# THE BIG NEW TELESCOPE: Its Builder Explains It

# SCIENTIFIC AMERICAN

November · 1936

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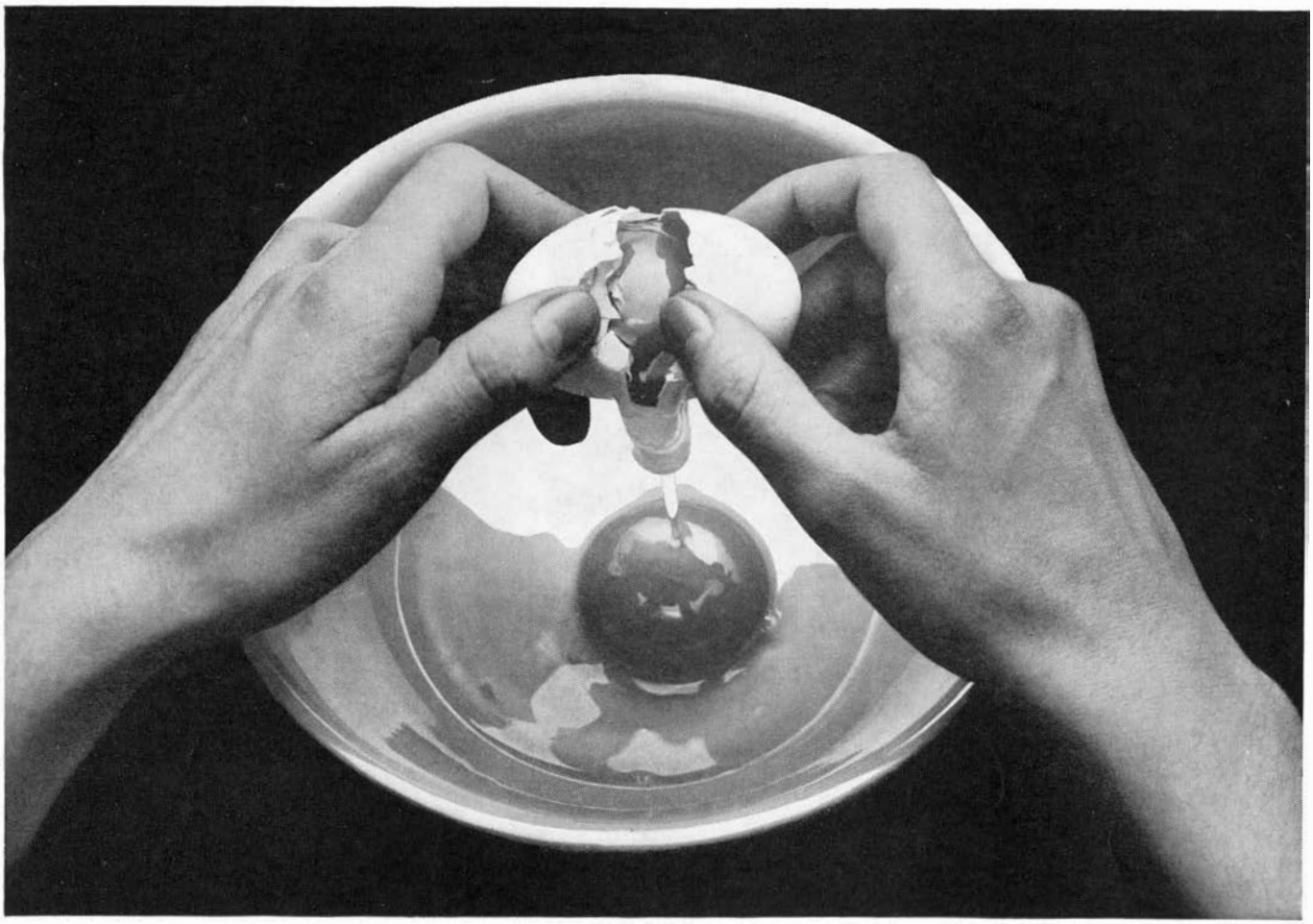

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# SCIENTIFIC AMERICAN

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NINETY-SECOND YEAR • ORSON D. MUNN, Editor


## CONTENTS · NOVEMBER · 1936



**THE newspapers have made the public familiar with the great disk of Pyrex glass cast at Corning, New York, and transported to California, there to be slowly converted by grinding and polishing into the huge 200-inch "eye" of a telescope far larger than any now in existence. On the cover is shown the great dome under which the telescope will be housed—its height will be 135 feet. In the drawing, Russell W. Porter has indicated an airplane landing in front of the dome, where there will be a landing field. Some of the astronomers will "commute" to this observatory by airplane.**


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# 50 YEARS AGO IN . . .

## SCIENTIFIC AMERICAN

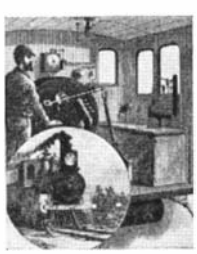
*(Condensed From Issues of November, 1886)*

DRINKING—"Science may be carried into everything. The science of drinking has been known and practiced in Europe for ages, and this is a science, simple as it may appear, when compared with the blind, irrational, and suicidal manner of drinking in the United States. This science consists simply in the tardiness of drinking. All drinks are taken sip by sip, a half or three quarters of an hour being consumed for a glass of beer. . . . By slow drinking the German accomplishes the object of drinking, and gives his animal economy a chance to say, 'Hold, enough!' which only slow drinking will do. . . ."

VENTILATION—"The fundamental conditions that are necessary in order to have a healthy habitation may be summed up as follows: (1) that of having fresh air to breathe amid walls and furniture kept at a proper temperature; (2) that of receiving the full light of the sun, and of having the objects about ourselves amply lighted; and (3) that of having no dejections remain in the house."

BESSEMER CONVERTERS—"At a recent meeting of the Iron and Steel Institute, London, Mr. James P. Witherow, of Pittsburgh, whose converter had been described by Mr. Hardisty, said that in America, within the past two years, considerable headway had been made in the development of the Bessemer process with the fixed or stationary type of converter."

AUTOMATIC TRAIN STOP—"The purpose of this attachment is to prevent accidents and collisions by a more effective safeguard than has heretofore been devised. . . . Attached to one side of the cow-catcher of the locomotive is a three-way cock, the lever for operating which projects at one side, so that an obstruction placed alongside of the track will operate the cock as the locomotive moves past. The movement of this cock . . . applies the brakes . . . operates the throttle valve . . . opens the sand valve for sanding the track . . . rings a gong bell placed within the cab and . . . opens the valve of the steam engine."

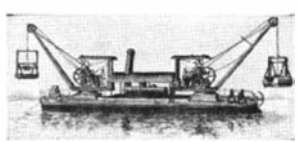


PREHEATING—"The steamship Bleville, of Havre, recently built and engined by Messrs. Alex. Stephen & Sons, of Linthouse, is a steel screw steamer, 300 ft, long, and is fitted with triple expansion engines of 210 N. H. P. The principal novelty is in the design of the boilers. In the uptake of these . . . tubes are so arranged that the water, before it enters the high temperature boiler, is heated by the gases from the fires, which would otