalling approximately 900,000 acres over which graze 50,000 head of beef cattle. These divisions employ approximately 450 Mexican laborers. Headquarters, where the beautiful ranch house is located, is Santa Gertrudis. On this tract a purebred Jersey herd supplies milk free to employees of this division and to former employees now living on pension in nearby Kingsville.

SUCCESS of the large enterprise is attributed freely to the co-operative work of the management personnel which acts as a smoothworking team. Each man is responsible for certain definite work but each also brings his contribution to the solution of any problem that may arise. Chairman of the board is Richard M. Kleberg who represents his district in the Congress of the United States. Robert J. Kleberg, Jr., is president and general manager. Caesar Kleberg is assistant ranch manager. Alice G. K. Kleberg is secretary and treasurer and A. L. Kleberg is office manager and secretary. Tom East is head of the sales department. General superintendent of farming is Worth Wright and ranch division superintendents are Charles Burwell at Laureles, Lauro Cavazos at Santa Gertrudis, Jim McBride at Encino, Tom Tate at Norias, and Tom East, Jr., at San Antonio Viejo.

Important job of chief veterinarian is held by Dr. J. K. Northway who is in charge of the dairy herd and who supervises medical care and breeding of all herds. The ranch raises its own horses, and every horse used by the ranch cowboys is an offspring of the Mexican quarter horse and the English thoroughbred.

Selective breeding is all done on the headquarters division. Breeding cows and bulls raised there are supplied to the other four divisions. At present there are approximately 40,000 breeding cows with one bull to each 50 cows.

Small wonder the beginnings of this magnificent property have received more than their share of romantic writing. It would seem, however, that there is more romance in the struggle for existence and financial success—in overcoming with science and ingenuity those obstacles, any one of which could have meant oblivion to the clan of King-Kleberg as great ranchers.

To this belief the many thousands of sleek, dark red cattle with those strange humps reminding one of the Orient, grazing in many herds and disdaining the blazing sun, give eloquent testimony.

PROBLEMS

Are Scientific American Readers Interested in Mathematical Problems? To Settle this Debated Question The Editors Offer These as a Test

By LEONARD KAPLAN
Lieutenant Commander (CC) United States Navy

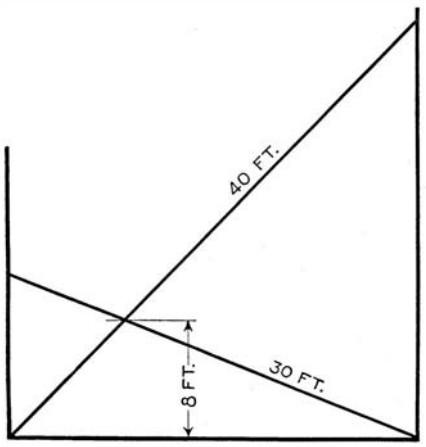
To the average human being a problem, like an unsolved puzzle, stands as a challenge. "Ha! you can't solve me," the problem seems to jeer, while the human being replies: "Are you positive? And just to show you how very mistaken you are, I am also going to solve you—and now." And solve it he does—well, maybe!

The five problems on the present page are offered by one of the United States Navy's builders of battleships whose recreation in off hours is this kind of sport. No prize is offered for their solution; they are presented merely because many readers like to tussle with something a bit tough. The answers, but not the solutions, are given on page 251. Of the two, the solutions are of course the principal factor, though for lack of space these cannot be published—some of them are rather lengthy. However, in case of heavy interest in any one of them the question of publication of the full details of solution will be reconsidered.

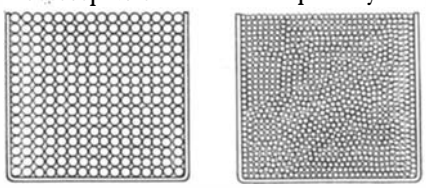
Whether you find these particular problems dead easy, plain easy, average, a bit difficult, or very hard, will naturally be a matter of relativity: that is, whether you happen to be a mathematician, a mathematician of sorts, or are a creaky mathematician (many a former good mathematician, alas, has found that, when not actively used for a few years, his once bright and shining classroom schooling in mathematics apparently has oxidized a bit). However, the tougher the problem the more satisfaction in cracking it. The "Problem of the Crossed Ladders" will require algebra, the "Problem of the Spheres" can also be solved by algebra, the "Problem of the Barge on a Rock" requires "trig," and both of the "Dog and Rabbit Problems" will necessitate use of the calculus.

Problem addicts are requested to address their entire problem correspondence direct to the author, in care of this magazine, but kindly not to the editors who, with a magazine to get out each month, have pressing problems of their own.—*The Editors*

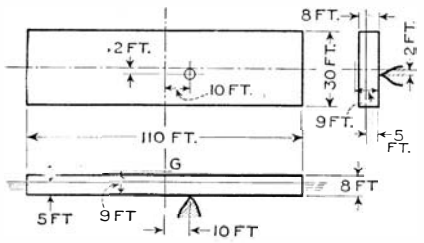
The Problem of the Crossed Ladders: Two ladders, one 30 feet long and the other 40 feet long, rise to opposite sides of an alley lined by vertical walls, and intersect (in projection) at a point eight feet above the ground, as shown in the drawing. How wide is the alley?



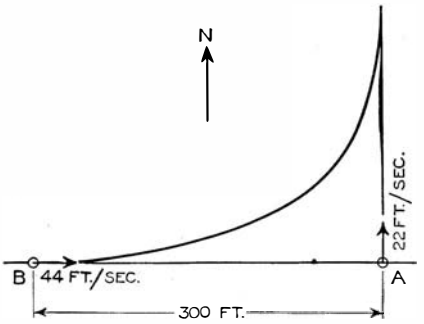
The Problem of the Spheres: A receptacle infinitely large is filled with spherical balls one inch in diameter. What proportion of the space within the receptacle will be occupied by the balls and how much will be void, assuming that the balls are stowed as compactly as possible [shaken down.—*Ed.*]? What will be the proportions if half-inch spheres are substituted, as shown?



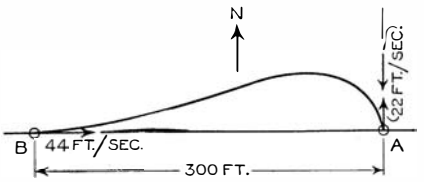
The Problem of the Barge on a Rock: A barge of rectangular section throughout, having the following dimensions: length 110 feet, beam 30 feet, depth eight feet, is floating on an even keel at a draft of five feet, with the center of gravity nine feet above the base. The barge touches upon a rock ten feet forward of the middle length and two feet outboard of the center line. The tide then falls six inches. Find the drafts at the four corners of the barge and the pressure upon the rock in this condition. (Assume salt water 35 cubic feet per 2240-pound ton.)



The Dog and the Rabbit Problem: A rabbit runs northward from a point *A* at a rate of 22 feet per second. A dog, starting from a point *B*, 300 feet west of *A*, at the same time, runs on an ever-changing course directly toward the rabbit, at a rate of 44 feet per second. How long will it take the dog to catch the rabbit? How many seconds after starting will the dog be headed northeast?



Second Dog and Rabbit Problem: A rabbit runs northward from a point *A* at a rate of 22 feet per second. A dog, starting at the same time, from a point *B*, 300 feet west of *A*, runs directly toward the rabbit at a rate of 44 feet per second. Assume now that the rabbit, after having run some distance north, sees the dog, reverses his course suddenly and runs south at the same rate of 22 feet per second, the dog meanwhile continuing to run at a rate of 44 feet per second directly toward the rabbit. How many seconds will have elapsed from the starting time to the time when the rabbit changes course, if both the dog and the rabbit are to arrive simultaneously at the original starting point *A*? In what direction will the dog be headed at the moment the rabbit reverses his course?



(*Answers on page* 251)

BERENICE'S HAIR

Recent Research Proves That This Nearby Cluster of Stars Is No Mere Accidental Conglomeration of Unrelated Bodies but Is an Interrelated System

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

ON a clear spring evening, when the Pointers have passed the meridian, and the middle of the Dipper is high above the Pole-Star, one may see, high up, and south of the zenith, a cluster of faint stars. Individually, these are far from conspicuous; but there are enough of them to catch the eye if the night is dark. Moonlight drowns them out almost completely.

Star gazers seem to have had an eye for such groupings, even though faint; for this insignificant group has had a name of its own and been recognized as a constellation since classical antiquity. It is known as Coma Berenices—Berenice's Hair. Alone among the ancient constellations, it commemorates a historic individual—Queen of Egypt in the 3rd Century B. C.—yet the name was generally adopted, and Catullus, 2000 years ago, wrote a mock-heroic poem in honor of this parvenu in the celestial spaces—probably itself a translation from an older Greek original.

The astronomer of the present day has a human, but not a professional, interest in these ancient tales; but the constellation itself has plenty to interest him. Like every other, it contains stars of individual interest—double, variable, and the like; but its appearance naturally arouses the inquiry: Is this a mere accidental conglomeration of unrelated stars, some of them far more remote than others; or a real cluster of objects at about the same distance, and of common motion and origin; or have we a real cluster, mixed up with other stars, in front of it and behind?

From what we know in other cases, the last would be the best guess. A number of star-groups, most of them recognized and named from antiquity, are now known to contain stars which are really related to one another—the Pleiades, the Hyades in the head of Taurus, Orion, the Great Bear (our modern Dipper), Scorpio, and the Southern Cross. But in all of these except the first, some of the most prominent stars belong to the foreground or background, and not to the true cluster. There are, however, other groups, almost as promising in appearance, which prove to be mere chance collocations—such as the pretty semicircle of Corona Borealis, or the great cross of Cygnus.

To distinguish one of these situations from the other, and to pick out the real cluster-stars from the interlopers, is sometimes easy. The naked-eye stars of the Pleiades, for example, are apparently moving in the heavens in very nearly the same direction, and at almost the same rate, so that there is no more reason to doubt their real connection than in the case of a flock of birds flying together across the sky. The same is true of many, though not all, the stars of the Hyades. Aldebaran, the brightest of all, is moving faster and in quite a different direction, so that it clearly does not belong to the group.

We can thus pick out, and omit from our counts, many of the aliens; but, though this test often affords a conclusive ground for exclusion, it is obviously not a perfectly safe test for admission. Among the many stars in the large region of the sky covered, for example, by the Hyades, there are likely to be a few whose proper-motions, by mere chance, happen to agree closely with that of a cluster star. Even when allowance is made, as is necessary in this instance, for the perspective effect of apparent convergence of the really parallel motions of the cluster-stars, a chance coincidence is still possible.

TO weed out these strangers, we may have recourse to the radial velocities, spectroscopically determined. The real cluster stars must be moving together—this is, indeed, the physical definition of the cluster. Hence they will all be approaching us (or receding from us) at the same speed (apart from perspective effects in a very widely scattered group). The great majority of the stars which show substantially the same proper-motion should therefore have the same radial velocity. Those which disagree by more than a reasonable allowance for the small errors of measurement must again be rejected—they have passed the first selecting screen, but not the second. We must be a bit careful here, for a star may be a spectroscopic binary, with orbital motion of its own. Repeated observations will show changes in the velocity as it moves around its orbit; and, if they are kept up, will make it possible to calculate and allow for the orbital motion—when the original test is applicable to the remaining motion.

There is still a third test. The stars of a real cluster can not differ greatly in distance from us—unless, indeed, the cluster itself happened to be an elongated cigar-shaped affair pointed directly at us, which is too improbable to bother about. For such practically equidistant objects, the differences in apparent brightness will reproduce those in real brightness—if one star *is* ten times as bright as another, it will *look* ten times as bright. When the apparent brightness (stellar magnitude) of the cluster members is plotted against the spectral types, a diagram of the familiar sort is obtained. Ordinarily, the bulk of the stars belong to the "main sequence" in which the redder stars of "later" spectral type are increasingly fainter, the redder they are. There are sometimes, though not always, a few bright red stars which really belong to the cluster, and are "giants." Ostensible cluster-members which fall outside these two classes are suspicious. Those which pass the proper-motion test, but fail here, usually fail also when the radial-velocity test is applied, and do not belong in the list at all. The chance that a star would, by sheer luck, get by all three of these tests is small enough to give us little concern (unless, indeed, we have thousands of probable cluster members to deal with—which has not yet happened).

This last test has another value. There are several clusters for which the distances of the stars may be found, reliably, but in ways of which there is no space here to speak. In these cases the real brightness of the stars can be found from their apparent brightness; and it then appears that the real brightness of a main-sequence star of the same spectral type (say G0, like the Sun) is closely the same in all the clusters—and also among the individual stars, nearer the Sun, for which we have good parallaxes. This means that stars similar in spectrum are at least pretty closely similar in brightness, and presumably in other properties.

If the same is true in other clusters, we can find their distances by comparing the apparent brightness of stars belonging to them with the real brightness corresponding to their spectral types. It is, of course, necessary to be sure that we are dealing with main-sequence stars, and not with the far brighter giants; but the diagrams already described make it clear that this can almost always be safely done.

A detailed, careful, and very convincing study of the cluster in Coma Berenices has recently been made by Dr. Trumpler of the Lick Observatory, who has already investigated many other clusters. Though known from antiquity, this cluster presents a peculiarly difficult problem. Its stars are fairly bright, but their proper motions are small, and in the direction of the general apparent drift produced by the Sun's motion in space. The unrelated stars are more likely to show apparent motions of this sort than of any other. Hence, though many of them will be rejected by the proper-motion test, the number which get by will be larger than for other clusters, and a list based on this test alone will contain non-members. The radial velocity, too, is small, and near the average for all the stars, but this test suffices to reject the majority of the stars which have sneaked into the first list. When the third test is made, by plotting the apparent magnitude against the spectral type, a few cases where both the other tests must have been passed by chance are revealed; and the remaining, thrice-tested list, should be trustworthy.

TO secure this result, all three tests have to be worked for all they are worth—and the account of the way in which this was done fills most of Dr. Trumpler's 28 large pages.

There is plenty of material for the proper motions, but the various sets of observations by nine different observers had to be most carefully compared. The minute systematic differences which are always to be found between the results of even the best work with different instruments and methods were carefully determined and allowed for, till, at last, a homogeneous set of results was obtained, representing the final result of more than a century of observations with the meridian circle, and 60 years' photographic work.

When these motions were plotted, those of a dozen or more of the brighter stars were so nearly identical as to make it certain that a moving cluster really existed. The fainter stars showed a group with this same motion, but more doubtful cases—as well as still more to be excluded.

The radial velocity test came next. Twenty-one stars had already been observed, at various places; 47 more were added by special observations at the Lick. Most of these stars are faint, and a great deal of work had to be done to get the three spectra per star which are needed to weed out variable velocities and get good average values.

To get uniform material for the third test, the photographic magnitudes of many of the stars were determined by new observations, and the results of earlier observers were re-discussed and combined with these. Most of the spectra were already given in the great Henry Draper Catalogue, but 18 faint stars were specially observed at Harvard to make the list as complete as practicable.

The constellation Coma Berenices, photographed by Edward E. Barnard at the Yerkes Observatory.

In his text Professor Russell mentions the origin of this odd name for the tiny constellation. In more detail the story is that Berenice was the wife of Ptolemy Euergetes, of Egypt, who reigned about 250 B.C. She was a blonde and she vowed that if her king, who had gone over to Babylon to fight a war, came back victorious, she would cut off her tresses of amber and place them in the temple of Venus at Zephyrium. The Ptolemy won his battle and the lady really made good her promise, but somebody stole the hair from the temple! The Astronomer Royal, a diplomatic man, thereupon jumped into the breach and named this cluster of stars Berenice's Hair, so Berenice had hair again

When all this mass of work had been done, it was at last possible to apply the three tests with the new, homogeneous data, and be sure of the significance of the results.

Out of an original working list of 212 stars, and an additional one of 21 fainter objects deserving investigation, 37 stars passed all three tests—leaving no doubt that a physical system of stars with common motion is really present. Seven fainter stars, for which radial velocities were not easily to be observed, pass the other two tests, and probably belong to the cluster. They are widely scattered over the sky, in a circle 7 degrees in diameter —making this one of the largest of all clusters as regards apparent size.

The brightest cluster star is of magnitude 4.8, and there are five others brighter than the sixth magnitude. Five other stars, in the same region, and above the same limiting brightness, have nothing to do with the cluster.

The proper-motion of the cluster is small, 0°.021 per year. Its parallax, determined by comparison of the real and apparent brightness of the cluster stars, is 0°.013, making the distance 75 parsecs, or 250 light-years. The real motion in space is in almost the same direction as the Sun's and at two thirds the velocity, so that the Sun overtakes it at the unusually small speed of 7.5 kilometers per second. The outer diameter of the cluster is about 30 light-years. The brightest star in the cluster is 50 times as bright as the Sun. The faintest which have so far been identified has about 1/30 the Sun's brightness. All the stars but two belong to the main sequence, and have spectra ranging from A0 to K2. The rate of decrease of brightness with increasing redness is very similar to the average for other clusters. The two giants are of unusually early types, A8 and F4.

The cluster is a "poor" one, containing less than 50 stars; but this is nothing remarkable, for nearly half the more distant galactic clusters which have been recorded in Trumpler's work are no richer. In its central part, stars brighter than one fifth the Sun's light are, however, more than 50 times as thickly strewn in space than in the general field outside, so that it is a very real affair. Indeed, calculation shows that the mutual attraction of its members should suffice to keep them together—though by no very wide margin. Compared with a rich cluster like the Pleiades, Coma Berenices shows a smaller proportion of faint stars. Whether this is true of other poor galactic clusters we do not know—they are too far off.

TWO incidental characteristics may be mentioned. This is one of the nearest clusters—only the Hyades and the Ursa Major group being nearer; and, as we see it, it is about as far as possible from being "galactic," since it lies within a few degrees of the north pole of the Milky Way. Its distance, in space, from the galactic plane is not abnormal. We are so close to it because we are—so to speak—right under it, which accounts for its apparently unusual position.—*Princeton University Observatory, February 5, 1939.*

Insects Cannot Win

Civilization's Unnatural Balance Cause of Apparent Victory . . . Most Insects Are No More Numerous, Only More Notorious . . . Many New Insecticides

By LEE A. STRONG
Chief, Bureau of Entomology and Plant Quarantine,
U. S. Department of Agriculture

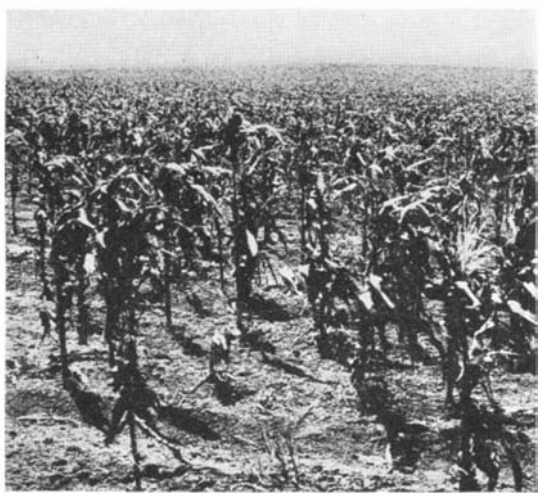
IT seems to be the general impression that insects are more numerous and troublesome today than they were during our youth. Is this true? Yes, and no. Some insects are more numerous and troublesome. For example: grasshoppers, which were long but a legend to us—a legend of the pioneer days in the Dakotas, Nebraska, and Kansas, those days when the sod-hut settler was driven from his claim by the vast hordes of Rocky Mountain locusts that swept into his fields and left no single green thing. It is also true that many new pests have come into prominence during the present generation. We have seen the coming of the European corn borer, the Japanese beetle, and the white-fringed beetle, the last so new that it is not known to the general public but is only too well known to the farmers in a small area in northern Florida and southern Alabama.

IT is not true, however, that most of our insect pests are remarkably more numerous than they were during the last generation. They are merely attracting more attention. The last generation accepted worms in apples as a normal state of affairs; and gouges in the side of potato tubers occasioned by white grubs and wireworms were expected. The early canning industry and the consuming public paid little heed to fragments of insects in canned goods. They could not be seen and were, therefore, "not present." Today we have a very discriminating public. An apple pack must be absolutely free of insects, and the canner is very carefully watched by health authorities to see that no insect fragments, even though discernible only with a microscope, shall be in the can that reaches the consumer. What was considered a very satisfactory crop a half century ago is nearly crop failure today, with exactly the same amount of insect damage. The rôle of insects as factors in human diseases and diseases of livestock has attracted very considerable attention. Even many plant diseases are carried by insects. Our public has also been made very insect-conscious by the press, the radio, and the motion pictures. The layman *knows* that insects can be controlled and therefore insists that they must be controlled.

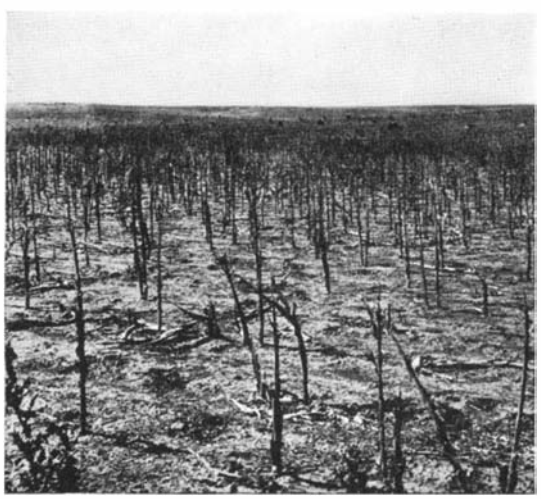
Will insects eventually destroy man? Not without some vast change in this earth on which we live. Quite true, they are capable of multiplying at a rate that is astounding. The progeny of a single pair of aphids, if they all lived, reproduced, and their offspring lived for one entire year, would fill up the Atlantic Ocean with their bodies. But this does not occur. Nature is a beautifully balanced machine; not static, but slowly progressing, first with one group being dominant, then another. The giant reptiles had their day millions of years ago. Then the changing earth gave the mammals an inning in the Tertiary period. But during this time, and long before, the insects were maintaining themselves in very similar conditions and even in very similar form to the insects of today.

In the primitive jungles of the tropics insects occur in countless numbers and kinds, but vegetation and primitive man live with them. That is the keynote of the whole situation. Primitive man, primitive conditions, all nicely balanced; but civilized man promptly destroys that balance. He introduces the plow. He cultivates large areas of exotic plants. He brings in livestock. New adjustments must necessarily take place. These adjustments, however, take thousands, even millions, of years and man cannot wait. In order to maintain this unbalanced situation that he must maintain with his present civilization, he must strike an artificial balance and he does this by, in one way or another, making his cultivated fields and domestic animals an unsuitable environment for the insects.

Probably one of the greatest advances in the control of insects was the discovery that arsenic, then in the form of Paris green, was very poisonous to insects. New arsenicals were discovered in rapid succession. The boll weevil that crept across the Rio Grande late in the 19th Century threatened to wipe out an entire civilization built up around the production of cotton in our southern states. This insect is adequately controlled by dusting with



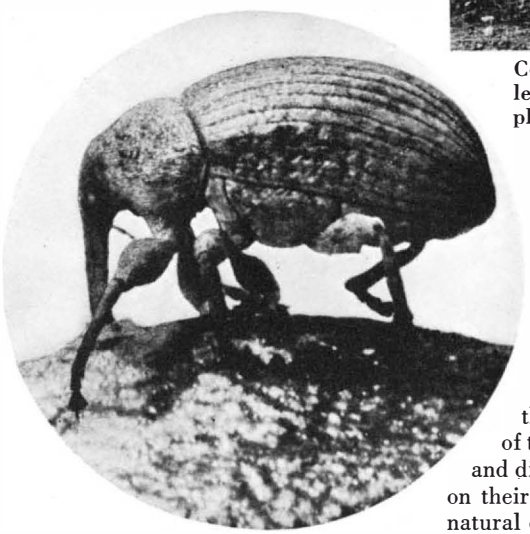
A healthy (though not very luxuriant) field of corn before it was attacked by grasshoppers. A fair crop might have been expected from it



The same field as that shown above, after grasshoppers had feasted on everything but the hard-skinned stalks. Such grim reminders of the appetites of hordes of insects have caused apprehension, in the minds of many, as to man's ability to defeat the insects

calcium arsenate. But, to illustrate how easy it is to upset the normal balance, the application of this calcium arsenate, in addition to destroying the boll weevil, destroys a number of insects that feed on the cotton aphid; and often the application of boll weevil control methods is promptly followed by serious outbreaks of the cotton aphid.

The last half century can almost be called a chemical age. The science of chemistry has advanced so rapidly that there is hardly an activity of man that today is not stimulated and in some cases made possible by the work of the chemist. This great development of chemistry has also vastly improved our methods of attacking insects, and today large numbers of highly trained chemists are working in the Federal Government laboratories at State experiment stations, in private insecticide companies, and individually on the improvement of munitions of war used in our battle with the insects.



Cotton picked from two plots of ground of equal size. Yield on the left is from the unpoisoned plot; that on the right from poisoned plot. The poison kills the boll weevil, shown greatly enlarged at left

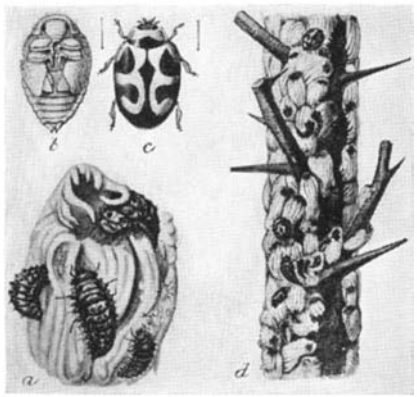
Of course many insects do not lend themselves to control with chemicals and many of our most successful methods of combating these pests have been along quite different avenues of attack. We control the hessian fly with our knowledge that this insect emerges at a very definite time with relation to climatic conditions. With this knowledge, we plant our wheat after the flies have emerged and died. We know that certain bark beetles—those pests which destroy more timber in any year than do the dreaded forest fires and which, in addition, are the predisposing cause of many of these fires because the insect-attacked forest with its tangle of fallen trees is a very potent factor in these great conflagrations—can be controlled, if discovered in their early stages, by simply felling infested trees and removing the bark or otherwise destroying the brood of bark beetles.

Another very important line of attack is our attempt to re-establish the balance in Nature's battle. This method is particularly applicable to insects brought to this country from foreign lands. In the land of their origin, these insects have an established balance. They are preyed upon by other insects; they are attacked by disease; they are fed upon by birds and mammals, and do not multiply in the devastating hordes that they do when they reach the land of the free—free of all their enemies and diseases. By studying these insects on their native heath, we discover these natural enemies and introduce them into our own land. Early in the citrus industry of California, the cottony cushion scale was introduced from Australia and grew "bigger and better" in the land of perpetual sunshine. An entomologist was sent to Australia to look into this matter. He found a little lady-beetle, the Vedalia, and brought it to America; the cottony cushion scale is no longer a pest in the citrus groves of California.

HERE, however, we will direct our attention to the control of insects with insecticides. This is no simple matter. It is not merely the discovery of a poison that will kill insects and then its application to *all* insects. That there are now estimated to be 624,300 different insects in the world, that in our own country we have records of over 20,000 different kinds of insects that are of some economic importance and over 6000 of these are actual pests, is not generally known. These insects have a great diversity of form and habit. They can live under almost any conditions found in Nature. Insects live in crude petroleum wells; they live in saturated salt solutions; they live in springs hot almost to the boiling point; they live on the most barren deserts; they live long periods of their lives under water. They feed in many different ways; they breathe in many different ways; they reproduce their kind in many different ways. All of these diversities require differences in treatment. A young mosquito lives in water, and any attempt to kill mosquitoes that are flying about the house is almost wasted effort. These insects, while in the water, breathe through a tube in the tail that is thrust above the surface. Hence an approved method of control is to separate this tube from the air by placing a film of oil on the water.

Plant lice, the chinch bug, all our scale insects, cannot be poisoned by placing poison on their food, as they do not feed that way. These insects have their mouth parts developed into a sucking tube which they thrust through the poison and into the unpoisoned plant tissue beneath. These must be killed with an insecticide that will destroy them by coming in contact with their bodies, or by a gas that will enter their bodies by other methods than through the digestive tract. Some insects are attracted to certain substances. These insects can be killed with poisoned baits. Others are repelled by certain substances, and crops are protected by applying these repellents. Each insect, by its peculiar habits, requires either a modification in the insecticide used or in its method of application.

Another factor that further complicates the problem is the changing standards of human welfare. For many years, arsenicals were standard insecticides. Then it was discovered that quantities of these poisons, believed to be detrimental to health, were being consumed on foodstuffs that had been treated with these insecticides, and prohibitive legislation against such foods made it necessary for the entomologist to start his attack anew. Certain other insecticides were not compatible with fungicides that were being used on the same plant for the control of the fungous diseases, and modifications or new insecticides were found necessary. The early work was largely with the inorganic chemicals as base materials in developing insecticides. We are now rap-



Imported from Australia, the Vedalia beetle, *c*, destroys the cottony cushion scale, on twig *d*, also a native of Australia. Beetle pupae, *a*, feed on egg mass of scale. Adult beetles feed on scale on the twig

idly moving into the field of organic chemistry in insecticide work.

Organic insecticides are showing great promise. Most of these substances are obtained from plants, some from cultivated crops, others from forest products, and still others from weeds. Those in another group are built up in the chemical laboratory and are known as synthetic products. Every year, the waste material of the tobacco industry is used to produce about a million pounds of nicotine, which is equivalent to about 2½ million pounds of the commonly used solution sold as nicotine sulfate. This material is one of our most valuable insecticides, having long been known as a fumigant and as a contact insecticide to kill such insects as aphids.

Recent research work has demonstrated that a combination of nicotine with a clay-like substance known as bentonite forms a very effective stomach poison which promises to become a successful substitute for arsenate of lead in the control of the codling moth.

In 1937, nearly 20 million pounds of pyrethrum flowers were shipped into the United States, the great bulk of the material coming from Japan, sizable shipments also being imported from Jugoslavia, Kenya Colony, and Brazil. An insecticide is prepared from these flowers which is the base of many of our most useful fly sprays.

The natives of the East Indies and Malaya have long known that the roots of a plant called derris, when pounded up in water, would paralyze fish and that fish so paralyzed were not in any way poisonous when eaten. The active principle of derris is rotenone, one of the most powerful insecticides yet discovered. It is 30 times more poisonous than lead arsenate to the larvae of the silkworm and when used on aphids it is 15 times as toxic as nicotine. It is so poisonous that one part in 13 million parts of water will kill goldfish, and yet is but slightly, if at all, poisonous to mammals—being only 1/100 as poisonous as lead arsenate to rats. This material is almost an ideal insecticide. It is not injurious to plants or animals sprayed or dusted with it. It does not leave on foodstuffs a residue that is poisonous to man or domestic animals, and it can be applied in doses small enough to be economical. In 1937, over 570,000 pounds of derris were imported into the United States from British Malay, the Dutch East Indies, and the Philippines.

In addition to derris, other plants contain rotenone. Of these, devil's shoestring occurs as a common weed throughout the United States—a plant belonging to the bean family which occurs on land so poor that little else will grow. Research work on the production of devil's shoestring having high rotenone content is now under way. This research may lead to our being self-sufficient in the production of rotenone. A third source of rotenone is a root from Peru and Brazil known as lonchocarpus. Last year we imported over a million and a half pounds of this root for use in compounding insecticides.

Oils obtained from corn, cotton, soybeans, linseed, peanuts, and many other plants have been found to have decided insecticidal value. Certain of these oils are more toxic to mealybugs than are the usual petroleum oils used for this purpose. They have a decided advantage over petroleum oils in that they are better solvents for such insecticides as rotenone. It has been found that the addition of soybean oil to nicotine bentonite increases the toxicity of nicotine on apples and thus insures better control of the codling moth. It has also been found that the addition of certain of these vegetable oils increases the toxicity of certain other organic poisons such as derris, nicotine sulfate, and anabasine sulfate.

Soaps made from corn oil, cottonseed oil, soybean oil, and other organic oils, possess high insecticidal value. It has been found that the fatty acids derived from plant oils may be used in place of acetic acid in Paris green and the resulting compounds have greater insecticidal value and are less likely to damage plant tissue than ordinary Paris green.

The future of insecticide development is very promising. An acid from the cocoanut is the base of a potent insecticide. Oat hulls and corn cobs yield furfural, and derivatives of this remarkable compound have given promising results. Sulfur, when combined with other substances found in plant oils, has been found to be quite toxic. Corn, rye, wheat, and other agricultural surpluses may be fermented to produce alcohols which, by proper combination, produce substances of great insecticidal and fungicidal value. The day may come when insecticides made from wastes and very cheap products will so reduce the price of insecticides that that margin on which the farmer lives, often so narrow, will broaden out and lead to a better farm life and, in turn, by reducing the cost of agricultural products, to a better national life.

Illustrations courtesy U. S. Department of Agriculture, Bureau of Entomology and Plant Quarantine

Many tons of poisons are sprayed on the cotton fields of the South every year by several different methods. Note the cotton blossoms in lower field

World's Safest Ships

Sea Disasters Too Frequent in Recent Years . . . American Ship Lines Attack the Problem . . . New Ships Will Have Vastly Improved Safety Features

By JOHN P. LEE

NEW safety features being incorporated in the S.S. *Ancon*, recently launched, will make her and her sister ships the *Panama* and *Cristobal* the safest ships in the world. These new vessels will be operated this year under the American flag by the Panama Railroad Steamship Line in service between New York and the Panama Canal, via Haiti.

The trio of ships are the first American-built vessels to comply with the safety requirements drawn up several years ago by the Senate Technical Committee on Safety at Sea, headed by Admiral George H. Rock, and the sub-committee on Fire Control, headed by George Sharp, noted naval architect, to assist in the formulation of legislation for use by the Bureau of Marine Inspection and Navigation.

In order to create the circumstances of an actual fire at sea, the experts conducted a long series of tests on an obsolete vessel, the S.S. *Nantasket*. Single staterooms, as well as a group of adjoining staterooms, were built into the old ship. Various materials, including impregnated and untreated wood, asbestos compositions, aluminum, and steel, were used in the construction of the rooms. A space of three feet was allowed between the walls of the rooms and the shell of the ship in order to permit observation from the side.

Portholes were simulated by running vents from the stateroom walls through holes opened in the ship's side. An artificial non-recirculating ventilation system was also provided.

The tests involved three types of stateroom construction: rooms built of steel-faced panels, with various type cores, of wood impregnated against fire, and of asbestos composition with special steel construction members or by orthodox joiner work methods using impregnated wood or asbestos composition. Some of the rooms were fitted with deck coverings, of various types, both within the test enclosure and on the deck above it.

To create a severe fire, cordwood and kindling, to the amount of five pounds per square foot of floor area, were stacked inside the room and, at a given signal, ignited at several points to produce a uniform spread of flame.

Each fire was carefully timed by observers. Temperature readings within test enclosures were made from thermocouples variously located, one near each corner of the room and one in the center.

TESTS showed conclusively that walls of substantial construction having panels of incombustible materials stood up without harmful bending or buckling, effectively confining the fire to the compartment they enclosed. Substances such as asbestos compositions, and corrugated and treated asbestos papers, were found suitable for such inner cores, faces of panels being steel, aluminum, or asbestos composition and in some cases with added thin veneers.

Under some conditions it was possible to employ thin combustible panel face veneers, combustible furniture, and combustible decorative trim without impairing the room's capacity for fire confinement. Fire zone bulkheads or main subdivisions equipped with easily closed fire doors were also developed for keeping flames originating in machinery, cargo, or public spaces from spreading throughout the ship. Further protection against fire, it was found, could be obtained by covering the floors and deck with various type deck compositions.

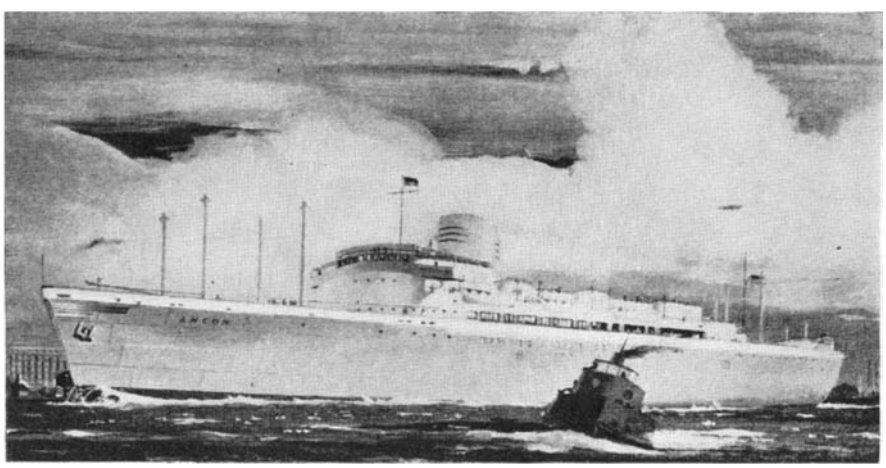
As a result of the fire test findings, all walls, ceilings, floors and other parts of the S.S. *Ancon* and her sister ships are being built of incombustible materials, so that any shipboard fire, no matter where its origin, can be confined within a limited area.

Additional subdivision of structure safeguards the vessels against damages resulting from collisions or hidden reefs and will make the *Ancon* and her sister ships practically unsinkable. Each ship will be sub-divided into 12 separate compartments, any two of which may be pierced simultaneously without affecting the ship's ability to stay afloat. Even if three of these compartments, under some conditions, are opened to the sea, the balance of the subdivisions will keep the ship afloat.

Never before used on any American ship, "Schat skates" will be fitted to the lifeboats to insure their safe launching even if the vessel is leaning sharply to one side. Instead of being operated by oars, these lifeboats will be propelled by hand levers connected to the propellers, so that pasengers can operate them without difficulty.

The interior decoration of the *Ancon* is being done by Raymond Loewy, noted industrial designer who is making clever use of numerous fireproof materials, such as stainless steel, aluminum, glass, and plastics. Stainless steel, for example, is to be used on some of the furniture; aluminum is employed for chair frames and stair railings; plastics, compositions, or glass for table tops.

So complete is the attention of experts to safety aboard these ships that, in the words of the committee of experts, "the hazard of fire need no longer be a serious menace to the safety of life at sea."



Artist's drawing of the *Ancon* as she will appear when completed

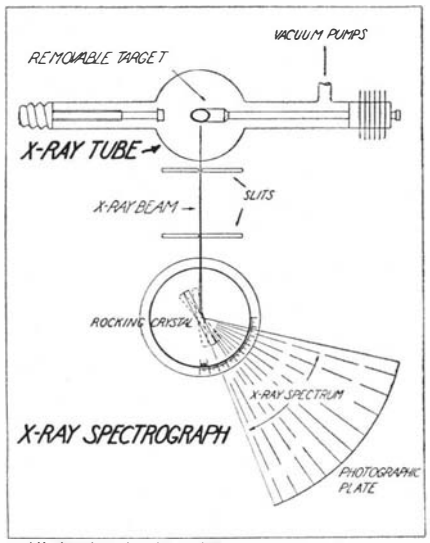
THE STUBBORN ELEMENTS

Some Chemical Elements Thrust Themselves Upon Us, Many were Found Chemically, but the Last Few Have Required Delicate Physical Methods of Search

By CHARLES W. SHEPPARD

THE story of element 87 presents a picture of the hard work, successes and failures, repeated promises and disappointments that have gone into the discovery of new elements. It also answers several possible questions that might be raised by the layman who seldom gets closer to such a discovery than reading about it in his newspaper.

The first question such a reader may ask is: how does the searcher even know that such an element ought to exist? To answer this, reference must be made to that familiar old bugbear of students of elementary chemistry, the Periodic Table of the Elements, in which all fundamental relationships are revealed. In that table, the elements are numbered, starting with hydrogen as No. 1 and ending



All drawings by the author

Figure 1: The X-ray spectrograph

with uranium, No. 92. Now it turned out, many years after that remarkable classification was made, that the number of any element, that is, its so-called atomic number, also gives the number of outer electrons in the atom of the particular element in question. When the table was first put together, many gaps were found, indicating unknown elements. Many of these were later filled in by various workers.

In the early days, it was easy enough to identify new elements by chemical means, but as each discovery was made, it left only the more stubborn cases for future workers, so that it became necessary to develop more powerful methods to detect new elements. Thus we arrive at the second question: how has the scientist known when he has a new element before him?

The most commonly used instrument for making such identifications is the X-ray spectrograph (Figure 1). This instrument makes use of the principle of X-ray diffraction. If a beam of X rays is projected through a crystal, such as calcite or rock-salt, a spectrum can be produced comparable with that formed when light goes through a prism or is reflected from a diffraction grating. This X-ray spectrum is not visible to the naked eye, but if it is registered on a photographic plate, certain lines can be recognized. Each line on the plate corresponds to a characteristic wavelength of X rays produced by the target of the X-ray tube. If we use a special X-ray tube with a series of interchangeable targets, these lines are found to be distributed on the photographic plate just as are the lines in a spectrum—that is, in such a way that their wavelengths can be measured. Also, for each target used, the lines fall in different places on the plate, so that each target has its characteristic wavelengths.

IT was the clever young English physicist, Moseley, who discovered that the atomic number for each element was the number of external electrons in the atom. With this discovery came a law concerning the X-ray lines of any element in an X-ray target. Moseley's law states that the wavelength of these lines is inversely proportional to the square of the atomic number of the element. Therefore, if we know the atomic number of the element we are looking for, we can predict the wavelength of certain lines in its X-ray spectrum quite accurately (Figure 2). If we set up our X-ray spectrograph so as to catch these lines where we expect them to fall, then, if the element is present in the target which we have chosen to use in our X-ray tube, we should know it.

This provides one good way to identify difficult elements, but it is well to have another to use as a check. One of the best of these, and one which is almost as sensitive as the X-ray method, is that of positive-ray analysis.

Early in the present century, just about the time that satisfactory pumps were discovered for producing a high vacuum, positive rays, or "canal" rays, were discovered. It was found that if an electrical discharge was maintained in a low vacuum, a long, thin tube or "canal" could be led from the discharge to a high vacuum, and that, by sufficiently fast pumping, the high vacuum could be preserved (Figure 3). If this canal were then given a high negative charge, positive particles could be pulled from the arc with a high velocity and shot through the canal into the high vacuum. These particles were found to be atoms of the type present in the discharge but minus one or more outer electrons, which accounted for their positive charge. If we put any particular element into the discharge on the low vacuum side of the canal, we can produce positive rays of the element.

Now, a stream of charged particles acts like an electric current. So, if we put a magnetic field across the beam, the beam will be bent. However, the heavier particles are deflected less than the lighter, and if they then strike a fluorescent screen or a photographic plate, there will be a series of spots, one for each particular particle depending upon how heavy it is. This gives us a good way of finding just how much an atom weighs

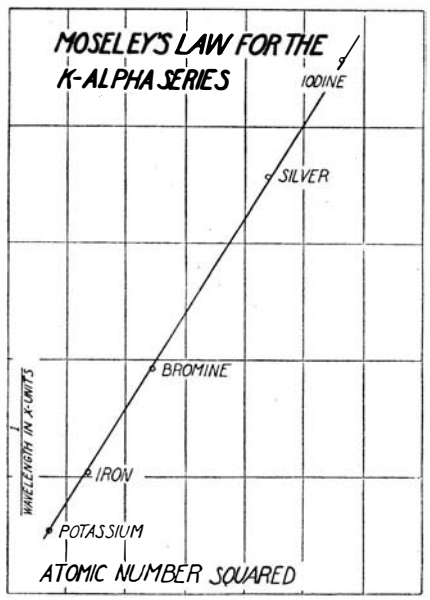


Figure 2: How Moseley's law works

and it has been a most useful device for this purpose. A conclusive way to identify a difficult element, therefore, would be to put it into such an apparatus to see whether we obtain a spot on our plate where we calculate that there ought to be one. Even better than this, if we do get such a spot, we can actually collect small quantities of the element in a pure state by putting some sort of collecting apparatus at this point. If we then examine these minute quantities with the X-ray spectrograph and get the proper Moseley lines, we are definitely sure that we have identified an element.

The next question one might ask is: where do we look for the element? To decide this matter, we obviously should determine its chemical properties. If we examine a Periodic Table, we find 87 in column I together with the alkali metals, lithium, sodium, potassium, rubidium, and caesium. This would suggest to us that our element would behave like its fellows: it would react violently with water to make a caustic hydroxide. For similar reasons, it should have their strong affinity for chlorine, bromine, and iodine. It should be found in minerals rich in caesium. Since it is in the same row with elements like radium, uranium, and thorium, it should be radioactive. Two minerals rich in alkali metals are lepidolite and pollucite. In 1929, at Princeton University, Dr. Bainbridge, using the method of positive-ray analysis, looked for the element in these two minerals, but failed to detect it. It was felt that possibly he had not succeeded beforehand in concentrating the element sufficiently in the material to be examined. Prior to this, a number of persons had looked for it but without success.

IN 1930, F. Allison and E. J. Murphy, using a magneto-optic method, reported the presence of the element in the above minerals, but it was felt that their work was not sufficiently conclusive. In 1931, at Cornell University, J. Papish and E. Wainer reported finding X-ray lines of element 87 in the mineral samarskite. These lines turned out to be false.

In 1936, H. Hulubei, in France, reported that he had found weak lines of 1032 and 1043 X-units (one X-unit is 0.00000000001 centimeters wavelength) on a large curved-crystal focusing spectrograph, an instrument very similar to the one described in Scientific American, May, 1932. These lines, he claimed, were the pair of element 87 called the L alpha doublet. However, a controversy arose, for in 1937, F. R. Hirsh, at Cornell University, reported that the lines were off by some six X-units, and it seemed much more likely that these lines were the L beta doublet of mercury which came at 1030 and 1037 X-units. Actually, mercury was known to be present, since it almost always is found in any X-ray tube which is connected to a vacuum pump of the

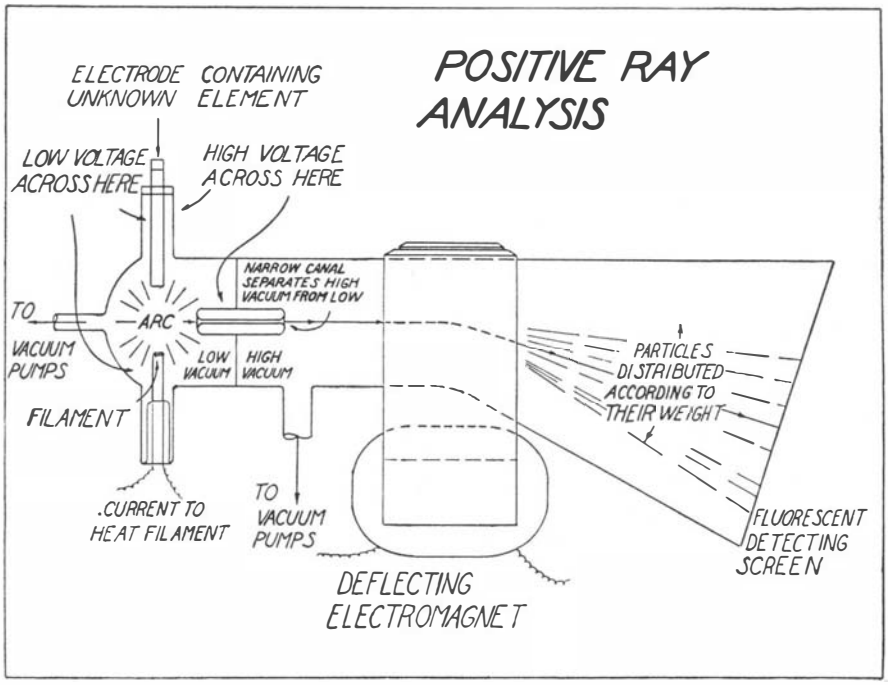


Figure 3: Set-up of apparatus for positive-ray analysis (see the text)

WHEN a man discovers a ton of gold or a stone in his shoe, he feels positively that he has made a discovery: his senses tell him directly. And so it has been with most of the elements. Difficult elements, however, cannot be apprehended directly by our senses but require intermediaries: apparatus. And sometimes the evidence is so tenuous that science remains uncertain. Thus, after all, it is only *relatively* possible to be sure of discovery—as is true of all knowledge. —*The Editor*.

mercury diffusion type. Hulubei had thought of this but based his claim on the fact that the lines persisted when he substituted oil diffusion vacuum pumps for his mercury ones. Nevertheless, it is felt among most X-ray spectroscopists that, once mercury gets in, it permanently contaminates the X-ray tube.

In this same report, Hirsh described an attempt to find the elusive lines in a concentrate obtained from California. Using a target of this material, Hirsh took an eight-hour exposure on the same apparatus as that used by Papish and Wainer, mentioned above. This apparatus had a mechanism for rocking the crystal during the exposure which, besides producing the spectrum, prevents possible flaws in the crystal from producing false lines. This exposure produced a very good line at the center of the plate which had been placed where calculations showed the line would be expected. Hirsh then took a longer exposure, using a material estimated to be concentrated to about nine times the extent of that of the previous sample. The line showed up more strongly. However, although he seemed to be "getting hot," Hirsh felt that there was something peculiar about this line, so, in order to be sure that it was not spurious, he put a blank copper target in the X-ray tube and, to his dismay, found the same line on his plate as before. Undoubtedly it was due to a flaw in the crystal of his spectrograph. The crystal was then set to rock through a larger arc and the line vanished. This line was the same one that Papish and Wainer had found on the same apparatus, so it seemed that the field was again open for the discovery of element 87.

It remained open until the fall of 1937, when Hulubei reported that he had recorded several additional principal lines of 87. The instrument which he used is the equivalent in sensitivity of many single-crystal spectrographs in one, and if the discovery holds up, it would seem to indicate that previous failures by others were due to lack of sufficient sensitivity.

LET us draw some comparisons. Most of us have at some time or other seen a small mountain of scrap iron and known that there is much more than we as individuals could possibly use. Then, in considering rarer elements, we might think of iridium, minute quantities of which are used to tip better grades of fountain pens, and which costs about $160 an ounce. In an even scarcer class are the elements of the rare earth group, most of which have never been isolated in the pure state. Finally, No. 87 is much scarcer, even, than these. Referring to pure caesium from pollucite, Bainbridge estimated element 87 to be present in amounts less than three parts in every 10,000,000 of this caesium and no doubt it is much scarcer, even, than that.

Pearls Through Artifice

Man's Two Principal Methods of Simulating Nature's Gem . . . Misconceptions About Biologically Synthesized Pearl . . . New Research Uncovers Facts

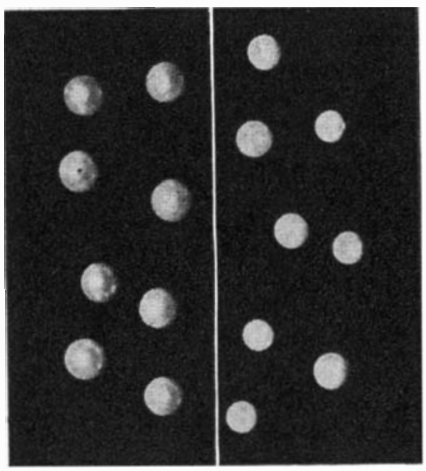
By A. E. ALEXANDER, Ph.D.
Pearl Fellowship, Mellon Institute, Pittsburgh, Pa.

IN attempting to simulate the highly prized natural Oriental pearl, man has resorted to two methods—one entirely manual fabrication, the other a combination of manufacturing and biological processes. According to the findings of the writer, the Japanese cultured pearl is structurally different and physically less homogeneous than the natural pearl. Contrary to the widely accepted belief, all specimens examined contain a relatively large mother-of-pearl bead or nucleus and not a "tiny irritant"—in nearly all cases comprising 80 to 90 percent of the total diameter of the cultured pearl. The process of culturing pearls is, so to speak, the biological analogue of veneering wood or producing a plated metal.

FOR more than 4000 years, men and women have been fascinated by the beauty of the natural pearl. The possession of these jewels has brought to their owners that esthetic appreciation of elegance, rarity, and authenticity which is the basis of values in all gems and works of art.

It would be strange indeed if during all these centuries no imitations or simulations of this most warmly beautiful of all gems had been developed. The case of the pearl, in fact, has been that of nearly every other rare possession, in that many attempts have been made to reproduce in cheaper form an article resembling as closely as possible the natural jewel.

But while imitation is said to be the sincerest form of flattery, the public is



Eight whole cultured pearls, left of line, compared with mother-of-pearl cores from eight cultured pearls of similar size. Cores *not* small grains

entitled to full knowledge regarding the differences between the authentic article and those made to simulate it. On this premise were developed the stamp of "sterling" on silver and of "24 carat" on gold, to distinguish them from the plated products, and to serve through law and custom as safeguards to the public and the ethical merchant.

It is felt that, up to the present time, the slow processes of law and public education have not yet brought about an adequate recognition of the differences between natural and simulated pearls. In fact, erroneous popular impressions have been reflected in published statements appearing in standard reference works.

In the case of the pearl, two lines of development have been followed in efforts to create through artifice products that simulate the rich iridescence of the rare and costlier natural gem. The first employs chemistry and ceramics to produce an imitation which is, of course, to be considered as a manufactured synthetic article.

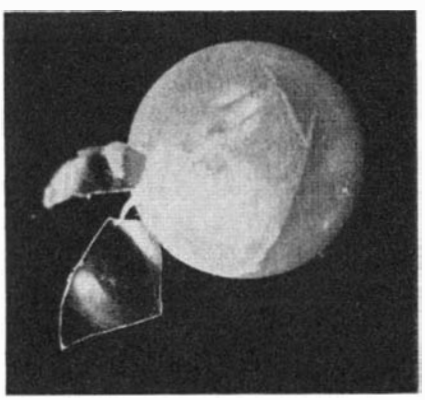
The second line of development has involved a combination of a manufacturing operation and a biological phenomenon to produce the so-called "cultured" pearl. In this procedure, an oyster is induced by irritation to enrobe a manually inserted mother-of-pearl bead—which in the present commercial article is relatively large in size—with concentric layers of nacreous material. This combination of operations and structures is unique as an industrial technic; an article so produced is in part manufactured, and the process is, so to speak, the biological analogue of veneering wood or producing a plated metal.

Methods for producing artificial pearls were recorded over 200 years ago, and doubtless many attempts go back still further. Two general types of imitations are manufactured, one employing a solid glass bead and the other a hollow glass sphere. The former are prepared by coating the glass core with a wide variety of substances, usually a lacquer to which "pearl essence"—essentially guanine, obtained from various species of fish—may be added. The hollow glass spheres are coated internally with "pearl essence" and are weighted by loading with wax and barium sulfate.

In 1935, 15,615 hollow or filled iridescent imitation pearls were imported into the United States. In the same year 86,375,289 inches—the unit in which importations are reported—of solid imitation beads of varying quality, with a total valuation of $49,803, were brought into the country. Of this number 81,392,590 inches were made in Japan.

A subsequent article will be devoted entirely to natural pearls. At this point it should be mentioned, however, that the formation of a pearl in a pearl-bearing oyster is a biological accident. Furthermore, it is interesting to note that by a curious paradox of nature this loveliest of gems is believed to be the result of a pathological condition.

The most ingenious development in pearl artifice has involved bending these natural processes to mass production methods. The original conception on which this industry is based is attributed to the Chinese. As early as the 13th Century, they discovered that, by placing an object—such as a small image of Buddha—in a living mussel and returning the



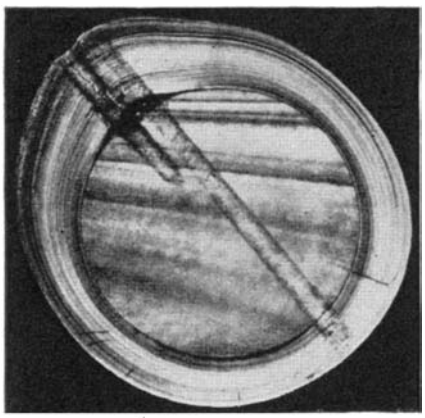
An imitation pearl—a glass bead, lacquered. Note thinness of coating which has been partially removed

mollusk to its natural environment, a deposit of nacre was slowly built up around this nucleus.

In 1890, in Japan, was begun the present-day commercialization of this Chinese discovery. It is indeed á feat of industrial biology, which may be compared in ingenuity with the accomplishments of the chemists in producing artificial rubies and sapphires. The founder of the industry, Kokichi Mikimoto, after many discouragements, succeeded in producing blister pearls about 1894. A decade or more elapsed before he was able to obtain a spherical form.

The following detailed description of the production of a cultured pearl is taken from Japanese sources:

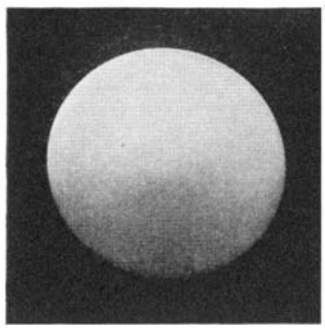
"The process consists of removing from a living oyster the mantle parenchyma which is used as a bag to envelop the nucleus of the pearl. When this nucleus, which consists of a tiny fragment of fresh water mussel, has been inserted in the fleshy bag, its mouth is secured with a cord, and the whole is introduced into the subcutaneous tissue of the shell-secreting epidermis of another oyster through an opening surgically made for the purpose. In the same operation the cord is withdrawn, the wound made by the lancet is disinfected, and the oyster having been returned to the sea is left to cover the nucleus with the many layers of nacre necessary to produce perfectly spherical pearls."



A thin-sectioned black cultured pearl. Note fineness of laminae and "grain" of large core. This pearl was originally drilled off center

The concentric rings in the natural pearl and in the outer section of the cultured pearl doubtless are related to some periodicity in the life processes of the oyster. In analogy to annual rings in trees, they might permit an approximate estimate of the period of growth. This information may be known to the Japanese producers, but it has not been published so far as we are aware.

In a thorough examination of a representative collection of several hundred cultured pearls, it has been found that, contrary to the general impression, the cores represent the major part of the



At left: **Whole cultured pearl with the nacre intact.** ***At right:*** **The same pearl with all but a small part of adhering nacre removed. Compare the size of core with the original pearl. Magnification is 4 times**

article. By means of a specially constructed micrometer gage used in conjunction with a binocular microscope, the writer has observed that, with few exceptions, the linear diameter of the core is 80 to 90 percent of the whole diameter. The outer shell of nacre is, therefore, comparatively thin. The widely accepted popular belief that the nucleus of the biologically synthesized pearl is a "tiny irritant," apparently rests on such statements as: "this nucleus, which consists of a tiny fragment of fresh water mussel, etc."

The nucleus consists of mother-of-pearl substance—ordinary calcium carbonate with an adhesive protein constituent—which has been manufactured from mollusk shells. This core or bead is shaped into a sphere by mechanical means and is then given a high polish.

AMONG procedures used in this investigation as well as by other scientific workers for the study of pearl material, are the usual chemical and physical tests and X-ray radiographic technic. The petrographic microscope has revealed particularly interesting information in the writer's research by permitting more searching examination of the structure of exceedingly thin sections. In the natural pearl the nacreous material has been deposited in very fine concentric layers throughout the jewel. In the cultured pearl the comparatively large core, as would be expected from its origin, is found to be built up in distinct parallel layers. The outer shell of nacreous material is seen to consist of concentric layers. The mineral matter is aragonite, the orthorhombic form of calcium carbonate, although in a few cases calcite has been encountered.

Because of the external characteristics of the shell of pearl matter, the layman may feel that the cultured pearl and the natural gem appear to be the same. By expert visual examination, however, and particularly by the use of special physical apparatus, the two can be differentiated. As in the case of other objects of esthetic value, it is necessary for the uninitiated to rely upon the knowledge of the expert, who by training and experience is qualified to reach authoritative conclusions on such matters.

The Japanese cultured pearl, with its margaritic substance around a mother-of-pearl bead, does not possess to a similar degree the mechanical homogeneity of the natural pearl. A knife edge applied to the surface, when struck with a light mallet, usually causes the outer shell to break off in whole or in part. Natural pearls show a different type of spalling, permitting the conclusion that the concentric structure does not have a zone of separation or weakness.

As an additional procedure for the examination of drilled cultured pearls, it was found that when a dye solution, such as methylene blue, is inserted into the bore by means of a fine needle, the color spreads at once throughout the zone of separation between the inner core and the outer nacre. The phenomenon is readily followed by the use of a microscope. When this test is applied to natural pearls, no penetration of dye takes place. It has been reported that this property of cultured pearls has been taken advantage of, to an extent that is not known, by dyeing them to improve color and appearance and to simulate the inherent characteristics of such special types of natural pearls as the black variety. We have observed specimens which give evidence of having been subjected to such treatment.

Accurate figures on the number of cultured pearls produced and marketed are not available. For several years prior to 1931 it is reported that an average of about 3,000,000 oysters were set annually, and in 1931 this number was increased to more than 6,000,000. Of the total number of oysters set, it is said that only 60 percent will produce cultured pearls of salable value.

The cultured pearl industry in Japan is "big business" and for that reason it is easy to believe that the number now being produced in Japanese waters exceeds by millions the quantity said to have been obtained in 1931. Labor in Japan has been both cheap and plentiful, especially so since women are well suited for this type of work.

The situation is further complicated by the fact that the business of reproducing cultured pearls is no longer confined to Japanese waters. Advertisements mention the South Sea Islands and an examination of some specimens reveals characteristics not found in Japanese cultured pearls. The extent of the industry outside of Japan is not known.

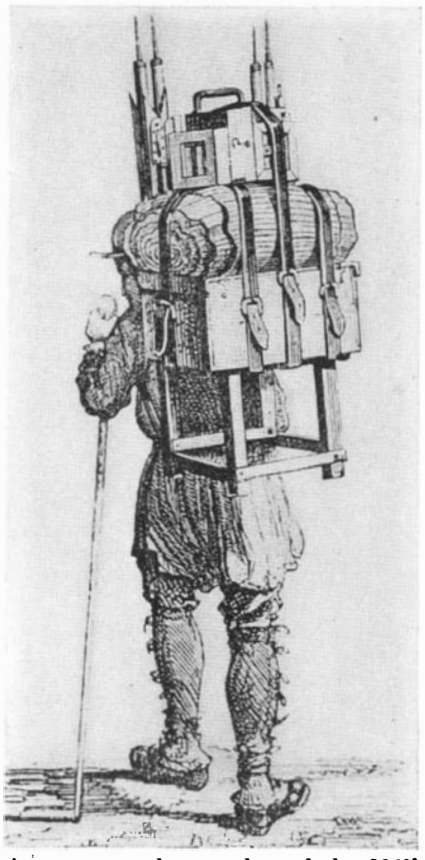
OTHER DAYS IN PHOTOGRAPHY

IN 1839, just a century ago, Daguerre announced his discovery that an image could be formed by light acting on an iodized silver plate. Then followed the tremendous popularity of the Daguerreotype, first successful forerunner of our present-day photographs. Through the Callotype and the wet-plate process, the collodion and the gelatin emulsions, progress was steady but slow. Only with the advent of flexible film did photography receive the impetus that has made possible the highly efficient cameras, films, and printing papers which we have today. The accompanying illustrations show some of the difficulties under which photographers labored during the 19th Century.

Illustrations from The Bettmann Archives

Right: A roof-top photographic studio of the 19th Century. Strong sunlight was necessary for picture taking, and the exposures stretched to seeming eternity—for the subjects. To keep the sitter from moving during these long exposures, an "immobilizer" was used

Left: In the days of the wet-plate process, the photographer had to coat his own plates in the darkroom. First he cleaned the glass thoroughly, then coated it with collodion and sensitized the surface. Plates had to be exposed immediately, before the collodion had time to dry out



An amateur photographer of the 1860's starts out to take a few pictures. He had to carry, in addition to his camera, darkroom and wet-plate-making equipment!

"On location," the darkroom tent is set up, a plate is coated, and an exposure is made at once. The photographer's assistant is ready with a newly sensitized plate

THE HYSTEROID PERSONALITY

While the Paranoid Type Aggressively Hews to the Line and Faces Facts, the Hysteroid Personality Seeks to Evade Difficulties by Sidestepping Reality

By PAUL POPENOE, Sc.D.
Director, The Institute of Family Relations, Los Angeles;
Lecturer in Biology, University of Southern California

WHEN an animal faces danger, it may react typically in one or the other of two contrasted ways: it may advance and attack; or it may retreat, run away, and hide. These primitive biological reaction-types color human behavior just as they do that of a tiger, a shark, or a scorpion. Greatly extended and variegated, they result in two contrasting types of human personality.

The paranoid follows the attack-pattern. The man (or woman) with a typical paranoid personality[1] is always on the aggressive. He is not merely ready to meet trouble when it comes: he is looking for it, and is prone to imagine it where it does not really exist. His whole life tends to become a fight.

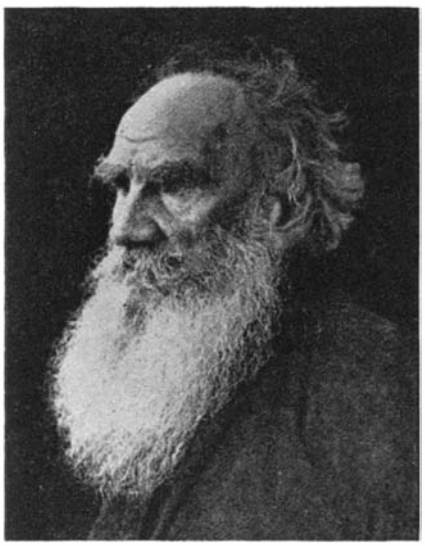
The hysteroid follows the other pattern. The man (or woman) with a typical hysteroid personality is always on the defensive; always trying to escape, not merely from real but likewise from imaginary dangers. His whole life tends to become an evasion, a sham, a pose.

There is a difference in the complexity, in the diversification, of the two types of personality, which reflects the differences in nature.

In general, there is only one way to *attack* an enemy: you simply attack him. You go after him tooth and nail. Corresponding to this, the paranoid pattern sometimes seems therefore to be fairly simple. By contrast, there are a lot of ways of *escaping* from an enemy. The animal may simply flee, depending on speed, as does the antelope, or it may, instead, dig a hole in the ground and crawl into it, as does the badger. It may pretend to be injured, as does the quail suddenly startled from her nest. It may pretend to be wholly dead, as do many insects and other animals, proverbially the opossum. It may change its color to become inconspicuous, as does the chameleon. It may throw out a cloud of ink to color the water and hide itself, as does the cuttle-fish. It may make itself offensive, as does the skunk. It may mimic an offensive species, as some insects do, so that enemies, confused, will avoid them. It may, though harmless, look so hideous and formidable as to scare away marauders.

One could find types of human behavior corresponding, figuratively, to all these and many other animal patterns. As methods of escaping trouble, they may properly be brought into the general picture of the hysteroid personality.

Historically, the term *hysteria* has a more limited use, applied particularly to physical conditions. Hippocrates, the Greek "Father of Medicine," described various vague and fluctuating symptoms in women, which he explained by supposing that the womb (*hystera*) wandered around in the body seeking humidity and, by transient pressure on various structures, caused transient symptoms of disease.



Among famous persons, Tolstoy has been mentioned as a hysteroid type

Modern biologists naturally take a less naive view of the physical basis of hysteria. They would relate it to two of the most primitive and deep-seated nervous mechanisms of the individual.

One of these is the tendency of an animal to make violent and spasmodic movements when trapped or frightened. Thus a bird, flying steadily enough, finds itself suddenly inside a porch. It beats violently against the windows and walls until it accidentally finds a way of escape, whereupon it once again begins to fly as evenly as before. The other mechanism is the sham-death-reflex as seen in the opossum.

In the case of a great shock or panic, such as might accompany an earthquake or holocaust, many persons are said to become "hysterical." They rush around wildly and apparently without reason, as does the bird trapped in a room. On the other hand, many fall into a sort of stuporous state (like the opossum) in which their behavior is irrational but actually, no doubt, serves the purpose of protecting the nervous system from further shocks that it could not withstand. Plenty of illustrations of both types of behavior were seen in soldiers during the World War.

ACTING through such fundamental mechanisms in the organism, the strong primal urges of self-preservation (fear, as in war) and species-preservation (sex) produce "hysteria." The process is, diagrammatically, something like this: (1) desire to escape from danger, (2) suggestion of a way of escape, (3) accidental escape through the way suggested (that is, some "symptom"), (4) fear of return to danger with recovery from symptom, (5) exaggeration of symptom, (6) fixation of symptom through the usual methods of habit-formation, (7) final existence of the symptom without any cause.

To make the picture more concrete, take such a case as occurred over and over again during the war. N. was knocked down by the concussion of an exploding shell. Of course he was bound to be somewhat injured. His arm was bruised. He was taken to the hospital and bandaged.

His whole being revolted against going back into danger. It was easy for him to "discover" that the arm was more seriously injured than the doctors thought. It did not get well—it became paralyzed. He had to be sent away from the combatant sector because his arm, now paralyzed, made him useless there.

His arm really is paralyzed now: but it is a functional paralysis, a hysterical paralysis. He is not malingering—that is, not consciously pretending. The whole process is unconscious but none the less real. He is sent to a convalescent camp. His arm shows no improvement: *the war*

[1] See "The Paranoid Personality," by the same author. Scientific American, February, 1938, pages 74-77.—*Ed.*

is still on. Then the announcement of the armistice is broadcast. He no longer need fear going back to the trenches. He no longer *needs* a paralyzed arm. Hence his arm begins to get well. The mere announcement that there would be no more fighting cured, sometimes almost miraculously, hundreds of soldiers with these hysterical disabilities ("shell-shock").

Such a case represents, in simplified diagram, the "classical" form of hysteria —the simulation of a disease as a protection against danger.

Anyone is theoretically capable of hysteria, because all have these fundamental biological mechanisms; but some are much more easily affected than others. Women are more susceptible than men, as Hippocrates recognized when he ignorantly picked out the womb as the source of trouble. The main psychological difference between the sexes, as reported by Terman and Miles in the most comprehensive study yet made ("Sex and Personality," 1937) is the greater aggressiveness of the male. Hence the paranoid personality is more likely to be found in men. Women will be more ready to escape than to advance and attack, hence the hysteroid tendency is more often distinguished in them. But since any woman can fight and under certain circumstances will do so; and since any man can and may run away, the possibilities of both types of behavior are present in both sexes.

Though contrasted, the two types are not mutually exclusive: all of us have some tendencies in each direction. It is only in pronounced cases, where the balance is greatly on one side, that we speak of the paranoid personality or the hysteroid personality. Most of us are betwixt and between.

THE pronounced hysteroid personality represents a special make-up that apparently depends to a considerable degree upon heredity. The following components tend to be present in varying amounts:

1.) A tendency to easy dissociation of the nervous system. This is characteristic of the extravert, not the introvert, and pronounced hystericals are likely to be of the extravert type. One part of the consciousness can be "split off" from the rest, as when a person is hypnotized. This makes possible the striking physical manifestations such as the genuinely paralyzed arm of a soldier who is organically sound. Hysteria may simulate almost any disability in this way.

2.) An imperfect development of the organism, a physical infantilism. This is often seen most clearly in the reproductive system, but presumably may characterize the whole organism.

3.) An emotional infantilism. Though adult by the calendar, the individual has retained the infant's characteristic egocentricity, selfishness, suggestibility, lack of self-control, vivid imagination, and immaturity of impulse. "Who, in the examination of a hysteric, has not hundreds of times cried out that he had a big child before him!" observed Pierre Janet, the French neurologist who gave the modern concept of hysteria much of its form. Really superior persons are rarely found to show symptoms of hysteria (a term now generally reserved for physical manifestations such as the paralyzed arm). They may have the hysteroid personality in some degree; but those who have it so markedly as to show striking results of dissociation are likely to be personalities that are undeveloped and poorly put together anyway. The history of witchcraft and of miraculous "faith cures" will yield any number of illustrations.

While the biologically defective personality marked by the three traits I have just named is most likely to make conspicuous—indeed startling—use of the escape mechanisms underlying a hysteroid personality, all of us have some tendency in that direction, as I have previously emphasized. The traditional "Sunday morning headache" which makes one feel that going to church would be harmful and that a game of golf or a trip to the beach would be more desirable—in fact necessary to well-being—is merely one of the everyday forms of hysteroid mechanism. Who of us will declare that he has never taken refuge in such an evasion?

Remembering that the purpose of hysteroid behavior is to escape from unpleasant, unwished-for, or dangerous situations, one can see how simulated illness can be used in a variety of effective ways:

1.) To escape from threat to one's life, as in the war-time hysterias of the "shell-shock" type.

2.) To escape from some other situation that is feared as dangerous. Miss Q. is afraid of sex, fears marriage, and therefore becomes a chronic invalid as a means of self-protection. Her relatives won't insist on her marriage, in that case.

3.) To escape honorably from responsibility. An important function of the hysteroid mechanism is to enable one to keep his own self-esteem, to "save his face," to think well of himself, at the same time that he runs away. Many a woman, faced by an invitation which she wants to decline, finds herself too unwell to attend. As is often the case with the hysteroid personality, conscious and unconscious deception blend into each other so closely that no one can draw a line between them. One of the characteristics of the hysteroid personality is its great capacity for self-deception. The woman who does not *want* a visit from her mother-in-law may take to her bed with a spell of indigestion just as real, in its way, as the soldier's visibly paralyzed arm.

4.) To escape from neglect, that is, to get attention. A large part of the everyday hysterical manifestations are of this type. The hysteroid, being essentially a spoiled child, with all the spoiled child's selfishness, conceit, desire to show off, and indifference to the interests of others, is continually getting attention by being unwell, being delicate, needing special care. Mrs. C., like ten thousand other dissatisfied wives, governs her husband and dominates the whole family in this way. She must not be "crossed" because it will affect her so unpleasantly. She must always be humored, catered to, toadied to, because she deserves so much sympathy. Her life is such a burden to her that the least we can do for her is to try to give her a little pleasure. And how she does "enjoy ill health!"

5.) To escape creditably from the consequences of some personal deficiency. Mr. L. is a tennis player—not a very good one but with enormous self-esteem. Like typical hysteroids, he plays only to win. He is not too scrupulous in his code of sportsmanship. If he loses, there is always a good reason. "I knew I wouldn't win today: I was miserably sick all night"; or "I didn't try this afternoon; my head was aching so badly that all I could do was wonder whether I could get through the last set without collapsing on the court." In such circumstances, you are supposed not to depreciate his ability but rather to admire his fortitude, to praise the plucky fight he put up against what he knew to be overwhelming odds! When he once reached the semi-finals and faced an opponent sure to defeat him, he "had to" default through illness; he went to the hospital with one of his spells and sent a pathetic telegram regretting the loss of the cup when he felt that it was right in his hands.

LEAVING now the classical form of genuine hysteria, it is important to follow the hysteroid personality out into its borderlands where it is manifested by mental rather than by physical symptoms. One will encounter, in such an excursion, a wide range of escape mechanisms such as have already been described among the lower animals.

Thus a man may escape danger and save his face, not by "flight into illness" but by flight into obscurity. As the cuttlefish conceals itself by a cloud of ink, so a man may conceal himself by a cloud of rhetoric and mysticism. Followers of various superstitions (astrology, spiritualism, some of the "New Thought" cults) surround themselves with a mumbo-jumbo of big words and meaningless ideas which make them feel very superior and protect them from having to compete in everyday life. This, like the form of escape preceding, shades off imperceptibly into an inferiority complex of the ordinary, uncomplicated type.

The underworld of the arts is inhabited largely by hysteroids. Faddist cults which

claim exemption from all the rules of physical and natural science form an excellent example of hysterical mimicry —the attempt to gain prestige by sham and wishful thinking. The hobohemians and Greenwich Villagers (using that term in a spiritual rather than a geographical sense) who take up post-ultra-super-modernism in art have in many instances found an exceedingly effective way of escaping from the danger of having to earn a living, of having to succeed by open competition in the world. Would-be actors and actresses likewise live on pose rather than on performance, in many instances. Anyone acquainted with this lunatic fringe of fakers and posers around the world of art cannot help being impressed by the infantile and disorganized personalities that comprise it.

The French novelist Stendahl (Henri Beyle) is a good illustration at a somewhat higher level. He loved falsehood and dissimulation just as a matter of "art for art's sake." He changed his name; he filled his books and letters with deliberate and useless falsifications of dates and places; he could not even R.I.P. under the truth but had a falsehood engraved on his tombstone.

IF we emphasize the trait of abnormal susceptibility to the determination of one's ideas by one's own wishes, we can follow the hysteroid personality into another wide field of human activity where Don Quixote has been named as the perfect literary illustration—always investing his surroundings with the forms that he wanted to see in them. It has been remarked that most of Ibsen's heroes and heroines (notably Peer Gynt) are typical hysteroids.

Turning from fiction to history, Napoleon I is worth noting as a typical paranoid who also had strong hysteroid tendencies that became more pronounced in his later years. During the Russian campaign, he was continually making himself believe that his forces were much greater than they really were, that the enemy was weaker than it really was; and his staff were often at their wits' end to combat this infantile behavior and to make him face the facts. His callous egotism and ruthless dishonesty are also typically hysteroid. When a man of first-class ability has pronounced paranoid and hysteroid tendencies at the same time, he is likely to be a first-class menace to his fellow men!

Politicians tend to fall into two separable groups. One is made up of the paranoids—aggressive, domineering, driving ahead ruthlessly, crushing opposition relentlessly; stubborn, suspicious, belligerent—a type illustrated by some political bosses in America and by such well-known figures as Georges Clemenceau and Thaddeus Stevens. The other is made up of the hysteroid type—posers, gifted with imagination and continually dramatizing themselves before the public. "Their natural bearing is pose," says O. Bumke, the German psychiatrist, of hysteroids in general.

Not to name any living worthies, probably at least a touch of this hysteroid element could be seen in men eminent in such diverse ways as Disraeli and Talleyrand, Alcibiades, and Thomas Jefferson; much more than a touch of it in the late Huey P. Long. When one passes to the small fry, the hysteroid tendencies are often paramount, and not always the

Wagner, the composer, is thought by some to have been a hysteroid type

pleasant hysteroid components, either—too often the unpleasant ones such as sham, dishonesty, double-dealing, callous disregard for the rights of others, readiness to repudiate legitimate obligations —anything to get ahead.

ALL this is just the opposite of the typical paranoid's behavior. Stubborn and persistent, he is the man to stand up for a principle, right or wrong; to die in the last ditch rather than abandon the "cause." The natural history of politicians deserves particular consideration because it furnishes excellent material to differentiate the behavior of paranoids on one side and hysteroids on the other.

Needless to say, the hysteroid personality is a prolific breeding-ground for criminal behavior. It will be found more rarely among those convicted of crimes of passion. It is almost universal among those convicted for crimes of gain—the white-livered crook who is trying to "beat the game" and get something for nothing; the double-crossing racketeer who is convinced that "only saps work." Indeed, the best known scale for measuring the hysteroid component of the personality was standardized by being given to convicts in a state prison!

This type of hysteroid blossoms most exuberantly among the "big shot" frauds and swindlers, the bluffers and confidence men who get even more satisfaction from strutting across the stage and "putting one over" on the public, than from their actual gains. Joseph Balsamo, who called himself Count Cagliostro, is one of the outstanding historical examples; John Law of the Mississippi Bubble another; Horatio Bottomley, once a member of the British Parliament, a third. For American examples, one has merely to look into the daily newspaper. The big business world contains too many; the business underworld is largely made up of them.

There is a hysteroid sort of "philanthropist" who represents—whether male or female—the worst traits of the "Lady Bountiful" type, an ostentatious and hypocritical humbug, dishonest in private dealings but loud in his pious protestations on the public platform. There is at the other extreme a hysteroid type of pauper—the whining beggar, apt at evasion of all responsibility, preying on society, living by deceit and occasional crime, satisfied with himself and completely lacking in sympathy for others.

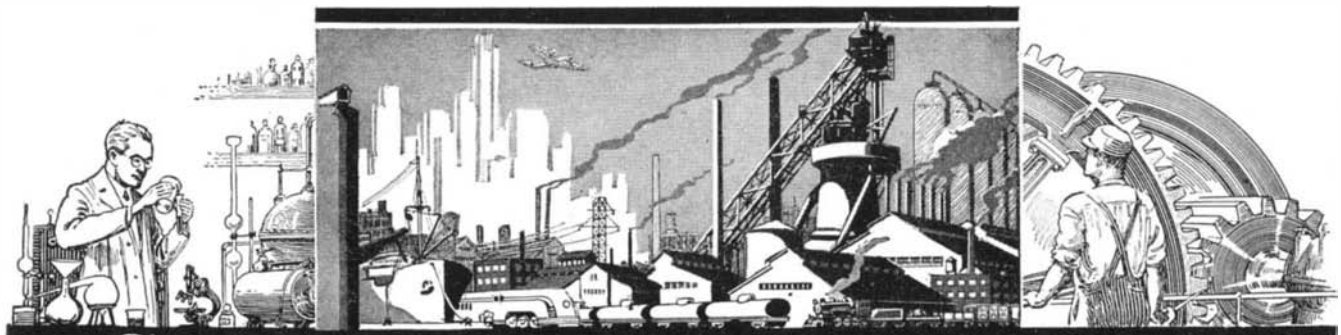
IN short, the hysteroid personality can be found in every walk of life. When combined with strong impulses to self-assertion, and associated with inborn talent, the hysteroid's dramatic flair and his ability to make his wishes seem real to himself may lead to great achievement, most frequently in the field of art, religion, or politics. Among eminent men who have been named by one writer or another as hysteroids are Berlioz, Blücher, Flaubert, Frederick the Great, Goethe, Molière, Muhammad, Nietzsche, Pascal, Rousseau, Schopenhauer, Strindberg, Tolstoy, and Wagner. The reader's own predilections will color his judgment but everyone will agree that at least some of those named belong among the hysteroids.

If the extreme hysteroid has a different type of constitution from the average person, it is evident that both prevention and cure will be difficult.

"Spoiled child" tendencies appear early and are largely fixed during adolescence. An education that prevents the development of a "spoiled child" will prevent the development of a hysteroid. Most is to be hoped, therefore, from a better technique of child guidance.

In dealing with an adult, one tries to make him see *why* he is sick, but also to give him *a desire to be well.* If the cause can be removed—if the patient can be made to face his situation honestly, and can be re-educated to make a superior sort of adjustment—his whole career will be changed.

But it would be optimistic to think that much can be done with an inferior, infantile, disintegrated adult who is making use, to his own great satisfaction, of such primitive biological mechanisms as are the basis of the hysteroid personality.



SCIENCE AND INDUSTRY

A MONTHLY DIGEST

Conducted by F. D. McHUGH

Contributing Editors

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

D. H. KILLEFFER
Chemical Engineer

Prospectors Now Dive for Gold

AN ingenious method of prospecting for gold and silver has recently come to light. Rather than drill into the ground by conventional methods, certain prospectors are now diving to the bottom of lakes in

Ready to dive—for gold!

Canada in their search for rich gold veins and silver ore deposits.

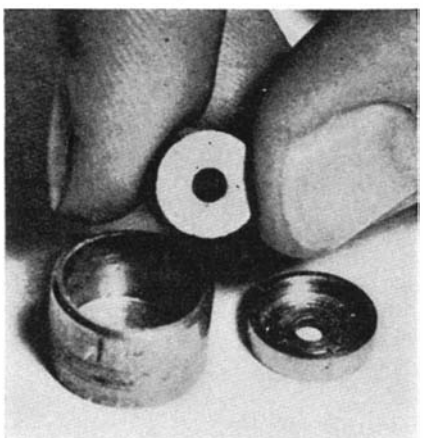
Largely responsible for making possible this under-water prospecting, is a device known as the McCaa Two-Hour Oxygen-Breathing Apparatus, a product of the Mine Safety Appliances Company. Strapped on the back like a pack and weighing approximately 30 pounds, the equipment consists of an oxygen container, a face mask, and tubes to convey the oxygen to the mouth of the diver. It functions without a pump, the oxygen being fed to the diver's lungs by means of an automatic lung in the equipment. This equipment, good for a two-hour immersion in shallow water, may be used in 40 feet of water for periods of one hour.

Accepted among geologists is the fact that most of the mines found to date are close to bodies of water, and that the best ore seems to occur under lakes. It is on this theory that the under-water prospector bases his efforts and hopes. The diving prospector, after donning the apparatus, takes with him a water-proof flashlight and a geologist's hammer. The practice followed is to have one man remain on shore, the diver carrying a line and making signals according to a prearranged code. The equipment carried is heavy enough to hold the diver down, yet not too heavy to permit him to move with ease with a swimming motion.

Most Powerful Permanent Magnet

THE most powerful permanent magnet in the world—one that will lift nearly 1500 times its own weight—has been developed in the Research Laboratory of the General Electric Company by W. E. McKibben.

The magnet weighs 1.85 grams, or 1/250th of a pound, and has been made to lift 2750 grams in tests. About half the size of an eraser on the end of a pencil, it will lift a five-pound flatiron with ease. The new magnet is several times as strong as those previously made.



The powerful magnet (between finger and thumb) and its steel casing

1500 times its own weight

The magnet is made of a material known as Alnico, an alloy of aluminum, nickel, cobalt, and iron. This alloy was first developed as a heat-resisting alloy which resisted scaling and deterioration at high temperatures. Research on the magnetic properties of alloys of this type was later carried on by Professor T. Mishima of the Imperial University, Tokyo, and General Electric perfected a process of heat treating by which the magnetic properties were more fully developed.

The new magnet employs the same alloy as previously used, but utilizes a steel sheath around the Alnico pellet to direct the magnetic flux against the keeper or object being attracted. The steel jacket also protects the magnet against demagnetization when not in use.

Exploding Walnuts

A NEW method of shelling walnuts, recently developed at the University of California, uses an explosion to burst the shells. The shelling operation, which is done

by machine, consists of passing the walnuts over a circular saw which cuts an opening through the shell; blowing explosive gas-air mixture into the nut; and finally passing the nut through a flame which explodes its gaseous content. This method of breaking shells avoids fracturing the nut meats, which are not affected by the explosive. The machine in which this series of operations is accomplished opens about 900 pounds of walnuts per hour.—*D. H. K.*

ANTHRACITE

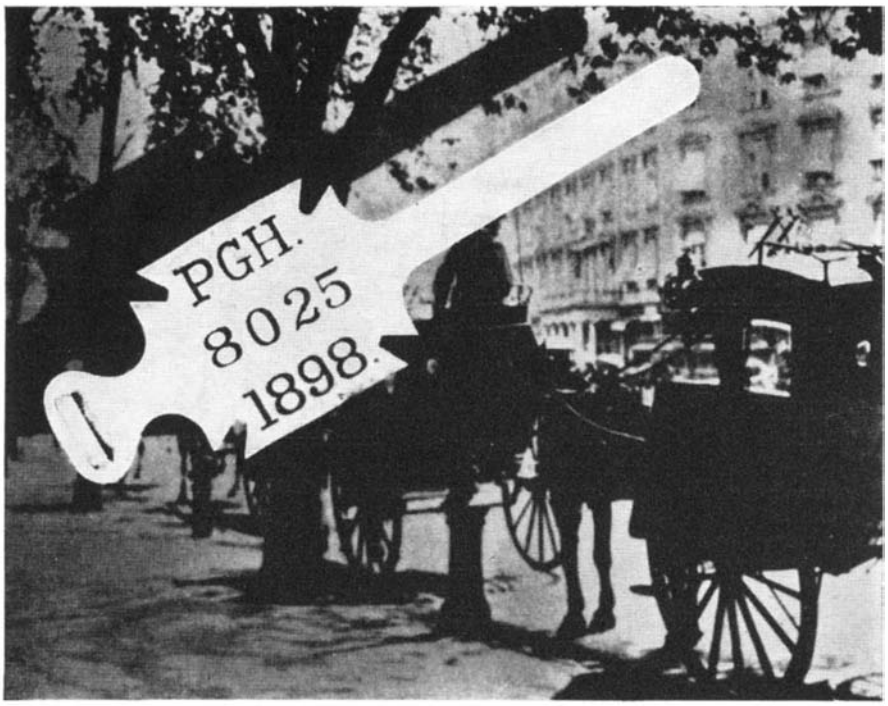
NEARLY 1,000,000 railway cars are required each year to transport anthracite coal, producing railway revenue of about $100,000,000. All the railway cars required in a year would make a train more than 8000 miles long—more than enough to reach across the United States and back.

Invention Helps Drainage Ditch Work

IMPROVED equipment for cleaning ditches is one of the by-products of large-scale work by CCC camps to put public drainage ditches in better condition. One new machine that promises good results was described by D. A. Isler of the U. S. Bureau of Agricultural Engineering before a meeting of the American Society of Agricultural Engineers. The machine consists of two winch drums on a truck chassis that has a light boom extending from one side for operating a scraper. It is used where dragline excavators cannot be used economically.

As Mr. Isler described the use of the machine, dirt loosened in the ditch by plowing is removed with scrapers pulled by a cable from one of the winch drums. Another cable running over the boom from the other winch returns the scraper to the middle of the ditch for reloading. He said three such machines have been built by the bureau and are now in use at CCC drainage camps.

The machine can be easily mounted on and removed from practically any make of truck of 1½ tons or larger. The apparatus is mounted crosswise of the truck bed. Rigid blocking is provided between the rear axle and the truck frame to eliminate spring action and stabilize the truck while at work. The blocking can be removed for traveling on highways. The cost of the attachment, not including the truck, is estimated at $1000. The outfit will handle 10 to 15 cubic yards an hour at a cost of 25 to 35 cents a yard. It is operated by a five-man crew.



Grand-daddy of the aluminum license plates for automobiles, now being used in Connecticut and Arkansas, is this aluminum tag for horse-drawn hacks issued by Pittsburgh in 1898. It was of such shape as to be fastened around one of the shafts of the carriage, with the tongue of the plate through the slot on other end

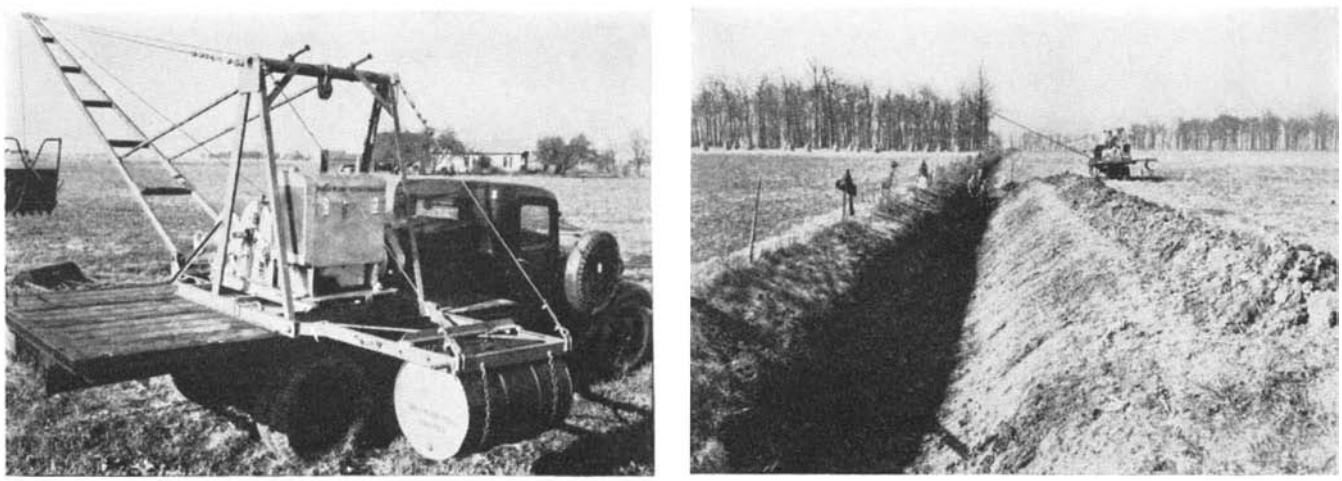
Man Will Win War with Insects

WAR between man and the insects, usually pictured as fraught with dire disaster to the human race, is going to end in victory for mankind, prophesied Professor J. J. Davis of Purdue University, in his address as president of the American Association of Economic Entomologists. (See also "Insects Cannot Win" on page 222 of this issue.)

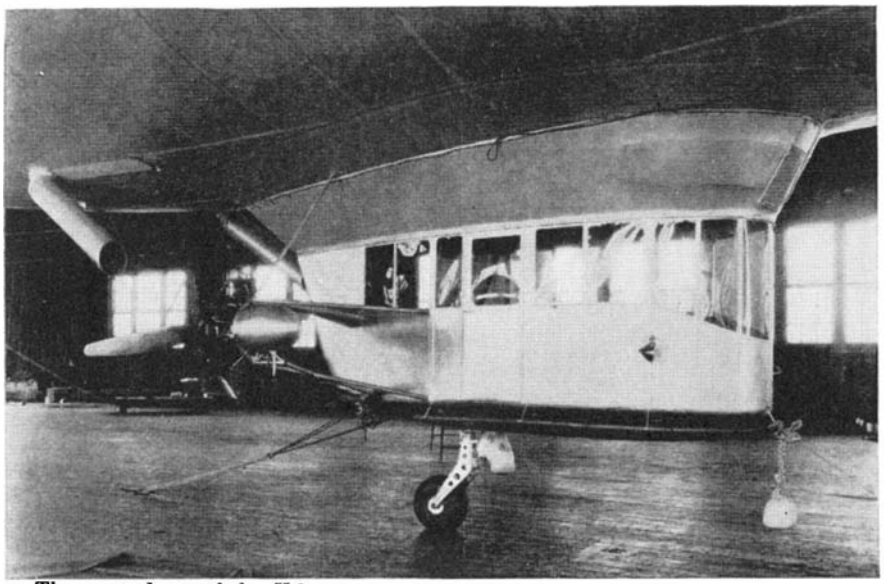
"When we realize that the science of applied entomology is scarcely more than 60 or 70 years old and note the progress in insect control during that time," said Professor Davis, "we realize at once that man is gaining the upper hand. We may anticipate the time when our chemical, electrical, and mechanical warfare, insect-resistant varieties of plants and breeds of animals, and our farm and home practices, together with the aid of insect natural enemies, will reduce insect control to a routine, just as the medical profession has reduced or practically eliminated disease fatalities which were once responsible for the loss of thousands of human lives."

Victory will not come automatically, though, Professor Davis warned. Not merely eternal vigilance, but eternal research, is its price, for the front is always changing, as new crops are menaced by new pests, or as new business or social practices change people's relations to insects.

Professor Davis expressed the feeling that while it is now comparatively easy to get funds for insect control by known means, and to meet situations as they now exist, not nearly enough support is given to the research programs and the training of new



The new ditch-cleaning equipment used by the CCC, *left*, and, *at right*, scraping a ditch



The control car of the *K-2* is built into the hull. Note the airscoop in the slipstream of the propeller. *Below:* The *K-2*, largest non-rigid airship, landing

research workers, to meet new problems that will arise in the future. He pointed out, as an example of a problem of the rather immediate future, the necessity for knowing much more about insect infestations in stored grain, in connection with the ever-normal granary project of the U. S. Department of Agriculture.—Copyright by *Science Service.*

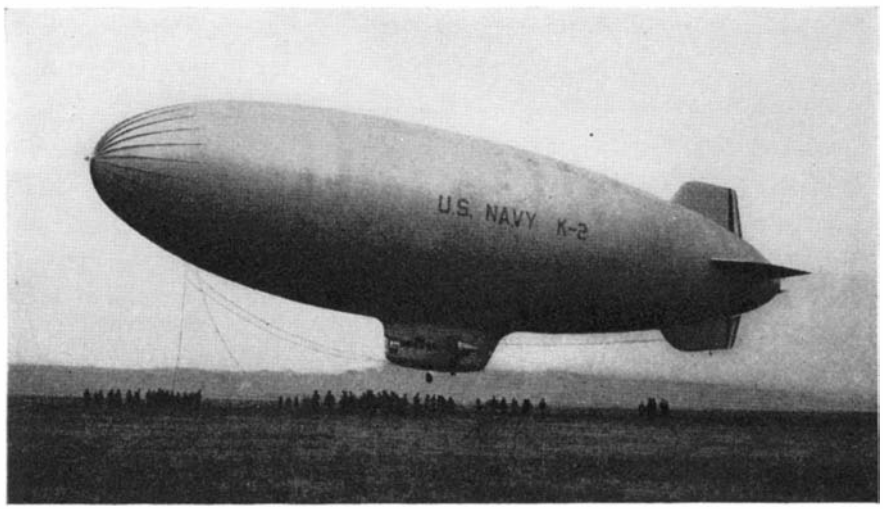
Heat vs. Humidity

COMMON report has it that discomfort in the summer time is due not to heat but to humidity. However, in air conditioning for comfort, most systems so far in use are based on cooling rather than simple dehumidifying. A new system, called "Caloride," actually does something about humidity and operates on the principle of reducing humidity to a comfort point without materially changing the temperature of the air. A special form of briquettes of calcium chloride are used to absorb moisture from air passed over them. The system uses ordinary city water as the only cooling medium and has no refrigerating machinery.—*D. H. K.*

Largest Non-Rigid Airship

WHILE the very large rigid airship is temporarily under a cloud, the much smaller non-rigids (commonly known as "blimps") are being built by Goodyear for both the Army and the Navy. Such airships did perform many tasks during the World War which no other aircraft could undertake, particularly in locating submarines, in patrolling the North Sea, in destroying enemy mines, and so on.

There is every reason to believe that, no matter what advances may have been made in heavier-than-air machines, the blimps will still serve a useful purpose in what we must unfortunately call the next war. This is all the more likely as the blimps have themselves advanced considerably over the crude form which they exhibited during the World War. Thus with the use of helium, and with certain structural refinements, it is found possible to eliminate the cable suspension of early days and the modern control cabin is built into the lower part of the hull. It provides comfortable quarters for a crew of seven—pilot, radio operator, navigator, mechanics. The old stove-pipe blowers have been replaced by neat airscoops placed in the slipstream of the propellers. The landing gear has become retractable.



With these various refinements the U. S. Navy *K-2*, largest non-rigid airship ever built (with 404,000 cubic feet of gas volume), has a speed of close to 80 miles per hour, a gross lift of 25,000 pounds, and a ratio of useful lift to gross lift which is so high that the new airship can cruise non-stop for several days. The two 550-horsepower Pratt & Whitney engines mounted in the outboard nacelles each turn three-bladed propellers 10 feet 6 inches in diameter.—*A. K.*

Enclosing the Aircraft Engine

ONE of the most obvious possibilities for improvement in aerodynamic efficiency lies in the reduction of the drag of the engine and cooling system. Lieutenant McCoy, reading a paper before the Institute of Aeronautical Sciences, strongly recommends that liquid-cooled engines should be enclosed within the wing, and that propellers should be driven through an extension of the motor shaft. Meanwhile, the N.A.C.A. has been making tests in its full-scale wind tunnel, to determine the drag of a typical liquid-cooled engine. These tests show that the engine nacelles of a four-engined model increase the drag of the whole airplane about 8 percent and the cooling (Prestone and oil radiators) system adds another 15 percent.

As a result of these and other studies, it would appear that liquid-cooled engines should be placed within the wing; the radiator should also be enclosed within the wing, with air led in through ducts from the outside. With the radiators placed at the largest cross-section of the duct, the drag increase is only 2 to 3 percent, as compared with the 15 percent of the conventional arrangement mentioned above.—*A. K.*

Air Power in National Defense

SPEAKING of "Modern Air Power" at the annual meeting of the National Aeronautic Association, Major-General Frank M. Andrews, Commanding General, GHQ Air Force, made it perfectly clear that the airplane has changed all conditions of warfare:

"Modern air power in future wars makes the picture different," said General Andrews. "The ability of air forces to operate in three dimensions enables them to move over land and water without regard to obstacles on the earth's surface. Their freedom to select the time and place of attack, to operate during day or night and to use the clouds for concealment, makes adequate defense against air attack on a grand scale a serious problem. Air forces, unlike ground forces, are not forced to wage an exhausting war at a nation's frontiers. The speed at which airplanes travel enables them to cover long distances in a short time. It is these characteristics of air forces that increase the power of the offense in war and make the airplane such a terrible instrument in the hands of unscrupulous governments."

Discussing the range of the bomber in the same address, General Andrews points out that our ocean bulwarks are shrinking and that only a short time ago two British bombers flew non-stop from Egypt to Australia, a distance of 7160 miles. "I believe that any of our large airplane companies would be glad to contract to build a bomber capable of a tactical range of 10,000 miles. If American airplane manufacturers can build such

a bomber, it can be done in other countries."

The well-informed views of General Andrews, news from Spain, news from China, the Münich accord, all make it perfectly clear that we must put forth a real effort to retain air power. In the production and number of service airplanes we lag behind seriously, and the Administration program of building planes in large numbers comes none too soon.

But while acknowledging our lag in the production of airplanes, we have been accustomed to comfort ourselves with the reflection that if we do not lead in numbers we lead in aeronautical research and in the performance and fighting qualities of such aircraft as we do have. Now the situation is changed regarding research. Thus, T. P. Wright, making his address as retiring president of the Institute of Aeronautical Sciences, gives a pessimistic view of our position in aircraft experimentation and development: "A few years ago the United States was well in the lead in research, development, and production of aircraft, a fact attested by all who had the opportunity of visiting European countries at that time and of witnessing the scope of developments there. Little could be learned from abroad at that time by Americans. Recently, however, visitors abroad have witnessed a great change. Many huge aeronautical laboratories have been established and are occupied in intensive research investigations. It is definitely established that the relative position of this country is reversed from 1934."

Brigadier-General W. G. Kilner, Assistant Chief of Air Corps, also speaking before the National Aeronautic Association, took a similar point of view. Our supremacy in prototypes has disappeared, and we are falling behind in research and fundamental developments. Last year Great Britain spent fifteen million dollars on research in military aeronautics, France more than ten million. No one knows what Germany and Italy spent for the same purpose. We spent only six million dollars.—*A. K.*

Inaccurate Airplane Bombing

IN our October 1938 issue Major Arthur E. Oxley discussed at length the question of the military value of airplane bombing, and pointed out that airplanes nowadays are forced to fly at such high altitudes that it is very difficult for them to hit important targets of military value.

Recent summarizing of the effects of the bombing of Barcelona in the Spanish Civil War bears out this conclusion. The records show that during the six days from December 5 to December 10, 1938, a total of 455 bombs were dropped by insurgent airplanes on Barcelona with the result that two people were killed and ten injured, while two horses were killed and one motor truck damaged. Obviously the only real effect must have been on property, for the residents of Barcelona had long since passed the point where air bombing did anything in particular to their morale.

The record further shows that during the course of the War this city was subjected to a total of 2000 air raids. Despite this extremely large number of raids, in which many thousands of bombs poured from the skies, no military objective was damaged greatly. The principal targets—the gas works and the central electric station—suffered only minor damages.

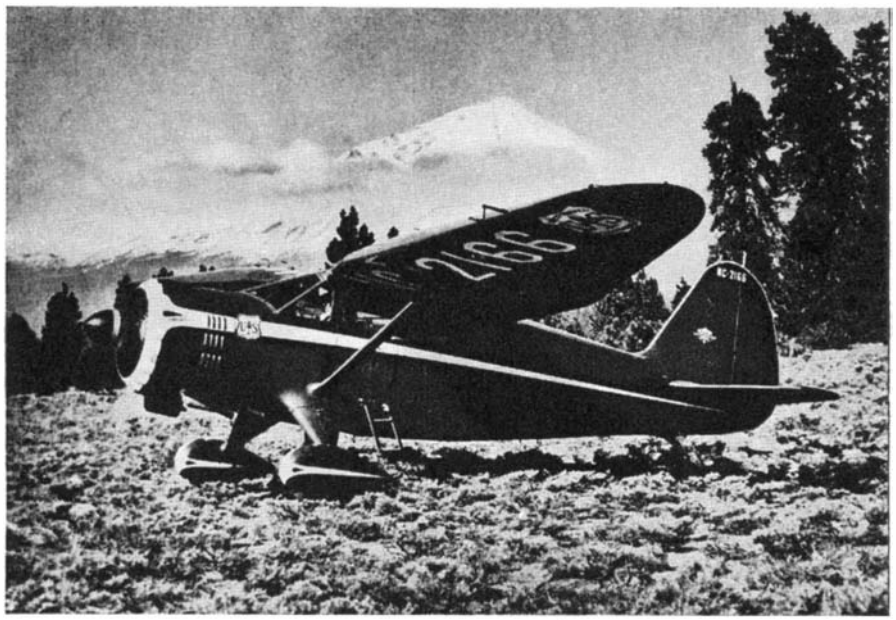
In view of these facts civilian populations everywhere will be reassured, though there is no question that much work has yet to be done in the matter of providing underground shelters such as were built in Barcelona.

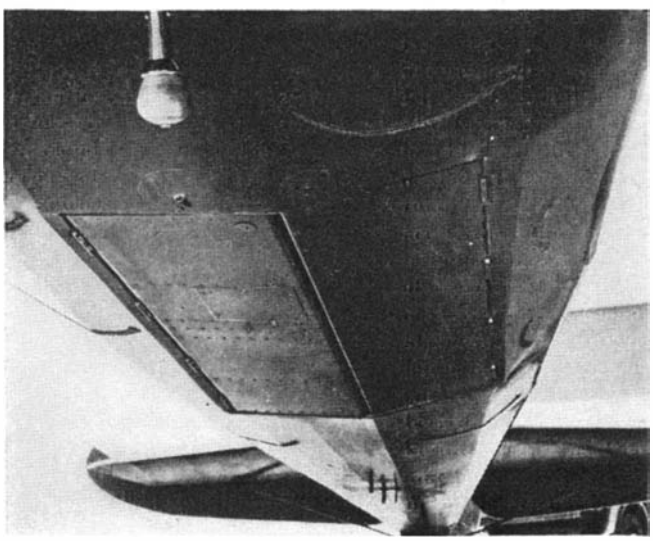
Airplanes to Fight Forest Fires

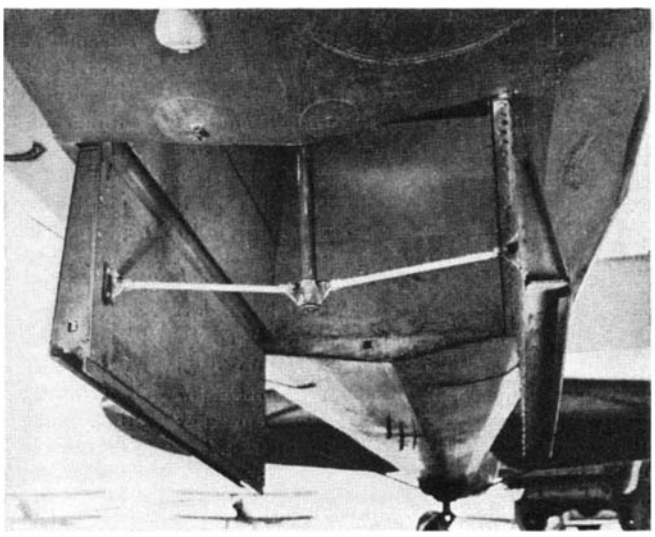
THE U. S. Forest Service has recently purchased a Stinson Reliant freighter model airplane, equipped with a 450 horsepower Wasp engine, for interesting experiments in fighting forest fires from the air.

Instrumentation on the ship is exceptionally complete to permit precision flying. In the bottom of the fuselage a special floor is incorporated (as shown in our photographs) with trap doors and a hatch opening 22 inches by 40 inches. Through this opening containers of water or fire-fighting chemicals can be released as desired. For cargo dropping work, guide boards are placed above the hatch opening. In addition to the hatch assembly and release gear, the ship is equipped with a new bomb-sight which gives a high degree of accuracy at low elevation. Military bomb-sights are intended primarily for high-altitude work and, aside from the factor of cost, are somewhat too complex for use in civil aircraft.

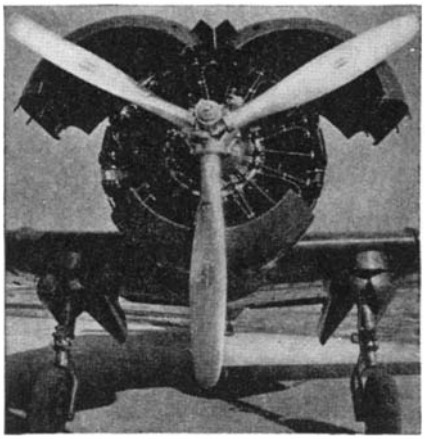
Before this new equipment can be put into practical service, a great deal of research will be necessary. The trajectory in space of inexpensive commercial containers must be studied. The bomb-sight and release







Specially designed plane built for the U. S. Forest Service for fighting forest fires. *Below:* Views of the trap in the fuselage, shown open and closed



How the engine cowl of the interceptor fighter described below may be opened for convenient servicing of engine. *Right: CW 21* in flight

equipment must be perfected. Then a new technique must be developed by which pilots and "fire bombers" will be able to protect our forests. Another incidental study is that of dropping supplies, with the aid of simple parachutes, to fire crews or others cut off from usual methods of transportation.

This basic research is of great importance and value, and we wish the Service every success in its efforts.—*A. K.*

A Great Interceptor Fighter

THE Curtiss-Wright *CW* 21 Interceptor Fighter is a magnificent machine, splendidly fitted for its work of intercepting and bringing down enemy aircraft. An interceptor should, in addition to great speed, have a high rate of climb (since modern bombers operate at high altitudes) and the *CW 21* can climb nearly a mile a minute with a service ceiling of 35,000 feet. Its maximum speed is well over 300 miles an hour, with its Wright Cyclone engine developing 1000 horsepower.

It is curious to see what a military airplane of this type has to carry. The weight empty is 3050 pounds, and the useful load of 1200 pounds is divided up as follows: fuel, 576 pounds; oil, 64 pounds; ordnance, 190 pounds; pilot and parachute, 190 pounds; oxygen, 22 pounds; radio, flares, miscellaneous, 158 pounds. The gross weight fully loaded is thus seen to be 4250 pounds, which is crowded into a relatively small machine with a span of only 35 feet.

One of our photographs shows the generally clean appearance of the *CW 21.* Another gives us an idea of the retractable landing gear and of the ready manner in which the engine cowl can be opened up for maintenance purposes. There are many other features in the design which deserve mention.

Everybody knows that the pilot's task in the modern plane is a heavy one, particularly because of the great number of instruments which he has to watch. To reduce the difficulty of watching many instruments, a "tell-tale" system is included and the indicator panel contains eight sets of lights which attract the pilot's attention to improper operating conditions. These lights signal immediately "Fuel Press. Low," "Oil Press. Low," "Tank Selector Off," "Mixture Lean," "Low Prop RPM," "High Blower," "Flaps Down," "Landing Gear Up." These titles of the signals speak for themselves.

The military pilot now has a multiplicity of machine guns or even a cannon at his disposal, and, at the same time, efforts are being made to protect him against enemy gun fire. In the *CW 21* there is a nosing-over brace incorporated in the structure directly behind the pilot which will withstand a force of 4½ times the weight of the airplane. The forward wall of this brace is a ¼ inch bullet-proof sheet of steel. An additional plate of similar material on the lower part of the bulkhead, the radial engine in front, parachute and seat below, protect the pilot from gun fire from almost all directions.

The detailed specifications of the *CW 21* confirm the impression that a modern fighting airplane is an exceedingly complex affair, in which strength and aerodynamics are an important part but are far from constituting all the elements of the design.—*A. K.*

Science and "The More Abundant Life"

SCIENCE has made possible a "new thing under the sun"—the more abundant life generally distributed, without one man having to make his gains off another man's losses. Research in pure science must receive public support if this happy state of things is to be stabilized and extended.

These were the main theses of Dr. Karl T. Compton, president of Massachusetts Institute of Technology, in his address at the opening session of the Third Dearborn Conference of Agriculture, Industry, and Science, reported by *Science Service.*

In pre-scientific ages, Dr. Compton pointed out, advanced cultures arose, but their brilliant accomplishments were always based on the exploitation of others. The Israelites gained their Promised Land only by exterminating the Canaanite nations already in possession there. The Greeks and Romans accomplished their miracles of art and learning, soldiership and law, only because they had slaves in the back of the house to do the hard and dirty work.

"But there is something new under the sun," Dr. Compton continued, "in that modern science has given mankind, for the first time in the history of the human race, a way of securing a more abundant life which does not simply consist in taking it away from someone else. Science really creates wealth and opportunity where they did not exist before. Whereas the old order was based on competition, the new order of science makes possible, for the first time, a co-operative creative effort in which everyone is the gainer, and no one the loser."

Static Suppressor

UNITED Air Lines, co-operating with Bendix Radio Corporation, have produced a static suppressor for aircraft use which seems to have high promise. When the pilot presses a button, an electrical device and a steel spring installed at the extreme rear tip of the fuselage release a wire into the slipstream which trails far behind the airplane. The wire is of very small diameter—smaller than the size of the sharpest point on the airplane. Previous experiments have indicated that static interference effects result from the uncontrolled discharge of static electricity accumulating on the wings and body of the airplane. With the trailing wire thinner than any possible discharge point on the rest of the plane, and a resistor to isolate the discharge of the electricity from the vicinity of the airplane itself, aircraft static has been eliminated to all intents and purposes by its use. Of course, the anti-static loop antenna which we have had occasion to discuss before in these columns is still retained in the system. The im-

The static suppressor for airplanes is installed at rear of fuselage

portance of eliminating static when a pilot is listening for instructions or finding his bearings in bad weather cannot be overemphasized.—*A. K.*

NITROGEN

FARM soils in the United States each year lose nearly 23 million tons of nitrogen through harvested crops, grazing, erosion, and leaching. Only a little more than 16 million tons are given back to the soil in the form of fertilizers, manures, rainfall, irrigation waters, and legume crops.

Electric Eye Trains for Bicycle Race

A "PHANTOCYCLE" went into training recently for the world's first hundred-thousand-mile riderless bicycle race, scheduled to start next May at the 1939 New York World's Fair.

In the test run in the Westinghouse Research Laboratories at East Pittsburgh, this riderless bicycle, steered and balanced by a photo-electric cell, clipped off 28 miles an hour, and the research engineers said it was ready to maintain this pace in a 365-day sprint, pacing off nearly 400 miles a day.

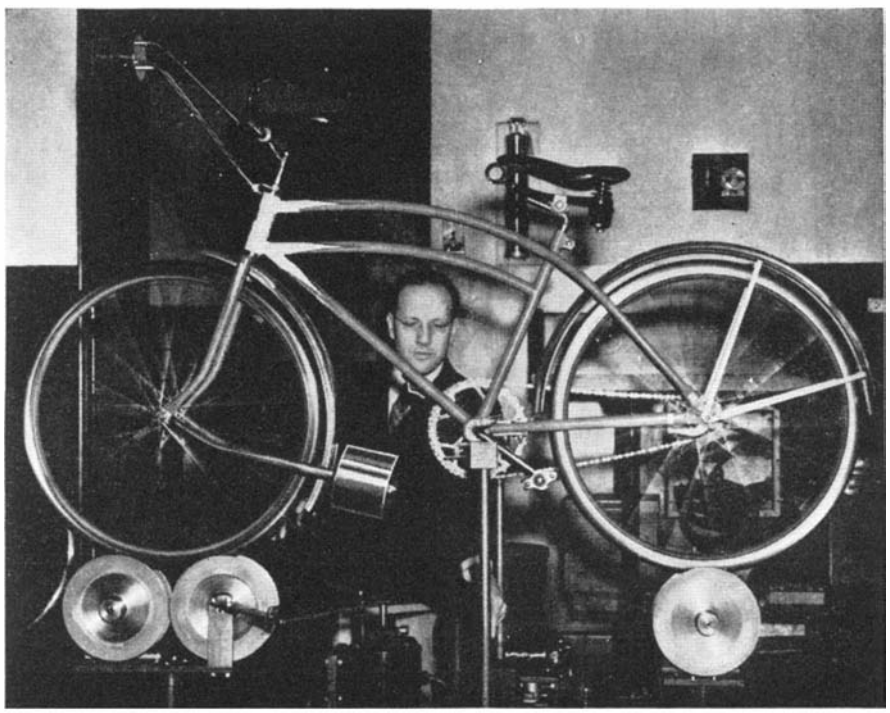
Unsupported by wires or braces of any kind, the bicycle coasted along on three metal rollers, depending on the electric eye and a team-mate called Silverstat to keep the wheel upright. Two corrective weights fastened respectively to the handle bars and front mudguard and the gyroscopic effect of the bicycle's front wheel added stability to the riderless wheel.

The electric eye is such a good rider that the bicycle can bear a three-pound sidewise push against its saddle before losing its balance and falling into its safety catch. In fact, the electric eye is so good that it can steer the bicycle without a quiver down the narrow groove formed by the three propulsion rollers.

The "beam" ride starts when a light beam strikes, under the pedals of the bicycle, a mirror which reflects varying amounts of light on the electric eye as the bicycle tilts from its upright position.

Sensing the tilting, the electric eye transforms the light energy into an electric current which is amplified and delivered to the Silverstat which, in turn, controls a regulating motor. This motor, actuated by the electric eye, steers the front wheel of the bicycle and moves the two attached weights to balance the machine.

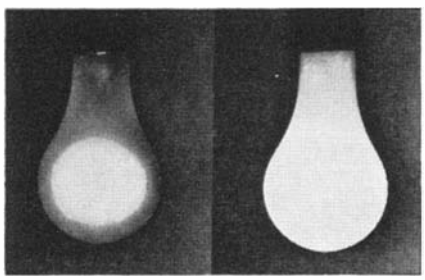
In this apparatus, the engineers explained, the front wheel of the bicycle becomes a "coriolis anticipator" and corrects the tilting even before the balancing weight has time to shift its position. The coriolis anticipator, formidable as its name sounds, is only a rotating flywheel capable of developing gyroscopic torque, or twist, in proportion to angular velocity of precession. In this case, the angular velocity of precession is the velocity with which the front wheel of the bicycle is steered to left or right.



Ready to ride for a year, controlled by a photo cell

Self-Diffusing Incandescent Lamp

LIGHTING engineers recently welcomed a new type of glare-free electric light bulb, called the most practical improvement in incandescent lamps since the appearance in 1925 of the common inside frosted bulb. The new bulb, known as the Wabash Superlite, was developed by the Wabash Appliance Corporation.

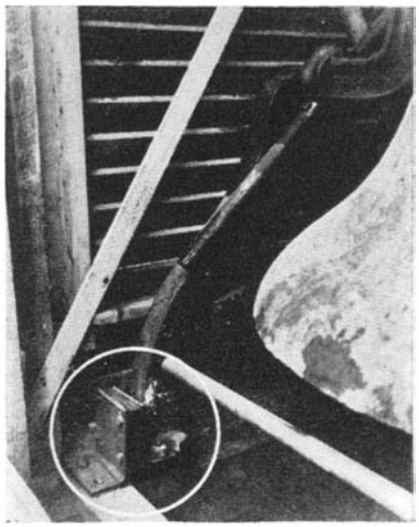


Old and new: Self-diffusing incandescent lamp contrasted to old type

According to Wabash, the new Superlite introduces light-conditioning in the bulb itself, producing soft, restful, surprisingly white illumination without the need for extra diffusing equipment or extra current. A new treatment on the inside of the glass breaks up the harsh raw light rays of the filament into soft, "counter-diffusing" light rays which are perfectly diffused over the entire bulb surface, and transmitted through the glass without loss of any light. Thus the "filament-fire" spot is eliminated, glare is stopped inside the bulb, and the light comes through perfectly conditioned for reading and working. All sizes of the Wabash Superlite, from 15 watts to 300 watts, are now in commercial production.

Rubber Mountings Keep Bell in Belfry

IT looked for a while as though the new Baptist Church at Fries, Virginia, would have to break with tradition and install its bell in the yard. But thanks to rubber, tradition won out. The bell now reposes in the tower of the church and everyone is happy about the whole thing.

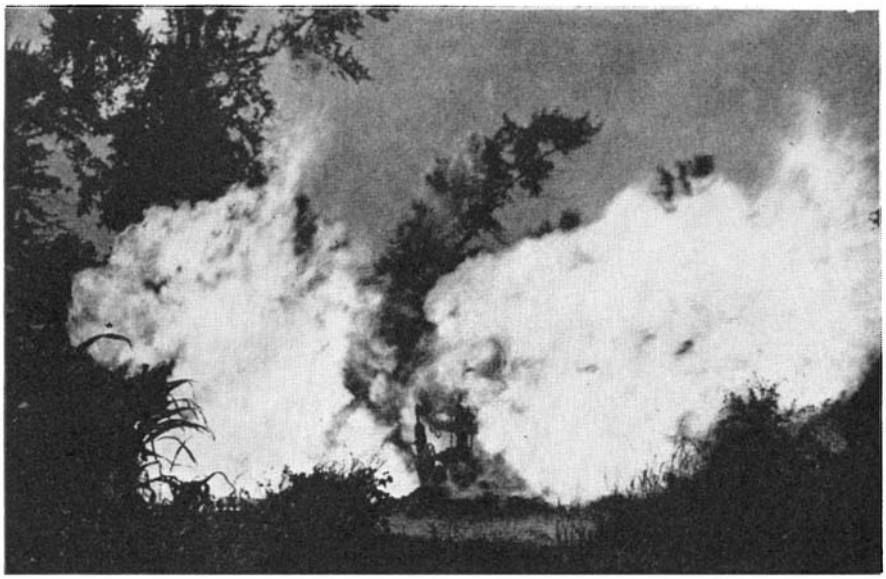


Bell mounting (in circle) to reduce vibration transmitted to belfry

The difficulty first arose at the time when plans for the new church were made. The church already owned a fine 1900-pound bell which they wanted to use. The plans called for a tower of ample size to house the bell but to build it heavy enough to withstand both the weight and the vibration would increase the construction cost considerably above the amount appropriated for the structure. In view of this, it was agreed that the bell would have to be installed in the church yard.

However, after the church was completed, the architect was again approached by the congregation regarding the possibility of installing the bell in the tower. He again refused on the basis that, while the supporting timbers of the tower were strong enough to hold the bell, the vibration created in ringing the bell would in time weaken the structure and might lead to an accident.

Then one of the officials of the Washington Mills (large textile manufacturers located in



Mushroom-like flames, bursting from a split casing of a gas well, *above*, were snuffed out, *below*, after casing was cut with wire rope

the same town) suggested that they try installing the bell on rubber mountings. As a result, it was mounted on four Vibro-Insulators supplied by The B. F. Goodrich Company. These rubber-to-metal, shear-type mountings are designed to carry a maximum load of 500 pounds, so one was attached to each of the four legs of the bell frame.

Tests were then made and showed that all damaging vibration had been eliminated. Thus, rubber permitted a tradition to be upheld at small cost and with complete safety.

Chlorinated Rubber on Roads

ADDITION of small percentages of chlorinated rubber to the tar used on roads as a binder for their surface has been found to reduce the tendency of the tar to run in the summer and to become brittle in winter. Tests of this idea are being made on British roads.—*D. H. K.*

Wire Rope Fights Gas Well Fire

WHEN a gas-producing well "goes wild" the proceedings are not simple. Experienced fire-fighters are not to be found in every community and, before they can be brought to the scene, the dangers and difficulties of fire-fighting may have increased many fold.

Thus, after the valuable Rankinside Development Company's No. 2 well burst into flame in Rankin County, Mississippi, it defied all efforts until the famous Patton Oil Well Fire-Fighters, of Houston, Texas, came to the rescue. The well, which had been yielding approximately 30,000,000 cubic feet of gas daily, was by this time a blazing inferno. The casing had split below the assembly of valves familiarly known as the "Christmas tree." Gas, at high pressure, was burning umbrella-wise all around the well, the "mushroom" flames not only making the fire extremely difficult to fight, but also endangering the entire field.

Mr. H. L. Patton, president of the fire-fighting concern, who personally superintended the job, was confronted with quite a problem. If the fire was to be "snuffed out" by the usual method, it would first be necessary to control the flow of gas so that it would rise in a straight column, or shaft of flame. This meant that the Christmas tree would first have to be cut off and the split casing cemented, and allowed to "set."

The heat was so intense that nobody could approach within 200 feet of the blazing well. Then President Patton had an inspiration. He bought 600 feet of 5/8-inch 6 by 19 Yellow Strand Rope, together with large quantities of valve-grinding compound. About 150 feet of the middle section of the rope was heavily loaded with the abrasive compound.

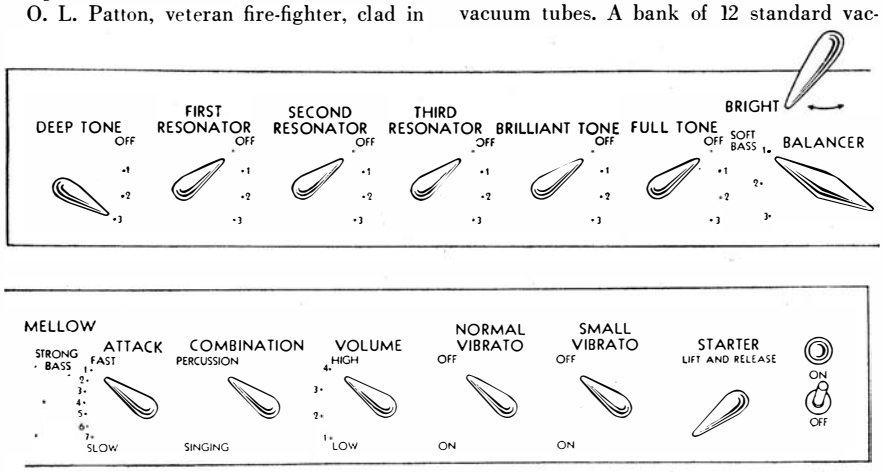
O. L. Patton, veteran fire-fighter, clad in an asbestos suit, and with streams of water playing upon him, then approached closely enough to try to "lasso" the Christmas tree with the cable. After two vain attempts, the rope was finally thrown around the pipe below the tree. One end of the cable was held fast 300 feet away. The abrasive-loaded section was pulled tight against the casing. Then after a complete circuit was made, each end of the rope was made fast to a tractor. The tractors see-sawed the cable back and forth until the pipe of the assembly was cut off cleanly and the flame roared skyward like a great plume. With the split casing cemented and set, the plume narrowed to a towering pillar. Mr. Patton had more than his share of grief on this contract. One of the tractors used in the "see-saw" process broke down the only bridge approach for the fire-quenching apparatus, and a road had to be built over a water-sogged field.

The "snuffing" apparatus consisted of a derrick mounted on a trailer. Its boom carried a manifold, which was lowered and fastened over the pipe, the flames shooting out of its top. By shutting off a valve, the flow of gas was momentarily diverted, the oxygen supply was cut off—and the fire was out. Water was then injected into the well to counteract the gas pressure and the well was re-capped.

Novachord—New Musical Instrument

A NEW musical instrument, the Novachord, based upon the principles of vibration, has just been produced by Laurens Hammond, inventor of the Hammond organ. The new instrument holds a certain similarity to the piano and has been called an "electric orchestra," which is something of a misnomer. While the Novachord can produce tones resembling those of the modern orchestra, can even call upon the classic voices of the clavichord and harpsichord to augment the resonance of the contemporary piano, it is in no sense an imitation of anything.

In form, the Novachord resembles the old-fashioned spinet, having a single manual keyboard of 72 notes which are played exactly as is a piano. It also has the regulation piano sustaining pedal and its volume is controlled by a swell pedal similar to that of an organ. But here the similarity ends. The tones of the Novachord are produced electrically by means of circuits of ordinary vacuum tubes. A bank of 12 standard vac-



These two groups of controls are used by the operator of the Novachord

uum-tube oscillators, tuned to the 12 half-tones in the highest octave of the instrument, supplies the original impulses from which all other notes are derived. Each octave, except the highest, uses "divider" tubes, the functions of which are to divide by two, exactly, the frequency received from the octave above. In this way, the frequency of all the A's, for example, is controlled by the "A" oscillator in the top octave.

The tones of the Novachord can be varied over wide ranges by means of simple controls mounted on the front panel above the keyboard. These, broadly speaking, are divided into two groups:

The group on the left controls the actual tone color by varying the harmonics. The group on the right varies the so-called "envelope" of the tone, a term used to describe the speed of attack and decay.

The system works out in this way: If the controls at the left are set to produce the same harmonics which piano strings produce and those at the right are arranged to give the same percussive "envelope," the instrument will produce tones similar to those of the ordinary piano.

If the left-hand controls are set to produce the harmonics of the violin and the right-hand controls to produce a sustained tone, an effect of strings is produced with no change in the playing technique.

Hence, the bitter-sweet voice of the oboe, the soft nasal tones of the harpsichord and

The Novachord

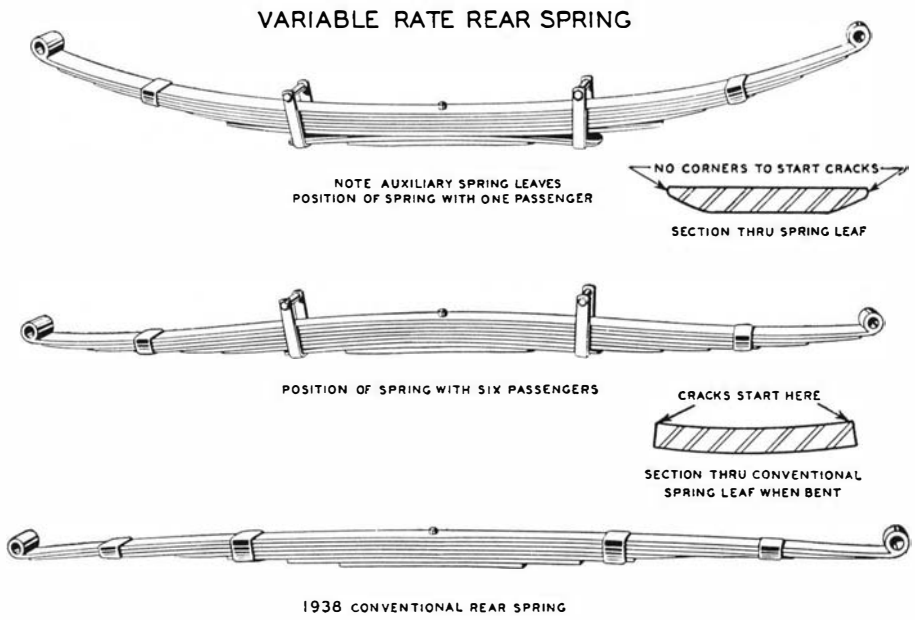
clavichord, the blare of the trumpets or the mellow ruminations of the French horn come forth accurately and without effort.

The music from the tone generator is amplified by conventional means and is heard through loud-speakers. The amplifying and speaking units are contained within the instrument, but for large installations where an unusual volume of sound is required, additional speaking equipment to any desired extent can be connected to the Novachord.

Variable-Rate Spring for Cars

EVEN as modern a mechanical marvel as the automobile had its beginnings 17 centuries ago. The search for better springing methods kept even the earliest vehicle engineers occupied. The history of springs, from their introduction in the third century to their climax in today's "Duflex" rear springs featured on the 1939 Pontiac, shows long and patient experiment.

The new spring is simplicity itself. To the conventional leaf spring, and directly below it, has been added a second but shorter leaf



spring. For light loads the car rides almost entirely on the main or upper unit which affords a slow, comfortable motion. As the passenger load increases, this upper unit comes progressively more and more in contact with the lower spring. As this occurs the rate of resistance to deflection builds up smoothly until full contact between the two units offers a maximum resistance to deflection.

Redder Red Lead

A NEW process for the manufacture of red lead is reported to yield a pigment of almost double the normal covering power and with a much enhanced resistance to corrosion. The new method consists in vaporizing lead in an electric arc and passing this vapor into pure oxygen where temperature and pressure are carefully controlled. Under these circumstances red lead (Pb_3O_4) is formed of excellent quality.—*D. H. K.*

Fewer Termites Get More Attention

IS there more cancer, heart disease, and other disease today than there "used to be" or are modern facilities for reporting these diseases and gathering statistics simply superior to those that "used to be"? Many think the answer is the latter.

Similarly, today one hears everywhere that there is now a new pest on earth, the termite, which is likely soon to reduce all our wooden buildings to shells which may cave in at any minute. We have always had termites, however. It is true, though, that we have become increasingly termite-conscious, but this is only in line with consciousness about many another condition that was once neglected but today is noticed and fought against.

The United States Department of Agriculture has the following to say about termites:

"There are probably fewer termites in the country today than there were a generation or two ago, but these wood-destroying insects get much more public attention than they used to. Last year the Bureau of Entomology and Plant Quarantine answered more than 4000 requests for information about termites. Inquiries came from every state in the Union.

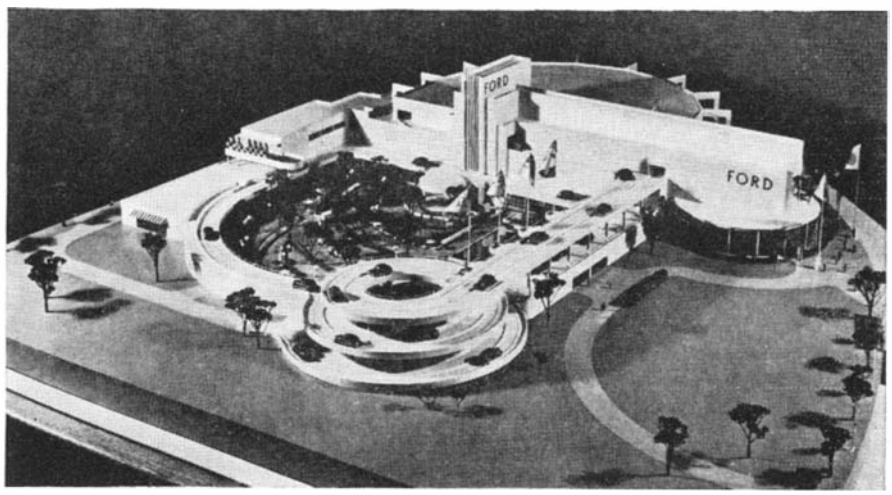
"The number of termites has probably decreased somewhat, says R. A. St. George of the United States Department of Agriculture. 'The decrease results,' he says, 'from man's efforts to build homes in wooded areas, which necessitates the removal of trees, logs, and stumps—the natural food of the insects—and in some instances, the draining of moist areas. Thus termites are deprived of their other main requirement, water.' "

Gas-Filled Cable an Outstanding Development

LOW-GAS-PRESSURE cable, most recent outstanding development in its field, is announced by G. B. Shanklin, engineer of the cable section of the General Electric Company. In the new cable, less insulation is required, for a given conductor size, than in the solid type of construction. As a result, gas-filled cables of a higher rating can be substituted for the solid types in existing duct systems without enlargement of manholes. At present cost of the two types is comparable, and, particularly in the voltage range from 10 to 35 kv, it is believed that the smaller diameter and possible use in smaller ducts of the gas-filled cable will assure its wide application. This voltage range was formerly the gap between the optimum ranges of the solid-type and the oil-filled

Gas channels in a new cable

The "roads of tomorrow" are being built today. *Above; left:* The Kew Gardens loop on Long Island and, *right,* the Pulaski Skyway in New Jersey. *Below:* The Ford exhibit at the New York World's Fair, in which is half a mile of road



constructions. The new product is almost as easy to handle in the field as is solid-type cable, and splices are simple. The adjustment of gas pressure can be handled economically by gas reservoirs when conditions require them. An alarm system can be installed to detect gas leakage.

The general construction of the new cable is quite similar to that of the oil-filled cables which are now widely used. The principal difference is that instead of being filled with gas-free oil, the channel spaces are drained before the cable leaves the factory and the cable system is filled with a neutral gas, nitrogen, under a moderate pressure (10 to 15 pounds per square inch). In line with its function of filling the gap between two earlier types of cable construction, its operating voltage stress, in volts per mil, is not as high as that of the oil-filled type but is considerably higher than that of the conventional solid-type impregnated-paper insulated cable.

"The Road of Tomorrow"

ONE of the most significant steps in the development of modern highway construction is the consideration now being given by several state legislatures to the building of "freeways." Such routes were first proposed a few years ago but very little progress was made in having them generally adopted until New York and Rhode Island passed the required legislation to enable their state highway departments to construct them. Among other states which are considering legalizing this type of road are California, Connecticut, Massachusetts, Maryland, and New Jersey.

The basic essential of the freeway is a right of way to which abutting property does not have access. Because present traffic in built-up areas is slowed down to an average of 15 miles an hour because of stoplights necessary to control it while cross-traffic advances, it is estimated that the rate of travel can be greatly increased and the safety of car drivers can be multiplied many times if intersecting roads are eliminated.

Another major trend in safe express highway construction is toward elevated highways which separate local and express vehicular traffic or all motorized traffic from pedestrians. Such highways provide for a complete physical separation of opposing streams of traffic, eliminate direct access to abutting property, eliminate intersections and incidental cross-traffic, and separate pedestrian and vehicular traffic both laterally and cross flow.

Taking a lesson from engineering experts who have definitely set the pace for elevated roads, the Ford Motor Company has constructed "The Road of Tomorrow" as an integral part of its Exposition building at the New York World's Fair. This road, which is more than half a mile long, rises by a spiral ramp from the ground level to a maximum height of 33 feet. Over it visitors to the Fair will be driven in cars around and through the building at an elevation which prophetically demonstrates the trend toward the day when vehicular traffic will be separated from pedestrian traffic.

"The Road of Tomorrow" will be reached from the patio of the Ford Building by short stairs to a loading platform which will be provided with tables, chairs, and umbrellas. The ride itself will be a delightful adventure, affording the passengers an unexcelled view of the entire Fair grounds and the surrounding countryside.

Rubber Molding Powder

A RUBBER powder containing about 96 percent rubber and having interesting and novel properties has been produced in the government experiment station in Java. The new product, called "Mealorub," is made by flocculating rubber from field latex, adding sulfur and zinc oxide, and subsequently separating the whey or serum by centrifuging. The powder has properties resembling those of a low protein rubber and hence has enhanced resistance to moisture. It is also suggested for use as a molding powder and for numerous other applications.—*D. H. K.*

Alloy Hardened After Fabrication

EASILY fabricated in its soft state, a new nickel alloy takes on a high degree of strength and hardness following simple hardening treatment. Also, it possesses high corrosion resistance. This "Z" Nickel (98 percent nickel minimum) is now offered in various fabricated forms and different degrees of temper by the Driver-Harris Company.

In the unhardened or quench-annealed state, "Z" Nickel is as readily worked as nickel, including bending, drawing, machining, and hot forging. When heat-treated, however, at low temperatures of 890 to 930 degrees, Fahrenheit, it attains a hardness of Rockwell C 35-45, at which levels it is 2½ to 4 times as strong as structural carbon steel and possesses good toughness.

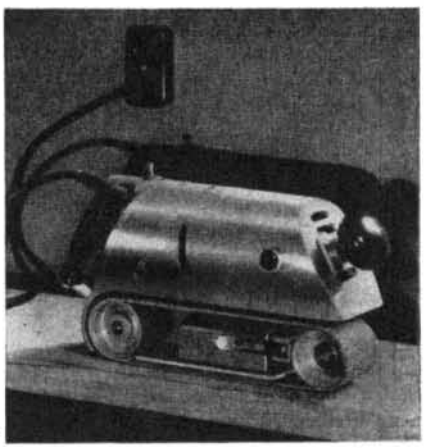
"Z" Nickel is being fabricated in cold-drawn rods, wire, and cold-rolled strip, in a wide range of sizes. Such forms are avail-

able in soft, half-hard, and full-hard tempers to meet intended fabrication and application requirements. Since the extremes of initial softness and ultimate hardness determine the full value of this alloy to users, exceptional care is taken in rolling and drawing operations.

The new alloy finds many applications, already including coil springs, spring clips, wire brushes, hand tools, and other items. It lends itself particularly well to deep drawing of parts that must withstand exceptionally hard usage.

HAND POWER-SANDER

BRINGING new speed, efficiency and convenience to metal and wood workers, a nine-pound, portable electric belt sander has just been announced by the Syracuse Guildtool Company. Featured by its handy compactness and moderate price, this new power tool was especially designed to make available to the average workman the advantages



of the belt-type sander, and to eliminate the costly drudgery of hand sanding, surfacing, and refinishing.

Light in weight, the GuildSander is usable in any position. It has the power to do all types of sanding and the adaptability to sand all straight or slightly curved surfaces. The front pulley may even be used as a spindle sander.

In quality, the GuildSander conforms to the recognized standard of larger and much costlier portable sanders. It is built with a die-cast aluminum frame, finished in baked aluminum enamel. The abrasive belts are of the endless type, and travel 600 feet per minute. They are two inches wide by 21 inches in circumference, and are furnished in all usable grits. They may be changed quickly.

The GuildSander is equipped with 110-volt universal motor that plugs into any light socket.

BETTER SPONGE RUBBER

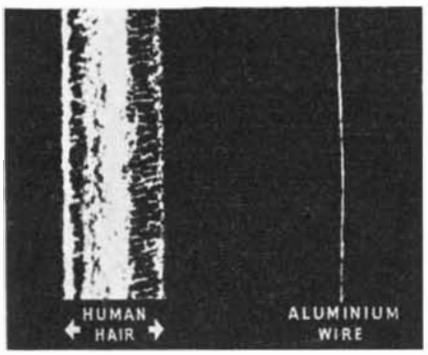
NEWEST adjunct to comfort is foamed rubber latex sponge used in upholstery, mattresses, and various cushion applications. This interesting material as produced consists of a hardened froth of rubber formed from latex, which is the milk of the rubber tree and primary source of all natural rubber. The process of manufacture begins with a concentrating operation to increase the ratio of rubber to water in the latex by passing it through a centrifugal similar to a cream separator. To

the concentrated latex are added sulfur and other compounds necessary to its subsequent vulcanization, and a foaming agent to aid the formation of a froth. The compounded latex is put in a beater similar to an egg beater or cream whipper which converts the thick liquid into a light, airy froth. This froth is stabilized by the addition of a gelling agent and is then vulcanized in a mold immersed in hot water at approximately 205 degrees, Fahrenheit, for the length of time required by the particular compound being made. This process, which is patented, is being used by several leading rubber manufacturers under licenses.

The principal application of foamed latex sponge is in cushions, mattresses, and upholstery, but in addition it is finding important uses as a shock absorber and cushioning agent in industrial machines. This method of making rubber sponge is much simpler than older processes which depended upon the generation of a gas in small bubbles within a doughy mass of rubber.—*D. H. K.*

Around the Earth with a Single Pound

WEIGHING 0.000000009246 of a pound per foot, the aluminum wire shown in our illustration compared with a human hair is not a freak or a museum piece; wire of



this diameter is used in string galvanometers for geophysical research and prospecting. The wire has a diameter of 1/10,000th of an inch, and a single pound of aluminum could be drawn into 20,000 miles of such wire. The cost, however, would be almost $500,000 for that pound.

Soap Bubbles for Grown Boys—and for Engineering

AS a lad you probably blew soap bubbles, but as an adult you might like to try it again with a better soap solution, making bigger, more lasting bubbles possibly inflated with hydrogen to make them float or to explode when ignited, especially if you could do it ostensibly for the amusement of some youngster. In the *Journal of Chemical Education*, G. A. Cook of the well-known Case School of Applied Science, Cleveland, Ohio, summarized the technique and showed why those bubbles of our "kid" days were not so good as some that can be had with a chemist's knowledge of the subject.

After much study of existing literature, including two excellent books that are available (C. V. Boys, "Soap Bubbles, their Colors and the Forces Which Mold Them," 1924;

also A. S. C. Lawrence, "Soap Films," 1929), the author made numerous experiments which are described in his article, and finally reached the conclusion that a solution which can be prepared from materials readily available and in a minimum of time, and which will yield bubbles lasting from one to five minutes in the open air (bubbles in closed vessels lasted as long as 100 *days*), is made as follows.

An ounce of powdered Castile soap is placed in a one-quart bottle filled with distilled water (available at most drug stores and filling stations). The bottle is shaken at intervals until solution is complete, and allowed to stand for 24 hours or longer. The clearer part is then siphoned off and the rest thrown away. To the clear portion, three tenths of its volume of glycerine is added and thoroughly mixed with it. The bottle must be stored in a dark place and at all times kept well stoppered. When it is desired to use the solution, about ⅛ cup of it is poured out and stirred with two or three pinches of tannin. (Tannin is the same as tannic acid and is available at drug stores.)

The article also describes the use of a new kind of soap called triethanolamine, for making flat soap films which last for several hours. Such films are important in research on airplane design and in the design of many kinds of machinery, because of an analogy between the tension, or stress, undergone by a structural member, such as a beam, and by a soap film stretched across specially shaped supports and strained by a blast of compressed air. Thus, the strain that would be experienced by certain parts of an airplane, for example, can be predicted without actually building the unit, and the best construction for a given need can to some extent be determined beforehand. The article gives references to papers in which work of this kind is reported and explained.

Smoked Turkey Process Uses Ultra-Violet

WHO doesn't like smoked turkey? Who does, you retort, and a good retort it is, for few are aware that this delicacy can be had in America. Turkeys cured, then smoked and cooked at the same time are sought after by the gourmets of this country, and the only source of supply, Pinesbridge Farm (in Westchester County, New

Curing turkeys before smoking


A turkey smoke-house

York) is kept busy shipping its product all over the country.

The process is secret, and begins with a special cure carried on in a refrigerated room. From there the turkeys are taken to the smoke-house for smoking and cooking. There precise regulation of heat, ventilation, and smoke is essential. In a matter of minutes a whole houseful of fowl may be irretrievably ruined if the attendant relaxes his attention.

For the last three years this farm has supplied smoked turkeys to the Waldorf-Astoria, Colony Restaurant, The Stork Club, the steamship *Queen Mary*, the crack *20th Century Limited*, and many other exclusive restaurants, night clubs, and establishments, and has filled orders for individuals whose names read like a page in Who's Who.

What is this secret process, and why cannot anyone smoke turkeys? First of all, the brine in which the turkeys must be cured after drawing them contains eleven herbs and spices, some very rare and obtainable only from a particular house in London specializing in them. During curing, and afterward until they are taken to the smoke houses, the turkeys are kept in a large refrigerator at a closely held temperature of 40 to 42 degrees, Fahrenheit, with the air circulated through the refrigerating units by powerful fans, and with all possibility of contamination by the mold of decay or the bacteria of disease eliminated by use of the Rentschler-James Process, which uses ultraviolet sterilizing lamps. From this refrigerator, birds are taken as required to the smoke houses, where they are hung over a wood fire. This fire cannot be made of just any wood, for the kind has an effect upon the taste of the meat. It has been found that apple wood is the best, and the farm's operator scours the nearby countryside for old apple orchards, which he buys and cuts into cordwood.

Acetic Acid in Petroleum Refining

DURING recent years numerous solvent processes have been introduced for the refining of petroleum. The latest of these, developed in India, uses glacial acetic acid as the solvent. By adding water to the acetic acid solution it can be given a solvent power varying at will. The principle of operation

of this refining method is to dissolve part of the oil, leaving the rest undissolved. In this way separations can be effected which are difficult, if not impossible, by distillation or other methods independent of solvents.—*D. H. K.*

Why Some Birds Move their Heads

THE vision of most birds is monocular, the visual fields of the two eyes being quite independent of each other. Monocular vision with two eyes, each having a short focus, wide-angle lens, has the advantage of giving a sharp and distinct retinal image of everything within two large visual fields. But it has the disadvantage of recording two independent single images each in a single focal plane, resulting in more or less inability to judge accurately the distance of any given object from the fixed point of the single eye bearing upon the object.

This disadvantage is overcome by the horizontal head movements of such birds as the doves, pigeons, coots, and gallinules and by the vertical head movements of the shore birds. Such head movements provide a base line from which distances may be measured, and the blotting out of the image between the extremes of this base line, assuming a retinal lag, results in a stereoscopic effect.

Thus the birds, under the apparent physical handicap of monocular vision, in reality, as a resultant of the movements of the head, possess all the advantages of binocular vision, in addition to the advantages inherent in double monocular vision.

Although it is believed that the attainment of the advantages of binocular vision is an important factor in the head movements of birds, it is not assumed that it is the only factor, or that it explains its origin.—*Austin H. Clark, Zoologist at U. S. National Museum.*

Fireproofing with Paint

BRITISH chemists have recently developed a paint to be applied to wooden structures to reduce the hazard of fire from incendiary bombs should a war occur. The paint localizes the fire produced by the bombs and has proved successful in small scale tests.—*D. H. K.*

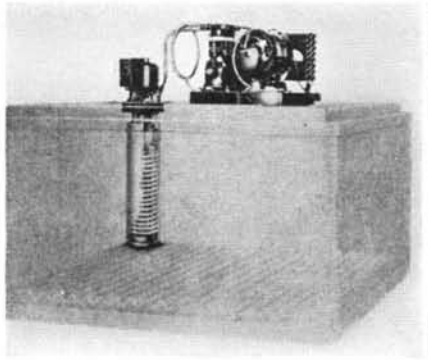
Drop-In Cooling Unit

ENGINEERS of Frigidaire Division, General Motors Corporation, have developed a new "drop-in" milk-cooling unit which can be installed in any standard type of milk-cooling cabinet, it was announced recently.

The new unit consists of a cooling coil and motor driven water-circulating device enclosed in a cylindrical steel shell. The cooling coil is connected to and refrigerated by means of a Frigidaire compressor.

The unit is shipped from the factory as a complete assembly which may be readily installed in an old or new milk-cooling cabinet and plugged into a convenient electrical outlet.

Proper temperature in all parts of the milk cooler are assured by the circulator which keeps the water bath constantly circulating during the cooling operation. Cool-



Drop-in cooling unit, motor driven, that can be installed in any standard type cabinet used for milk-cooling

ing to temperatures below 50 degrees as required by many states is also insured, thus retarding bacteria growth and eliminating spoilage and rejection losses.

The unit is completely automatic in operation; eliminating the labor required by old style cooling systems. The new unit is available in two sizes for cooling two to six cans of milk per day. It is ideal for the requirements of the small dairy.

Efficient Copper-Oxide Rectifiers

COPPER-OXIDE rectifiers having a capacity of 3000 amperes at six volts are now being economically used to supply direct current in an electrotyping operation. Rectifiers of this type have been used for many years in various applications requiring relatively small amounts of electric power. The present installation is the first in the electrotyping industry, and during approximately six months of operation has proved itself both efficient and economical. The initial cost of the copper-oxide rectifying system is approximately half that of a motor-generator installation of the same capacity, and since no moving parts are involved it has no tendency to wear out. The alternating current as purchased is passed through a transformer to bring it down to the low voltage required and the current at low voltage is then rectified.—*D. H. K.*

Finding Meteorites

SPECIMENS of 70 meteorites have been added to the collections of the Smithsonian Institution, at the nation's capital, during the past year, 62 of them representing new falls. This brings the Institution's total number of meteorites to nearly 700, or more than half of the known meteorites reported to have hit the earth. The largest specimen acquired last year weighs close to 90 pounds and the smallest only a few grams.

The Smithsonian is eager to obtain as many as possible, is actively engaged in building up a great collection of these meteorites for study, and encourages people to search for them. The students of meteorites to a large extent depend upon the chance discovery of them by the people throughout the country, and to stimulate the search, the Smithsonian rewards the finder.

Meteorites are all very heavy for their size, and much heavier than the average rock on this earth, the reason being that they sometimes consist of an alloy of iron and nickel, usually over 90 percent iron. When the stony

meteorites are found they consist largely of heavy magnesium silicates and usually contain inclusions of the iron and nickel alloy. The iron alloy is attracted to a magnet or will influence a compass needle, so the meteorite hunter is advised to look for heavy, dense objects whose surface appears to have been streamlined and to test them either with a horseshoe magnet or a compass.

No meteorites contain any metals worthy of the cost of recovery. Their value lies in the scientific information they contain which can only be obtained by careful laboratory study of their structure and composition.

Hard Paper Statuary

SCULPTORS have been provided with a new medium for their art in the form of paper pulp hardened with synthetic resins. The product known as "hard paper" is about as hard as boxwood and has a uniform, non-directional grain throughout. Promoters of the idea expect this new medium to compete favorably with stone, iron, bronze, and other materials used by sculptors.—*D. H. K.*

First Aid for Motorists

IF automobile manufacturers would supply an illustrated first aid handbook with every car, it would help to cut down the dire and far too frequently disastrous results following automobile accidents. This proposal of a first aid handbook with every automobile was made by Dr. Charles S. Venable of San Antonio, Texas, at a meeting of the Southern Medical Association.

The folding jack handle in every car makes a good arm or leg splint, Dr. Venable said, but unfortunately John Q. Public does not know this. Neither, Dr. Venable pointed out, does Mr. Public know that a piece of fence or a small limb from a tree can be used for a splint.

Instead of using such handy objects, he jackknifes a person with leg or back broken in an auto accident into the back seat of a car. As a result, a simple broken leg bone may result in lifelong disability. Or the patient with the broken back, doubled up into the rear seat instead of being left flat on the ground till an ambulance comes, arrives at the hospital with his spinal cord crushed and may be paralyzed or die. If the patient with broken back or neck is kept in a flat, horizontal position, Dr. Venable explained, he has a good chance to recover without disability.—*Science Service.*

New Hectograph Product

A NEW idea in the preparation of master copies for both gelatin and liquid type duplicators has been introduced to the field of hectograph duplicating processes. This new product, issued under the trade name HECTOmasterGRAPH, comprises a sheet of marginally coated hectograph carbon, a protective sheet and a master-copy sheet in one unit, and is said to effect a great saving in time in the preparation of master copies. It is also claimed that the new form will greatly simplify the hectograph method of duplicating and eliminate all of the previously objectionable features which, until now, have been prevalent in the use of hectograph car-

bon papers. Due to the fact that the carbon and the master-copy sheet in one unit is ready for use when taken from the box, the operator finds no necessity for touching the hectograph sheet itself, thus avoiding all possibility of staining the fingers or clothing.

Fabricating Non-Ferrous Metals

A NEW process which makes possible precision shaping of non-ferrous metals and plastics, in sizes and designs which formerly could not be produced, has recently been introduced on the market. It literally begins where methods of extruding or rolling end, for it produces, in any length rods, designs too complicated and sizes too small to be secured by any other known method.

Undercuts, which hitherto have frequently proved an insurmountable obstacle in construction, are entirely solved by this method. Precision, too, can be held down to .002 inch, and even less, if required.

The accuracy and multitudinous designs which are possible by this new process can be quickly produced, at low cost. Scientists, engineers, and designers can, by this process, without prohibitive cost of dies or milling work, immediately have almost any conceivable shape made to order in the shortest time.

In the automotive field alone, many designs which have hitherto defied the skill of productive and tool experts, can now be manufactured with surprising facility.—*C. F. Greeves-Carpenter.*

Answers to Problems

The answers to the problems proposed on page 219 are as follows:

Crossed ladders: 27.87 feet.

Spheres: 0.74048 in either case, since the ratio is the same for balls of any diameter.

Barge: 4.660, 4.012, 5.166, 4.518 feet; pressure is 38.73 tons.

Dog-rabbit I: 9 1/11 sec., 6.105 sec.

Dog-rabbit II: 3.717 sec. 68° 36′ 54″ east of north.

HERE COMES TELEVISION!

(*Continued from page* 209)

eliminate the event of going to the theater. Television, however, will probably make use of many films, either shorts or films made especially for television.

I am not eminently qualified to speak on the subject of the television receivers that are soon to be marketed. I assume, as I have said, that they will be reliable. There will probably be both table and console models, embodying several sizes of Kinescopes—perhaps five-inch, seven-inch, and twelve-inch tubes. The largest of these gives an image approximately 7½ by 10 inches in size. Almost all of the models will also reproduce the sound associated with the picture; but it may be that the less expensive models will require the addition of some form of ultra-short wave adapter to the radio receiver already in the home to enable it to pick up

sound to accompany the television image.

It will seem to many that the largest size television image now practically obtainable will still be far too small for home entertainment needs. A comparison will be made between television's images and those of the motion picture. The habit of viewing scenes on a large size movie screen will probably prejudice many persons against television's present images. I believe, however, that most persons will be surprised at the amount of interesting detail that can be portrayed in the larger size television images. It must be remembered that the television image should be seen at the proper distance. At a distance of five feet the eye subtends the same angle at the television screen that it does from the rear row of the average motion-picture theater. Experiment on devices for producing larger images by projection methods is under way. The present projection tube, with its associated apparatus, is still too complicated and cumbersome for home use.

There will also be many persons inclined to "wait until they perfect this thing" before they consider the purchase of a receiver. They will feel that there will be rapid obsolescence in the receivers; that perhaps standards will change in a short time and render the receiver that cost perhaps several hundred dollars a useless piece of furniture.

This factor of obsolescence is certain to count rather heavily. What assurance can we give against rapid obsolescence? Television has been long in developing and has progressed through an evolution that has seen many methods and standards tried and discarded. If a single set is to receive the programs of all stations within a given service area, uniform standards must be set up for all transmitters.

A subcommittee on standards of the Radio Manufacturers Association has tussled for years with this problem. The British, in 1936, established a public television service in the London area, operated by the British Broadcasting Corporation and financed out of receiving set licenses levied on every radio set. We in the United States have followed the success of the British standards, adopted those which proved their value and rejected those which to us seemed inferior to those proposed and tested here. For more than two years the NBC station in New York has been a proving ground for many of these standards. Now the body of standards proposed for an American public service in television has been adopted by the radio industry and recommended to the Federal Communications Commission. They represent an advance over those prevailing in Britain.

Here, I believe, lies the answer to those who feel that we are starting television broadcasting without adequate study and preparation. The adoption of these standards was not precipitate. For technical reasons, if for no other, American television has been delayed to assure the adoption of the best possible group of transmission standards. They were arrived at without prejudice to anybody's claims and I feel certain they offer the enduring basis for American television. I feel certain, too, that they will not soon be modified and that receivers based upon them will give years of satisfactory service to the first buyers.

But, after all, the best way to judge television is to see and hear what it offers. Take a look at the images when you can. I think you will be as enthusiastic as we are.

Books

SELECTED BY THE EDITORS

SCIENCE FOR THE CITIZEN

By Lancelot Hogben

FEW of the writers of popular books of the type that treat the several sciences from astronomy and physics through to the biological branches are capable of coupling their presentation with penetrative interpretations of the social significance of these advancing sciences, but Hogben's new book combines this feature, in a work that bids fair to become a best seller, like his "Mathematics for the Million." Thus the reader (or student, for the book is partly for reading and partly for a little harder study) will come to understand much more than the mere fact-collecting kind of person—he will comprehend the significance of science as thinking people do. (1082 pages, 6 by 9¼ inches, 480 illustrations.)—$5.60 postpaid. —*A. G. I.*

U. S. CAMERA ANNUAL

Edited by T. J. Maloney

IT is impossible to describe in the short space of a review the wide range of pictorial material presented in camera annuals, of which U. S. Camera has become one of the outstanding examples. Probably the most pertinent thing that we can say about this particular volume is that Edward Steichen was the sole judge in selecting the photographs which are presented. (9 by 12 inches, 196 pages of photographs and descriptive material plus an advertising section and an index containing much technical data. Spiral wire binding.)—$3.00 postpaid.—*A. P. P.*

MONEY-MAKING HOBBIES

By A. Frederick Collins

THE author has collected in this volume a large number of hobbies which can be turned into money, including the making of toys, tools, and so on, from paper, textiles, and Cellophane; the making of pottery; weaving; leather tooling; woodworking; model-building; electro-plating; metal work; and printing. Included also are money-making entertainment hobbies and, of course, photography finds an important place in this book. (322 pages, 5¼ by 7½.)—$2.10 postpaid.—*F. D. M.*

THE ENDLESS QUEST

By F. W. Westaway

HISTORIES of science are abundant but the very word history frightens the average reader; he thinks of the dry bones of things long since gone. Books of general science treated non-historically also abound. The present work, however, is a compound of the two, but the bones are not dry. It is an account (very exhaustive—over 1000 pages), of the growth of science, in which its many discoveries and theories are fully explained by a notably lucid writer. The "endless quest" refers to the past 3000 years of science but the reader reaches modern science before he has covered a third of the book, and the current science of our own times is well explained in all its main branches. A truly remarkable compendium, bright and friendly, never dull or labored. (1080 pages, 5¾ by 8½ inches, 241 illustrations.)—$3.10 postpaid.—*A. G. I.*

BEWARE FAMILIAR SPIRITS

By John Mulholland

A READABLE collection of accounts of ghosts, haunts, apparitions, and spirits, also of outstanding psychic mediums of the past, such as Home, Slade, Margery, and so on. The author is a magician. His book could not be called very scientific—if indeed it is possible to be very scientific, at least at present, about these things—but is chatty, informative, and amusing. Fraud, chicanery, and deception are the explanations reached in nearly all the cases discussed. (342 pages, 5¾ by 8 inches.)—$2.60 postpaid.—*A. G. I.*

THROUGH THE OVERCAST

By Assen Jordanoff

AMATEUR aviators, professional flyers, everyone connected with or interested in the rapidly advancing science of aviation will find here a complete and welcome treatise on what is generally known as "blind flying." Instrument flying, the basis of this entire book, has become such an essential part of modern air transportation that a book of this sort fills a very definite need. (356 pages, 8 by 10½ inches, thoroughly illustrated with pen and ink drawings.)—$3.10 postpaid.—*A. P. P.*

THE SUN

By Giorgio Abetti

AS an addition to the carefully chosen libraries of astronomical books which most amateurs gradually collect, this meaty volume can be recommended as a purchase of lasting and substantial value. Such books, or any general books on the Sun, come but seldom. It is technical but not too technical for the serious amateur, and in eight chapters treats of: how the Sun is observed, visual and photographic observation, spectroscopic observation, the outer envelopes, physical constitution, radiation and temperature, the Sun among the stars, and the Sun and the Earth. The author is a noted Italian solar physicist and his book is dedicated to the late Professor Hale. (360 pages, 5½ by 9 inches, 157 illustrations.)—$5.10 postpaid.—*A. G. I.*

HEARING—ITS PSYCHOLOGY AND PHYSIOLOGY

By S. Smith Stevens, Ph.D., Dept. of Psychology, Harvard, and Hallowell Davis, M.D., Dept. of Physiology, Harvard

AN outstanding work, in fact a landmark since it summarizes between two covers the results of the great wave of investigation into the physiology and psychology of hearing made possible by the application of radio amplification technic to this kind of research. The book has an introductory section on the fundamentals of the science of sound, with a minimum of mathematics; then it deals with what is heard when sound reaches the ears; next with the relation between stimulus and sensation; and then how it is heard (the functional anatomy of the ear is included in this part). While not a popular work, it is not too technical for thousands of studious laymen eager to comprehend the new knowledge of hearing. (489 pages, 5¾ by 9 inches, 165 illustrations.)—$4.75 postpaid.—*A. G. I.*

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

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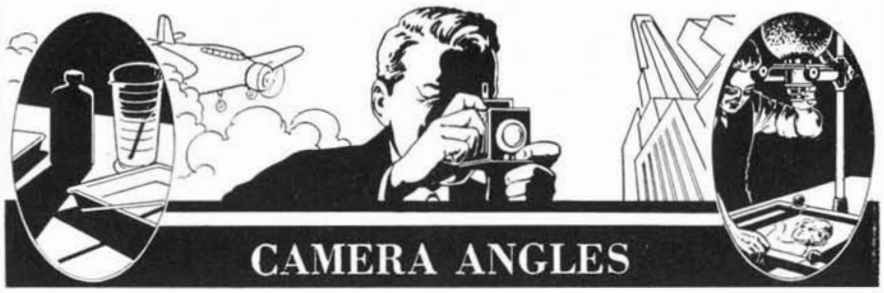


Conducted by JACOB DESCHIN

The Texture Matrix

A BOON to the miniature worker and the fine-grain problem, and offering an opportunity to all photographers to introduce surface texture effects not inherent in the printing paper, the so-called texture screens are finding a wide public. William Mortensen, with his steel engraving texture matrix, is probably responsible for bringing the method into the vogue it enjoys today. That his lead has been followed by others is indicative of a growing interest among amateurs desirous of improving the surface appearance of their prints.

Recently, we had an opportunity to try out the latest variation on the texture matrix theme; namely, the Dia-Matrix Screens, which are available in three textures—Tapestry, Bromoil, and Charcoal. Of the three we personally lean strongly toward the last as offering the most for one's money in the final appearance of the print, but that will doubtless be disputed by other users of the screens, who may prefer the other two.

Bromoil

The screens, which are available either in

"Straight" enlargement

the 8- by 10-inch size or the most common salon size, 11 by 14 inches, are individually hand-made and spotted. Like photographic film or paper, the screens have an emulsion side, on which the texture markings have been applied, and a plain, untreated side. In use, the emulsion side of the screen is placed in contact with the emulsion side of the sensitized paper on which the print is to be made, the uncoated side of the screen facing the negative image projected from an enlarger. Closest contact is achieved through the use of a regular printing frame, but in lieu of this a sheet of glass may be employed. The printing frame is to be preferred for the obvious reason that unless there is absolute contact between screen and paper, uneven impression will be the disappointing result.

There is no hard-and-fast rule as to what constitutes the correct printing depth when employing these screens, for the degree of texture imprinted on the sensitized paper

Tapestry

Charcoal

varies with the subject, the amount of image detail one desires to retain, the general effect aimed at, and other factors. For large heads, for example, a longer printing time may be allowed and a consequently clearer, that is, darker, impression of the texture achieved, than might be the goal where a landscape is involved. In exposing the examples shown on these pages, printing time was three and one half times that required for the "straight" enlargement. And this seemed to be about right for the subject. Also, different paper surfaces will make for differences in the comparative effects achieved with these screens. In general, it may be assumed that semi-matt and matt papers are the most suitable.

Besides the surface of the paper and the length of the exposure, the degree of texture may also be controlled by the type of developer used. A brilliant negative is recommended, though it is held that any good negative, whether contrasty or soft, will yield satisfactory results, employing a contrasty print developer and a contrasty paper for the former, and a soft paper and soft print developer for the soft negative.

The screen markings being naturally most evident in the shadows, one must be sure to print long enough to imprint the texture in the brightest highlights. The beginner in this work must guard against a certain timidity in this regard for the texture impression must inevitably call for a darker print than would result without the use of the screen.

Owing to the necessary coarseness of the screen impression, which is due to its hand-worked appearance, opportunity is afforded for sketching in little changes here and there. For this purpose an ordinary lead pencil may be employed.

Fountain Pen Flashlight

IT'S not sold as a photographic accessory but there's nothing handier for some darkroom purposes than the inexpensive little flashlights shaped like fountain pens which you probably have seen in the stores. Immediately coming to mind is its use for "flashing in" dark areas in a print during enlarging. Those light or meaningless areas that interfere with the effective presentation of the main subject in some prints are thus conveniently snuffed out without affecting other portions of the projected image. The clip with which these devices are equipped makes it possible to have the flashlight always handy as it can be carried in the pocket alongside one's fountain pen.

Flash Synchronization Tester

MAKING possible a regular program of checking the synchronizing outfit, a new testing device for the purpose of checking the relative timing of a camera shutter with the flash of a flashbulb has been made available by the General Electric Company in the G. E. Synchrograph. The Synchrograph consists of a case with an aperture at each end, a film-holding chamber taking 4-by-5 film, a rotor which is twirled by means of a knob, and two simple optical systems by which light entering at the apertures is directed to the film through slits near the respective ends of the rotor. The device may be used in any ordinarily lighted room.

In use, a Photoflood bulb is placed immediately behind the ground-glass focusing screen, the lens board of the camera is racked out so as to position the lens close to one aperture of the Synchrograph, and a Photoflash lamp is placed in the other socket, the cord being plugged into the socket of the synchronizer. The Photoflash lamp is placed in line with the other aperture of the Synchrograph, and a shot is made.

Development and fixing of the film in the usual way will reveal one of three conditions: Shutter opens at peak of flash (correct synchronization); shutter opens ahead of peak (thin or blank negative; synchronizer needs adjustment to delay opening of shutter); shutter operates later than the best part of the flash (should be adjusted to open sooner).

Small Stops and Definition

THE widely held notion that the smaller the stop the greater the definition afforded by a lens is disputed by Ilford, Ltd., of England, who support their stand with the accompanying photomicrographs which are from very fine line printed originals taken on Thin Film Half Tone Plates. The first set of lines shows the definition at *f*/20; the second set, the result when stopping down to *f*/40; and the third set, the result

f/20 *f*/40 *f*/80

at stop *f*/80. While the difference between *f*/20 and *f*/40 may not be so clear in the scaled-down reproduction shown here, it is very apparent as between *f*/20 and *f*/80. The conclusion is that the relatively large stop of *f*/20 gives better definition than *f*/40 and much better than *f*/80.

"This applies to all types of lenses," say the Ilford people, "and arises from the diffraction of light which occurs at the edges of the stop and has nothing to do with the photographic material employed. With a small aperture there is greater diffraction which causes light to be scattered beyond the edge of the image and so produces the ill-defined edges sometimes found in practice."

PHOTOGRAPHING WINDOWS BY DAYLIGHT

IF you should ever have occasion to photograph a display window during the day, whether for love or money, here's a tip we picked up the other day. The chief trouble with window pictures is that of reflections from across the street, as you doubtless know. These two photographers we were watching overcame the difficulty by stretching behind the camera a long sheet of black cloth about three times the width of the window being photographed. Operation of the camera shutter was by "remote control" employing a long cable release.

BLUE TONING OF PRINTS

A WIDELY used formula for the blue toning of prints was recently published in the *Zeiss Magazine*. The formula, for use only with chloride and chlorobromide papers, follows:

Gold Chloride Blue Toning Formula

Solution A		
Water	250 cc	8 oz.
Gold Chloride	1 gram	15 gr.
Solution B		
Water	250 cc	8 oz.
Citric Acid	3 grams	50 gr.
Solution C		
Water	250 cc	8 oz.
Thiocarbamide (Thiourea)	3 grams	50 gr.

These are stock solutions. A working solution to tone three 11- by 14-inch prints consists of one ounce of each of the above solutions plus ten ounces of water, the working bath being used at 65 to 70 degrees. Toning commences in five minutes to a half hour and is completed in from a half hour to two hours. Agitate during toning for even action of the bath and wash afterward for a half hour.

The prints must be washed well after fixing and before toning and again after toning; prints must be fixed in a plain or acid fixing bath without any hardening agent; and prints must be so exposed and developed as to be lighter and have less contrast than is desired after they are blue-toned. Also, different tone depths will be obtained with different paper developers.

BACKGROUND ON HOOKS

OUR six-by-six-foot background (stretched on a wood frame), supported by projecting wooden "L's" at the sides, had been standing on the floor of our studio for a long time when a visiting friend objected. His argument, which was the more forceful because it echoed our own suspicions, was that the background was taking up about two feet of space to which it had no right since the space between it and the wall was absolutely useless. His suggestion was to knock off the supports and hang the back-

On hooks

ground from the walls, with a pair of hooks at each side. For all but full-figure pictures, the background was high enough, being separated from the floor by only a few inches. For full-figure portraits, or similar shots, the background could easily be lifted off the hooks and stood on the floor at a slight slant, with the wall as a support. That we thought the idea a swell one is attested by the accompanying photographic proof.

Panatomic-X in Larger Sizes

HITHERTO available only in the 35-mm negative size, Panatomic-X may now be had in a wide range of roll-film and film-pack sizes. The manufacturer recommends this new film as an all-around emulsion, including the requirements of copying photographs, half-tone reproductions and documents, technical photography, and salon and exhibition work.

Ferrotype Plates

THUMBING throught the current issue of Studio Light, the Eastman Kodak Company's house organ for professionals, we found a suggestion concerning ferrotype plates that should help the amateur as well. It will be real news to many that ferrotype plates, which are frequently washed and upon which wet prints are placed to dry, may actually be damaged by water.

"Some enamels," says the writer, "are totally impervious to water, but the particular enamel used for ferrotype plates is not. After these plates have been repeatedly allowed to stand in water for considerable lengths of time some of the moisture penetrates the enamel, rusts the metal beneath, and causes small blisters and uneven surface roughness. This, of course, ruins the plates."

The advice is, first, not to allow the plates to soak in water for hours at a time, and, second, never to set them away to dry with drops of water on them.

Add Photography Influence

WE don't know where it is all going to end up—and who cares?—but it seems that photography is still poking its nose into activities outside its sphere. A Fifth Avenue store, for example, was, at the time of this writing, dramatizing, newspaper-headline style, its offerings of women's attire, and using press cameras to put the story over. In each of a half dozen or more windows was a Speed Graphic camera, with synchronizing flashgun attached—Kalart, Ab-

bey, Mendelsohn (playing no favorites, you see)—and an 8- by 10-inch plate-holder on which the appropriate advertising legend was written in chalk—or was it white ink? Attracted plenty of attention, too.

Another non-photographic activity that included photography, nevertheless, was the annual National Sportsmen's Show at the Grand Central Palace, where a candid camera contest was held in connection with the program. That helped, too.

For Large Wall Spaces

LARGE empty spaces in the home can be beautifully utilized for hanging your best photographs by constructing a more or less permanent "salon" wall. Purchase a sufficient length of monk's (or friar's) cloth, which comes 50 inches wide, to cover the area in question. You may, of course, have your "salon" any width or length you desire or your facilities can accommodate. Next purchase some molding of plain design and have it cut and mitred to fit the two long sides and the two short sides of the "salon."

Tack the cloth on to the wall, driving the tacks as close to the edge of the cloth as possible, pulling the cloth taut, this way and that until the cloth is attached to the wall without wrinkles and with the squares in the cloth running vertically and horizontally—not askew. When this has been done to your satisfaction, you are ready to cover up the somewhat unsightly edges with the molding. The molding should be sanded down and then treated to a coating of linseed oil. After it is dry, tack the molding in place. This will cover up the edges of the cloth and dress up the "salon" considerably. The linseed-oil treatment will eventually cause the molding to turn a golden brown, which will give it a more pleasing appearance than some paint colors.

After the "salon" is complete, you have an area of display space of a certain length and a certain depth. Allowing generous spacing above and below as well as between pictures, decide on the hanging arrangement for your pictures, which should, of course, be mounted, preferably on 16- by 20-inch mounts. Drive in picture hooks at the required places and hang your pictures.

An arrangement such as this is probably most suitable in the basement playroom, in the den, the attic, possibly the spare garage—if any—which could very reasonably be turned into a sort of studio, if you felt so inclined. At any rate, it's an idea, and maybe you can add your own notions to bring the scheme nearer to the requirements of your own facilities.

Kalart Contest Winners

PRIZES totaling $250 have been distributed in the Second Annual Kalart Synchro-Sunlight Contest to winners in various parts of the country. The first prize of $100 went to G. A. Curtis, Minneapolis, Minn.; the second of $50 to Francis H. Griswold, First Lieutenant, A. C., Langley Field, Va.; and third of $25 to Forest J. Sorenson, Ames, Iowa. The first two winners are reproduced here.

Announcing that the third annual contest will be inaugurated this summer, the Kalart Company officials comment on the second contest as follows:

"In analyzing synchro-sunlight pictures

First prize—Synchro-Sunlight

Second prize—Synchro-Sunlight

for the second contest it was found that a great advance has been made in the quality of the pictures submitted. Photographers are beginning to learn how to use the synchronized flash in their daylight photography. The majority of photographs covered subjects and scenes related to the immediate family life. Naturally, the most interesting subjects were those of babies, children, and pets. These synchro-sunlight photographs predominated in the contest and there were many fine examples."

The Zeiss Annual Show

MORE pictures are telling stories without benefit of caption or title than ever before, according to the findings of the committee in charge of the Fifth Annual Zeiss Ikon Photographic Exhibition, which opened at the offices of Carl Zeiss, Inc., in New York recently and is now on tour around the country. "It is apparent from a survey of this exhibition," say the committee, "that the present-day photographer, while retaining the qualities of spontaneity and aliveness to human interest which characterized the old 'candid' shots with all their freshness, is now combining these qualities with pictorial and technical excellence. Portraiture is informal, but has the qualities that make for good painting or good graphic art of any type. It is also noteworthy that more pictures tell a story without a caption or title necessary. Like a good cartoon, the essentials of the drama are all there within the confines of the picture."

"Several years ago," the committee continues, "a survey of photographs such as this showed an interest in candid camera shots which tended to take the subject off-guard,

possibly in an embarrassing moment. The photographer was alive to the human interest and the photograph showed spontaneity. The trend then went definitely away from these so-called 'candid' shots toward the pictorial, stressing composition and pictorial excellence even in action shots. Cropping a photograph to bring out the pictorial values became an important part of the work."

This year's exhibition differs from previous ones, in that it is limited to 300 prints, of which 200 are in an Invitation Section and 100 prints, as we have previously noted in this department, are the result of a nation-wide contest.

The selected prints were picked from a total of more than 4000 entries, including photographs both from amateurs and professionals throughout the United States.

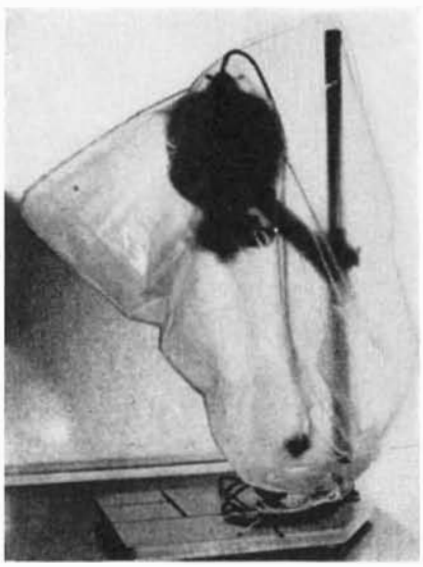
Included in the Invitation Section are prints by Adolf Fassbender, F.R.P.S., M. U. Wallach, Helen Thompson Farrell, Margaret Bourke-White, Dever Timmons, A.R.P.S., F.R.S.A., J. Ghislain Lootens, F.R.P.S., Toni Frissell, Nickolas Muray, Remie Lohse, Harold Harvey, Bob Leavitt, A.R.P.S., Otto John Gaul, A.R.P.S., Vernon Whitman, Carl Mydans and Truman D. Vencill.

51 Movie Cameras

THE motion picture cameras being manufactured, sold, and used both in this country and abroad, now number 51, according to a survey just completed by Besbee Products Corporation, makers of amateur movie accessories. These cameras include 8, 16 and 9.5-mm frame sizes, with electric and clockwork motor drives.

Enlarger Helmets

NO need to stress the importance of keeping dust away from the enlarger, particularly the one employed to project miniature negatives. It is rather difficult, sometimes, to keep the enlarger as free of



Protection from dust

dust as we would like, so it is with something of welcome relief that many workers have seen the advent of the so-called enlarger "helmet," a simple oil-skin pillow-case-like bag, with strings. The bag, or "helmet," is merely pulled over the enlarger and the strings drawn together and tied. One such device is shown in the illustration.

WHAT'S NEW

In Photographic Equipment

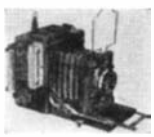
If you are interested in any of the items described below, and cannot find them in our advertising columns or at your photographic dealer, we shall be glad to tell you where you can get them. Please accompany your request by a stamped envelope.

LAFAYETTE NEGATIVE FILE: Size of ordinary book, yet accommodates up to 400 negatives depending on size. Each file equipped with 100 glassine envelopes and two index cards on which numbered spaces provide for entering titles of 400 negatives in correspondingly numbered envelopes. Files available in three sizes: for 35-mm and Bantam film; vest-pocket No. 127 size, and 120, 620, 116, and 616 negatives. Hinged cover equipped with latch and snap fastener.

PILOT SUPER ROLLFILM REFLEX CAMERA (With *f*/4.5 lens, $25; *f*/3.5, $32.50; *f*/2.9, $40): Features built-in visual exposure meter; removable lens, interchanging with 4⅛ inch *f*/4.5 anastigmat lens in focusing mount ($18); an eye-level finder; and metal focal plane type shutter with speeds to 1/200 of a second. Pilot offers choice of two picture sizes, making either 12 pictures 2¼ by 2¼ inches or sixteen 1⅝ by 2¼ inches on 120 film roll. Double exposures prevented by special film winding and locking device.

E. Z. VIEW NEGATIVE FILE (30 cents): For storing and inspecting 35-mm negatives. Has 12 rows of plasticized glassine, folded accordion-fashion, permitting viewing of 144 negatives by transmitted light. Half-moon cut-out on side allows manipulation of film.

MODEL F KALART RANGE FINDER ($24): Designed for use on 3¼ by 4¼ and 4 by 5 Speed Graphic cameras; similar in construction to Model F now being installed on new 2¼ by 3¼ Miniature Speed Graphic cameras at Graflex factory. Model F may be adjusted for use with 10.5 to 30-cm telephoto lenses. "The new Model F," say manufacturers, "will focus down to four feet with a 18-cm lens; whereas all range finders in the past have been limited to a near distance of six feet. This is the first time in photographic history that a range finder has been produced which can accurately focus lenses of these focal lengths down to such close distances." Complete instructions accompany each Model F outfit.



X-ACTO KNIVES ($1 each set; extra blades, 50 cents per set): For retouching negatives and prints; for keen cutting in many arts and crafts. Controlled like pencil point for delicate work. Blades have keen scalpel edge shaped for various specific needs. Blades replaceable. Handles polished aluminum, scientifically balanced, available in two sizes. No. 1 accommodates six small blades; No. 2, six large blades.

SKYVIEW ENLARGER ($65, complete with *f*/4.5 Wollensak lens and lamp): American-made. Takes negatives 2½ by 3½ inches and smaller in universal negative carrier.

Double condenser lens system, using standard enlarging lamps. Lens Wollensak f/4.5, 3½-inch focal length. Micrometer focusing mechanism. Enlargements to 16 by 20 inches on baseboard. Latter of plywood, 18 by 24 inches. Cast aluminum constructions. Heavy, chromium-plated upright column. Complete unit counterbalanced.

HANKSCRAFT AUTOMATIC ELECTRIC TIMER ($10): Controls light time while making enlargements, leaving operator's hands free for print control, developing, and attending to darkroom details. Timer plugged into electrical outlet and turning off focusing switch connects it for dialing. Time dialed like telephone dial. Intermediate seconds below five and above ten are dialed by placing pencil point in small second holes at edge of dial device. Timer finished in black Bakelite; requires no special wires.

RAYGRAM NEGATIVE PROCESSING KIT ($1.50): For fine-grain development of all negatives. Comprises Ray-Del fine-grain negative developer, Ray-Stop hardening short-stop, and Ray-Fix fixing bath, all three in powder form and put up in handy double compartment containers complete with instructions and a time and temperature chart. Ray-Del is non-staining, well-balanced, gives full detail and long scale; has good keeping qualities.

BESBEE PAPER TRIMMING BOARD ($3.50 for 10-inch size): Base made from reputedly unbreakable plastic, Textolite, developed by General Electric. Black base clearly squared with white engraved lines to aid in trimming paper evenly. Material being trimmed held flat by smooth, transparent, celluloid guide. Cutting surfaces held to proper cutting tension by spanner spring against blade. Entire unit light and portable.

LAFAYETTE FOOT SWITCH ($2.95): Intended primarily for use with enlargers, but has other applications as well. Entirely enclosed and protected switch and foot pedal; capable of handling up to 350 watts. Assembly of cast iron finished in gray crackle. Switch is connected to any equipment by simply plugging line cord of equipment into receptacle provided by switch, and in turn plugging line cord of switch into lighting outlet. Switch is on only when pedal is depressed, snapping off instantly when foot is removed.

FEDERAL NO. 636 VARIABLE PROJECTION PRINTER ($29.50; $1 extra west of Mississippi): Fixed-focus enlarger with interchangeable lenses. Always in focus whether used for enlarging, copying, reducing, or microfilming. Interchangeable (anastigmat) mounted lenses of various focal lengths adapt the enlarger to cover any size film up to 2¼ by 3¼ for enlargement up to 5 by 7 inches. Standard equipment anastigmat lens No. 101, which makes 5 by 7-inch prints from full vest pocket (1¾ by 2½ inches) negatives; 3½ by 5 prints from half vest pocket and Bantam size, and 2½ by 3½ prints from double-

Elkay Adjustable Roll-Film Developing Tank ($3, complete with reel): Made of moisture-proof Bakelite. Accommodates all sizes of roll film from 35-mm to 116. Elkay Adjustable Roll Film Split-Second Reel ($1.00) is separately available as "extra" reel for Elkay or other standard roll-film tanks.

SI-MI X-Y Reversal Compound (15 cents per tube): For developing positive color transparencies with the same ease as black and white negatives. Manufacturers assure positive color transparencies may be made with this developer from Dufaycolor—roll, cut and film pack—in 15 minutes. Equipment calls for a developing tank (or trays), a Dufaycolor Developing Kit, and a tube of SI-MI X-Y Reversal Compound.

Speedgun Model A (complete with soft moisture-proof pouch and three batteries, $18, $19): Designed for use with Speed Graphic cameras and all cameras having U front. Change in attaching bracket for tripper is only adjustment necessary to fit gun to other cameras. Model A is newly developed and redesigned Mendelsohn. Battery case of satin finished smooth dural; can be used with either two or three cells. Auxiliary section carrying third cell can be removed when three cells not needed. Bayonet-type catches. No wires in battery case. Case attached to camera by special mounting bracket secured by tapped screws. Gun slides in horizontally, providing support for camera. Special safety switch forms release button. When button is turned to safety position gun cannot be fired accidentally. All connectors molded Bakelite with positive contacts. Speedgun provides for side lighting and auxiliary control by means of built-in socket. Also built in: provisions for taking picture by means of standard cable release, and wired-in-series outlet for focal plane shutter synchronization. Five- or seven-inch reflector furnished is aplanatic, fully adjustable to all bulb sizes. Speedgun Model G-2 ($17.50): For Speed Graphic and Graflex cameras. Speed gun attaches directly to body of camera, fitting over shutter winding knob. All moving parts of synchronizer enclosed in housing approximately 1½ inches square. Mechanism so arranged as to prevent blowing of bulbs as shutter is wound. Provided with calibrated control for different speeds and bulb types, synchronization possible up to 1/1000 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. **Is there a quick method of drying a roll of 6 by 6-cm film so that enlargements may be made as soon as possible after washing of the negatives has been completed?—L. M.**

A. A "warm-breeze" fan will do the trick. Hang up the film strip, remove surplus water carefully from both sides either with a viscose sponge or cotton, and allow the negatives to dry "normally" for several minutes. Then plug in your electric fan and direct the heat toward the film strip, taking the precaution of providing a reasonable distance between fan and negative strip so that drying will be gradual and the heat will reach the strip fairly evenly.

Q. **Do photo chemicals, in general, deteriorate when kept dry and in the container? For example: I have a pound of carbonate I bought six months ago and it is only half gone. Is it likely to harm the quality of either negatives or prints when I use the last of it, say, six months from now? How about developing agents, such as metol and hydrochinon? An ounce lasts me a half year.—A. W.**

A. Provided you observe the precaution of keeping the chemicals absolutely dry, with secure covers and stoppers on cans or bottles, chemicals in the dry state will last a long time. Deterioration, through oxidation, begins really to set in seriously when the dry chemicals are converted into solution.

Q. **I am considering buying a German-make camera. My brother is and will be in Germany for some time and I have thought of sending him money so that he could get the camera there. Could you please tell me what duty I might have to pay if he keeps the camera there and uses it to supplement his own camera and then brings it to me when he comes? Or, as another possibility, what arrangements would have to be made if he were to send it to me direct?—J. B. P.**

A. In either event, it would be necessary for him, when he brings the camera into this country, or for you, if it were shipped to you, to pay a duty of 20 percent on about half the American list price of the camera, or the price paid for the camera abroad, whichever is the higher figure. Were a camera involved in which the lens had a higher value than the camera, a duty of 45 percent would be assessed. In addition, it might be necessary to obtain special permission from the manufacturer's office in this country for the privilege of importing the camera. In general, it is not advisable for individuals to bring cameras into the country. The importer here cannot be expected to feel a responsibility for a camera he had no hand in importing and from which he gained no profit. Therefore, should anything go wrong within the year covered by the guarantee the individual importer of a camera would have no redress from the importer or, as the term is loosely used, the "agent" in this country. In addition, the camera purchased abroad will have the Continental type of tripod bushing requiring the use of a bushing adapter to bring the size down to the American standard. And, of course, the focusing scale will be marked in meters, not in feet.

Q. **I am enclosing a pencil sketch showing the general outline of an enlarger which I am planning to build. I have an anastigmat lens *f*/5.4 salvaged from an old camera, and it is this lens which I propose to use in the enlarger. I would appreciate it if you would briefly describe the essential features and requirements of the enlarger—P. G. H.**

A. Answering your questions in the order indicated by the sketch, a 100-watt lamp of the opal enlarging type will provide a satisfactory light source; the lamp should be located opposite the center of the condensers and mounted on a movable rod to facilitate altering the distance between lamp and condensers. (Your sketch shows one condenser; to utilize the full value of the condenser type of illumination, two must be used.) The illumination should, of course, be sufficient to cover the entire area of the size negative being enlarged. The condensers employed should be seven inches in diameter or a little larger than the diagonal of the 3¼ by 5½-inch negative you are planning to enlarge. The condensers should be mounted convex side toward each other and flat side outward. The negative holder should be

located as closely as possible to the condenser, and should be provided with a mask, with an opening just large enough to accommodate the negative being enlarged. You do not mention the focal length of your lens so we cannot give an accurate reply to your question concerning the distance from the negative to the lens. However, assuming your lens has a focal length of six inches and a two-times enlargement is the smallest you will require, the distance from negative to lens should be nine inches. If the focal length of your lens is slightly greater, allow for a greater extension, perhaps as much as ½ to ¾ of an inch. For greater enlargements than two times, this negative-lens separation will be proportionately shortened as the enlarger bellows is raised. For a six times enlargement, for example, this separation, under the circumstances, will be only 7 inches.

***Q.* I have a 12-inch 8-by-10 rapid rectilinear (*f*/8) lens. Am planning to remove one glass disk (either front or back) to increase the focus to 24 inches, and attach to 2¼ by 2¼-inch camera. Kindly advise me what your opinion is on this subject. Would you rather recommend a telephoto lens, say about 7 or 8-inch focal length?—P. W. T.**

A. While this is rather unorthodox procedure, there is no reason why you should not be able to use the big lens on the small camera. However, you understand, of course, that you will have to provide the lens with a tube so it will be separated by 24 inches from the film plane. Furthermore, since one element of the rapid rectilinear will admit only about one-fourth the illumination of the complete lens, your *f* value will be cut to *f*/16 at full aperture. You may, of course, retain the *f*/8 speed by using a 12-inch tube and employing the complete lens. Concerning the purchase of a telephoto lens of 7 or 8-inch focal length, one of the principal advantages is the likelihood of greater lens speed. Chiefly, the question must be answered by your own needs or desires: what type of work do you wish to do; what distances do you wish to work from; how much of the subject do you wish or need to include on your negative? Other questions will occur as you study the subject more thoroughly.

***Q.* Can you suggest a book which will help me to sell snapshots? I would like to know something definite about selling them. What size print to send in and whether one should sell negatives or just prints. Can you suggest places to send various types of pictures?—H. C.**

A. H. Rossiter Snyder has been putting out booklets on this subject for years and many amateurs owe their camera pin-money successes directly to his advice. The booklets may be seen in practically all photographic bookstores. "Photo Markets", by John P. Lyons, and the "Universal Photo Almanac and Market Guide" contain extensive lists of possible markets for photographs. Among the helpful books on the subject are: "Making Amateur Photography Pay", by E. J. Ezickson, a practical news picture syndicate man; George W. Hesse's "Camera Journalism with the Miniature Camera"; and "Press Photography", by James C. Kinkaid, a working press photographer. Answers to your several questions will be found fully discussed in these books. Generally speaking, for journalistic purposes, 8 by 10-inch glossy prints are required, although 5 by 7-inch prints are also acceptable in most cases. Whether to sell only prints or the negative itself is a matter for individual decision, of course. In some cases, where exclusiveness is desired, as by a picture syndicate, the sale of the negative is taken for granted. Generally, a higher price should be obtained where the negative is sold.

***Q.* A friend of mine recently advised me to purchase a panchromatic monotone viewing filter. He recommended the use of this before each exposure. Will you please tell me just what the good of this is, how it works, and the proper method of using?—F. A. C.**

A. The panchromatic monotone viewing filter, of which a number are now on the market, is employed to indicate to the eye approximately how a scene looks to the "black and white" negative; that is, it is used to interpret color values in monochromatic terms. Generally, the viewing filter is mounted monocle style, with a cord attached. Another type is one which is placed over the lens itself and the subject viewed on the ground glass. Where it is desired to use a color filter in making the actual exposure, the proposed taking filter is added to the viewing filter and the subject viewed through both. In making the exposure only the taking filter is used, of course.

***Q.* For some time I have been interested in preserving printed matter in the form of small negatives, a process commonly referred to as "microfilm." I would like to use a Retina 35-mm camera and some of the cheaper or "positive" film stocks. I have tried several films but in each case got grain which I consider too large for the best results. I would appreciate very much any information that you would be able to give me on this problem.—L. E. W.**

A. A film now being generally employed for the purpose you have in mind is Agfa Reprolith. This is available in 35-mm perforated stock in minimum quantities of 100-foot rolls. A special, extremely high contrast developing formula which must be used is packed with the film.

***Q.* I have in excellent condition my first camera, obtained in 1901, a 3¼ by 4¼ No. 3 Folding Pocket Kodak. Could you tell me what *f* value corresponds to each of the three stops (three round holes in a metal slide)?—W. A. M.**

A. Very likely the *f* values of these stops are *f*/11, *f*/16 and *f*/22. The best way to find out is to calculate the stops for yourself. Learn the focal length of the lens by setting the lens at infinity and measuring the distance from the front of the lens to the plane of the film. Probably you will find this to be 5¼ inches or thereabouts. Now measure the diameter of the largest of the three round holes. Divide this into the focal length and the result is the *f* value of the particular round hole measured. If the hole measures ½ inch in diameter, the stop is approximately *f*/11, the next smaller would then be *f*/16, and the smallest *f*/22.

TELESCOPTICS

A Monthly Department for the Amateur Telescope Maker

Conducted by ALBERT G. INGALLS

GOOD as the reflecting telescope is, likewise inexpensive, its image performance does not equal that of the refractor, though its images are more brilliantly illuminated and it is achromatic. Pondering the reasons for this, Norbert J. Schell, 1019 Third Ave., Beaver Falls, Pa., believed the chief culprit to be diffraction effects from the central obstructions—the diagonal and its supports. This difficulty is eliminated by the Herschelian type of reflector, but then another one is introduced: astigmatism.

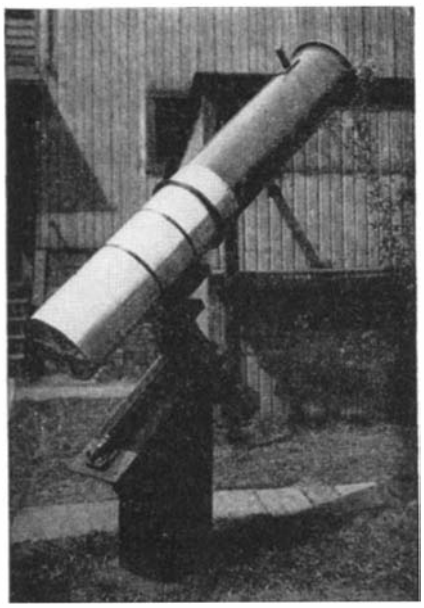


Figure 1: **The off-side reflector**

A hint half hidden on page 614 of "ATMA" suggested to Schell the answer, telling how the late Prof. W. H. Pickering experimented to kill off evil effects of central obstructions in a reflector. Over the outer end of the telescope he placed a diaphragm having a hole of less than half diameter and far off-side, near the edge, so that the light that passed through it entirely escaped the diagonal and spider. Even though the mirror area was thus very greatly reduced, the seeing at once improved and the images appeared like those given by refractors.

Schell repeated this experiment and found Prof. Pickering's words true. The upshot was the design and construction of the off-side telescope shown in Figure 1, in Figure 2, and in principle in Figure 3. At first it looks about like any ordinary Newtonian reflector (except that it looks unusually trim) but—far from it! Study the upper part of Figure 3.

"The method decided upon," he writes, "was to make a mirror of a certain diameter, but give it a figure the same as if it were a section cut out of a larger mirror, and to one side of the center. The image from such a mirror would come to the same point as if the imaginary large mirror were in use, but it would be sufficiently to one side of the section actually used to permit us to view it direct, or else use a flat or even a secondary, without obstructing the path of light to the mirror."

To make this mirror, which would not be paraboloidal but eccentric or lop-sided, "it would be possible," he states, "to grind and polish four mirrors distributed around a center and blocked up with fillers, the whole assembly figured as a paraboloid and then taken apart, but it would be doubtful if the difficulties would be justified, considering the large size of the assembly." For this and other reasons (one, it is suspected, being that there was a more interesting, even if harder, way) it was decided to figure the off-side mirror singly.

"At this time," Schell continues, "I explained the scheme to Mr. T. G. Beede of Youngstown, Ohio, who has had 45 years of experience in producing high-grade surfaces and who has no equal, to my knowledge, in this class of work. Mr. Beede became interested.

"As Figure 3 shows, the 10″ mirror is a section of an imaginary mirror 25″ in diameter and 75″ in focal length—long enough to use at primary focus, yet short enough to apply a future 2:1 secondary to give 15:1 final focus—that of the usual refractor, if this were desired.

"From this point on the entire job is a great credit to the ability and patience of Mr. Beede. The figuring job is not one to be recommended for beginners!" [As H. A. Lower comments, "it is easy to do—on paper—but what a lot of aspirin one would need before he made one on glass!"—*Ed.*]

Well, Beede made the off-side or lop-sided mirror, and the final result was, in Schell's words, "star images that were small planet-like disks, with ring systems surrounding them more nearly of the theoretical kind than we have ever seen in any reflector. Also increased detail on the Moon and planets—for example, colors in Jupiter's bands more pronounced—due to concentration of an estimated 90 percent of the light in the central disk."

The tube used is 13½″ in diameter, with a small flat 5″ inside focus, the image being brought out at right angles to the tube. The mirror is tilted about ½″.

Afterward it turned out that there was already an off-side mirror at Mt. Wilson and two at the McMath-Hulbert Observatory. Schell swears on "ATM" that he did not know any such mirror had ever been made, and, even if several had, Beede figured the peculiar mirror from scratch since he had no instructions not of his own gradual making.

So far so good, but how did he do it? For that is what the reader has no doubt been asking as he read the above. This question we put up to Schell and he came through with all he and Beede had. Here it is:

"While this is written by myself, Mr. Beede has concurred in the figuring description, he and I having gone over the matter the last time I was up to see him." [Youngstown 40 miles N.W. of Beaver Falls, Beaver Falls 30 miles N.W. of Pittsburgh.—*Ed.*]

"The mirror was worked by hand, face up, on a fixed pedestal, throughout grinding, polishing and figuring. No machine work or mechanical controls whatever were used, although a mechanical control was tried first and discarded, as it was found unsatisfactory.

"After bringing the mirror to a true spherical surface, no further movement completely around the pedestal in the ordinary way was possible. The mirror was always placed on the pedestal support in the identical position with relation to the axis line during the figuring, and a mental picture of the condition of the surface guided the application of the figuring tools.

"The figuring tools were pitch-coated in the usual manner. Their size was varied, but they were all sub-diameter tools, the diameters varying from ½ to ¼ of mirror diameter, as needed. No advantage was found in the use of tools of shape other than round, and their edges were not trimmed to a rosette, or similar form.

"Considerable difficulty was encountered in getting a proper understanding of the surface from the appearance under test (Figure 3, bottom), and the effect of the application of the tools in correction. Mr. Beede found it a distinct advantage to use an elaboration of the knife-edge, consisting of two knife-edges facing each other in the form of a narrow perpendicular slit. By this means the cut could be made from either direction, thus reversing the shadows.

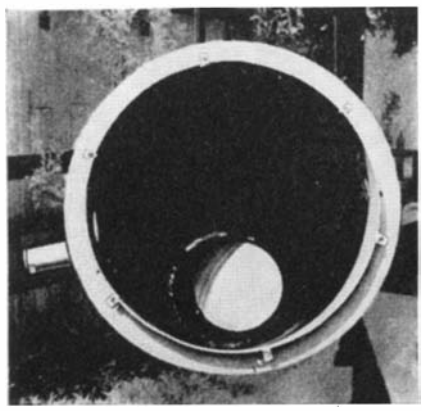


Figure 2: **The non-concentric mirror**

"These mirrors, when placed in this position for testing, while spherical, show marked astigmatism, with the greatest apparent bulge toward the axis, depending on the position of the knife-edge, and the figuring consists of lowering this apparent bulge and bringing the remainder of the surface into collimation. Likewise, when tested with eyepiece, while spherical, the returned pin-hole image (a slit would not be satisfactory here) shows a marked coma, and as the figuring progresses, the coma will shorten accordingly, if proper action is taking place in the figuring; otherwise the distortion of

the image indicates improper polishing action. This type of test and the figuring to correct the surface is not unlike correcting large refractor objectives described many years ago by Alvan Clark where he stressed particularly the local correction necessary to round up such lenses, the local figuring being necessitated by differences in the refracting power of one portion of a piece of glass compared with another portion; and is quite apart from the zonal correction having to do with spherical aberration ordinarily associated with surface conditions or shape of a lens. While we do not have this

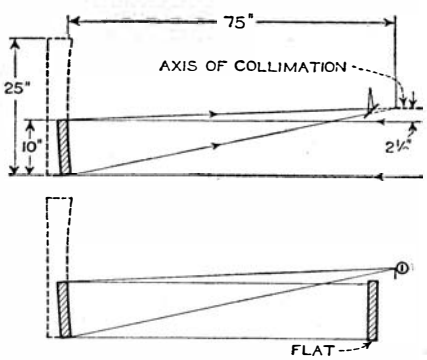


Figure 3: General plan of off-side telescope, and set-up for testing

trouble in mirrors, we have similar work in figuring an off-axis mirror.

"The figuring was found to require strokes following the varying radii, as indicated by the distances from the theoretical axis, great care being necessary literally to coax the surface down without getting too deep. Also it was found that, since the reduction involves undercutting the sphere, it was best to continue this action until the extreme outer edge area (*i.e.*, side away from the axis) blended with the remainder of the surface. In other words, it was better not to attempt a combination action of lengthening the radius of the outer zones and shortening the inner ones.

"As previously stated, extreme care was necessary in orientation of the mirror relative to the axis-line when placing on the testing stand, as this would present an altered aspect, making it difficult to determine the state of correction.

"The final criterion of correction was the quality of the pinhole image as received at the testing position after the three reflections taking place in the set-up.

"The above is the result of experience in working three of these mirrors. The first was finished after running up several blind alleys and getting back out of them again. I feel that an experienced mirror worker will follow this description, but no doubt if he tries it, will use his own methods and get there just the same. So much depends on the individual, and his sense of touch and experience, in this hand work, that to lay down hard and fast rules is impossible. It is easier to do it than to tell how it is done. I think it was Ellison who once said that a man could read all the books on the subject and still might not have the ability to figure a good mirror."

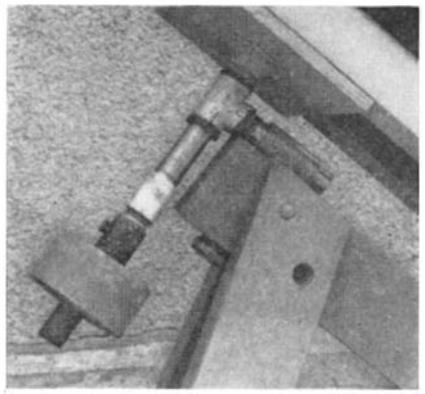
Now that Schell and Beede have presented the working hints, who will undertake lop-sided mirrors? The surface is not an ordinary figure of revolution, and the work is irregular. Perhaps prudence is the better part of valor, if one is really a tyro.

THE BEGINNER'S CORNER

FROM day to day readers who have made telescopes from the instructions in the book "Amateur Telescope Making" kindly send in to this department descriptions and photographs of them and, while lack of space prevents publication of more than a very few, they are all closely studied here under a reading glass, and all details noted. The one shown below struck this department as perhaps being one good solution of the beginner's problem of choosing a type of mounting for his first instrument. It is simple to build, inexpensive, efficient, portable, yet it is neat and trim. This is one of two similar telescopes made by R. M. Watrous, M.D., 2027 Noyes St., Evanston, Ill., and Mrs. Watrous.

Admittedly, this is not the telescope the average person has in mind to make; not elaborate enough. To attain one's dream there are two ways. First, study the literature over and over, make numerous designs, evolve a complete one, build it. Second, study the literature, make a simple design like that below, build it, *use* it for a few weeks or months, and then, in the light of actual experience (which inevitably brings to light numerous factors which no amount of mere study will reveal), design and make a telescope that will satisfy you. Those who choose the first course often say later: "I don't think so well of this design of mine as I thought I would, but I put too much work on it to discard it lightly now." For the preliminary telescope the Watrous type is offered as an excellent solution.

Mrs. Watrous and Watrous telescope



Detail of the simple mounting

The axes are common pipe fittings. First, a T with long nip and pipe-nut is attached to the main leg of the tripod through a hole. This T, also the other T shown, is bored out internally—about a 50-cent machine shop job—to take the two stub shafts. (By another arrangement, sometimes used, the axes turn on the threads already on the fittings, but since pipe fittings have tapered threads, this usually results in annoying looseness.) The lead counterweight is cast around a sleeve of larger pipe which is anchored with a set-screw.

The square tube of the telescope is made of straight ½″ stock, wood, two at each corner, edge nailed (better screwed) and is very rigid. Paint inside black. If near bright lights, enclose the lower 12″ or so.

Make main leg of tripod parallel the Earth's axis.

Vary the details to suit your own taste. Larger pipe fittings are suggested; Dr. Watrous himself mentions that the telescope shakes a little too much in a breeze.

TELESCOPTICS

(*Continued from preceding page*)

FEW amateurs attain the distinction of having the results of their work published in quite so "toney" a purely scientific journal as *The Astrophysical Journal*, but Dr. Otto Struve, Director of Yerkes Observatory and one of its editors, has called to the attention of your scribe in a letter "the recognition which the professional astronomers have given to Mr. H. A. Lower of San Diego by printing his marvelous photographs of the Milky Way. I am extremely enthusiastic," he adds, "about the efforts of the two Lowers, of Mr. Arthur DeVany, and of other pioneers in the construction and use of the Schmidt camera. These men have rendered a real service to astronomy and have produced results of permanent value."

Harold Lower's textual contribution to the journal named (January number) consists of but half a page of very compact descriptive matter written in the scientist's traditional objective style, but the photographic contribution it so concisely describes consists of six full-page photographs in Orion, Cepheus, and elsewhere, taken by his father, Charles A. Lower, in red light with the Lower Schmidt. These are reproduced on fine paper. "I call to your attention," Dr. Struve continues, "the conspicuous little nebula shown on one plate. This nebula is shown only on the red photograph and is absent on the photographs secured with violet light. An inspection of our standard photographs of the Milky Way by Professor Ross, Professor Barnard, and others shows that the object can be barely suspected on some of the best violet exposures, but it seems to have escaped previous detection and is not listed in the NGC or IC. I am mentioning this case only because I think it should serve as an additional stimulus to our amateur astronomers."

Examination of the red-filter plate mentioned, and comparison with the no-filter plate of the same area, reveals a prominent object looking like a tuft of nebular matter on the one where there was nothing on the

other. And so it looks to this department, which, however, lays no claim to knowledge of astronomy (telescope making is mechanics, not astronomy), as though the Lowers had discovered at least some kind of world, even if it is not southern California real estate. Moreover, they have themselves been discovered by the astronomers.

In the same number of *The Astrophysical Journal* there is a 14-page article on the tests of the 82″ mirror recently figured by C. A. R. Lundin, formerly of Alvan Clark and Sons, now of Warner and Swasey, for the McDonald Observatory, its author being Dr. J. S. Plaskett, Director of the Dominion Observatory, Canada. Dr. Plaskett is an expert among astronomers in testing large mirrors, having been called in by numerous institutions to test completed mirrors before their acceptance. The article shows in full detail how such mirrors are put over the jumps; too bad that lack of space prevents reprinting it here, at least at present. Concluding his tests Dr. Plaskett states: "The quality of the mirror proved to be unequalled by any mirror previously made or tested," a completely categorical statement made possible by the fact that the mirror's maximum departure from perfection was nowhere more than seven tenths of one millionth of an inch!

IN *The Astrophysical Journal* for December, 1938, G. A. Mitchell of Pasadena has a five-page illustrated article on "A Simplified Spectrohelioscope," describing the construction of a rotating-disk type of instrument. Readers of the Hale chapters on the spectrohelioscope in "ATM," will fully understand the significance. The design is such that all the mechanical work except one piece can be done with a breast drill, file, and a few taps. Mitchell is an amateur telescope maker whose vocation is the manufacture of the Mitchell Motion Picture Camera, standard camera in the Hollywood studios.

MOST normally constituted scientists enjoy reading scientific fiction of the H. G. Wells type, provided it is original and really clever. Hearing that Harold A. Lower had contributed to the January number of *Astounding Science-Fiction*, your scribe visited the newsstand and picked up a copy to see how good the yarn would be. Disappointment! For the "yarn" turned out to be a straight descriptive article on stellar photography with Schmidts and other fast astronomical cameras, and at that, a pretty stiff, technical one—and not astounding.

IN *The Journal of the Royal Astronomical Society of Canada*, H. Boyd Brydon, of Victoria, B. C., recently published four articles on the design of small observatories, giving many detailed drawings of several types. These articles in separate form as a circular are now available for two bits, from the society named, at 198 College St., Toronto, Ont., Canada. Incidentally, Brydon has also published an article on "Two Inexpensive Drives for Small Telescopes," in the January number of the same journal, this also being two bits.

THE Amateur Astronomical Association of Des Moines is the name of a new organization of which C. O. Davis, Des Moines, Iowa (no local address furnished), is the secretary.

CURRENT BULLETIN BRIEFS

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

THE NOBEL PRIZES, by Fritz Henriksson, is a 60-page booklet which tells the inside story of these well-known awards. It quotes Alfred Nobel's will and tells just how the Nobel Foundation is set up to carry forth the work of awarding prizes in broad fields of endeavor. A list of prize-winners is given and the book concludes with a compact historical survey of the Nobel family. Illustrated. *American-Swedish News Exchange, Inc., 630 Fifth Avenue, New York City.—One dollar.*

PRACTICAL SPEEDS OF FILMS AND PLATES AND EXPOSURE METER MANUAL, by Joseph M. Bing, F.R.P.S., goes a long way toward solving the exposure problem, which is undoubtedly the photographer's greatest stumbling block to success. It gives information on exposure meters and their use as well as a clear explanation of the various film-speed rating systems. A supplement gives a complete listing of practically all film emulsions on the market, together with their speed ratings. *Photo Utilities, Inc., 10 West 33rd Street, New York City.—25 cents.*

TECHNICAL DEVELOPMENT AND ITS EFFECT ON AIR TRANSPORTATION, by Edward Pearson Warner, is a James Jackson Cabot Professorship lecture which is essentially a straightforward history of the progress that has been made in aircraft design from 1914 to date. A carefully worked-out comparison of figures presents a statistical record of the rate and nature of the progress that has been made toward the production of an airplane that will be able to give close competition in economic terms to surface transportation. *Norwich University, Northfield, Vermont.—50 cents.*

SUMMER COOLING IN THE WARM-AIR-HEATING-RESEARCH-RESIDENCE WITH COLD WATER is a 92-page technical report of research undertaken to determine to what extent water from city water mains can be used in house cooling. Results appear to warrant further investigation. *University of Illinois Engineering Experiment Station, Urbana, Ill.—90 cents.*

HANDEE TOOL OF 1001 USES is a 64-page, thoroughly illustrated booklet which deals with various types of Handee power tools and their uses in the shop and home. Dozens of photographic illustrations supplement the text. *Chicago Wheel & Manufacturing Company, 1101 West Monroe Street, Chicago, Illinois.—Gratis.*

ARC WELDING ELECTRODES AND ACCESSORIES is a 34-page catalogue that deals with procedures for producing all types of welds in mild steel, for welding all metals used to any extent industrially, and for applying surfacing metal to meet any type of wear-action in service. The details cover, among other things, recommended current ranges and arc voltages; arc length; polarity of welding current; and so on. Properties of welds produced in various metals are given and typical welding applications are illustrated. Request Bulletin 410-A. *The Lincoln Electric Company, Cleveland, Ohio.—Gratis.*

SELECTING YOUR MINIATURE CAMERA FILM is a 52-page booklet which describes in detail six different types of 35-mm film. Included is practical information on film speeds, color sensitivity, grain sizes, and so on. *Agfa Ansco Corporation, Binghamton, New York.—Gratis.*

A GUIDE FOR RETAIL ADVERTISING AND SELLING is an 88-page book which gives definitions, recommendations, standards, and so on, covering the advertising and sale of jewelry, fabrics, furniture, radios, rugs, and many other commodities. It is of particular value to anyone who handles advertising, whether on the purchasing or the publication end. *National Better Business Bureau, Inc., 405 Lexington Avenue, New York City.—$1.00.*

NORTON ABRASIVES FOR THE LAPIDARY is a 24-page illustrated booklet which not only describes and illustrates the equipment used in gem working but also tells how it is used and what types are best fitted for specific purposes. *Norton Company, Worcester, Massachusetts.—Gratis, as long as limited supply lasts.*

MODERN SHOP EQUIPMENT, General Catalog No. 39, is a 70-page catalogue which presents complete information on a high-grade line of lathes, shapers, drill presses, and other shop equipment. Many of the photographs show how the equipment described is used in actual practice. *Atlas Press Company, Department 7, Kalamazoo, Michigan.—Gratis.*

DUFAYCOLOR MANUAL contains information and technical advice on the subject of color photography. It is designed particularly for the advanced amateur and the professional photographer.—*Dufaycolor, Inc., 30 Rockefeller Plaza, New York City.—25 cents.*

THE G-E SPIRAKORE TRANSFORMER describes in complete detail the newly developed electric transformer which was the subject of a feature article appearing on page 157 of the March issue of Scientific American. The pamphlet is lavishly illustrated with drawings and photographs which tell the whole story. Request publication GES-2038. *General Electric Company, Schenectady, New York.—Gratis.*

MOLDED COLOR is a spiral bound, 24-page, pocket-size booklet which tells of the development of a molding plastic which is now available in a variety of colors for industrial applications of numerous types. *Plaskon Company, Inc., 2112 Sylvan Avenue, Toledo, Ohio.—Gratis.*

DEEP WELL PUMPING PLANTS is a 24-page technical analysis of the fuel consumption of deep well pumping plants. Data given will be of particular value to engineers who encounter problems in similar work. *Kansas State Board of Agriculture, Topeka, Kansas.—Gratis.*

LEGAL HIGH-LIGHTS

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

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

Liberty

TEETOTALERS to the contrary notwithstanding, ginger ale and beer are goods of the same descriptive properties, according to a recent decision of the Court of Customs and Patent Appeals.

In the case in question a brewer filed a petition to cancel the trade mark of a ginger ale manufacturer consisting of a representation of the Statue of Liberty. The brewer had adopted and used on beer, prior to any use by the ginger-ale manufacturer, a trade mark consisting of a representation of the Statue of Liberty together with the word "Liberty." The Court found that the trade marks were deceptively similar to each other, and that beer and ginger ale were goods of the same descriptive properties and accordingly held that the trade mark of the ginger ale manufacturer should be cancelled.

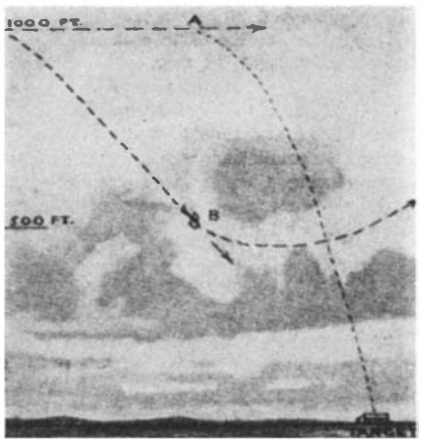
Paddy's Market

PADDY'S Market was the colloquial name for an open-air market of peddlers and retail vendors doing business on one of the public streets in New York City. With the inevitable march of progress the market was forced to move from one location to another and finally was not permitted to do business on the public streets. The peddlers and vendors had formed an association under the name "Paddy's Market Produce Dealers and Merchants Association, Inc." and when the market was no longer permitted to do business on the public streets the Association rented premises near its former outdoor location and the Association in turn subleased space to its members. Thereafter several individuals engaged in business under the name of "The Original Paddy's Market" and the Association filed suit against the individuals to restrain them from using the name on the grounds that it amounted to unfair competition. On motion of the Association, an injunction was granted against the individuals restraining them from using the name "The Original Paddy's Market."

Pride vs. Modesty

PROUD though we may be, our natural modesty places a certain restraint upon our announcement that once again Scientific American was one of the determining factors in a suit for patent infringement and as a result was instrumental in saving the United States Government from paying profits or damages in a suit for patent infringement.

A suit for infringement of a patent relating to aerial bombing was brought in the Court of Claims against the United States Government. The patent in suit related to a method of dropping bombs whereby the aircraft was pointed downwardly in a generally vertical direction and the bomb was dropped while the aircraft was in this position, thereby reducing to a minimum the horizontal moment which is ordinarily imparted to a bomb by an aircraft flying in a horizontal direction. It will be appreciated that in aiming bombs many different factors must be taken into consideration, one of which is the velocity of the plane when the plane is flying in a substantially horizontal direction. It was contended in behalf of the patentee that he had eliminated



"Fig. 7.—Making a dive toward the target. Leaving out wind-pressure, *A* would be the airman's point of release to hit the target while going 40 miles an hour. If, as shown also, he preferred to nose-dive to half-altitude, *B* would be his effective point for letting go his bomb." Quoted from *Scientific American Supplement*, April 22, 1916

the factor of horizontal plane velocity, or had, at least, reduced it to a minimum.

On behalf of the government it was contended that the method of bombing described in the patent had been described and published many years prior to the date of filing the application for the patent and in support of this contention a copy of the *Scientific American Supplement* of April 22, 1916 was introduced in evidence. The *Scientific American Supplement* contained an article entitled "Scientific Bomb Dropping" which, among other things, stated: "If the aviator dives (Fig. 7) toward his target, accuracy of aim becomes easier, and effective work can be done without scientific instruments; but risk from hostile fire becomes greater." Fig. 7 of the article referred to in the quotation is reproduced on this page together with the descriptive explanation thereof which appeared in the *Scientific American Supplement* in 1916. It will be noted that this figure shows both the method of releasing bombs while a plane is flying in a horizontal direction and while a plane is diving downwardly.

In view of this article and other publications referred to by the Court the invention described in the patent was held to be old and the patent was declared invalid.

Imported Perfumes

THE Circuit Court of Appeals for the Second Circuit recently rendered an opinion which will be far-reaching in regulating the practices of the perfume industry.

Perfume consists of a compound or concentrate including essential oils, flower essences, and animal matter or chemicals, which are blended together in varying proportions in accordance with the formula of various perfumers. This perfume compound is a somewhat oily, heavy liquid which, while used occasionally commercially, is not saleable to the public until it has been diluted with alcohol. When the perfume is applied the alcohol evaporates and leaves the perfume compound or concentrate in minute quantities.

It has been the custom of leading perfumers to import the compound or concentrate into the United States and to dilute it with alcohol here. Perfumers adopted this practice because the concentrate or compound may be imported considerably cheaper and the savings in customs duties are substantial. This product has been sold quite generally as an imported perfume or merely with the name of the perfumer and the words "Paris, France" or "Paris and New York."

The Federal Trade Commission has issued a number of complaints against leading perfumers charging that this practice constitutes misbranding under the Federal Trade Commission Act.

One importer appealed to the Circuit Court of Appeals from an order of the Federal Trade Commission directing that it discontinue marketing perfume so prepared as imported perfume. It was argued that the alcohol was merely a carrying agent and dilutant and that it had no effect on the finished product, that the essential portion of the perfume—namely, the perfume compound—was what the public was interested in, and since this was imported the perfume could properly be sold as an imported product.

The Court of Appeals held that the concentrated compound was not what the purchasing public normally understood as perfume, and that the addition of the alcohol (which constitutes from 80 to 95 percent of the finished product) was a manufacturing step necessary in order to sell the perfume to the public.

As a result of this decision it will be necessary for manufacturers who add alcohol or other diluting agent in the United States, to place a statement upon the containers in which the perfume is sold, to the effect that the perfume concentrate or compound was diluted with alcohol in the United States.

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For MEN

who want to become independent in the NEXT TEN YEARS

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

The man across the table will laugh.

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

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

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

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

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

"I've got what I wanted."

And the other will answer:

"I wish I had those years back."

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

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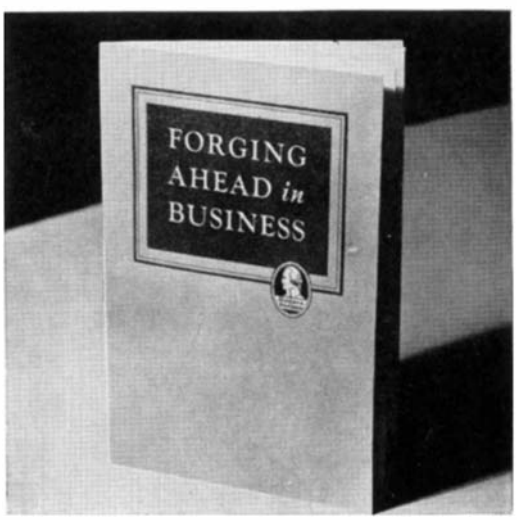

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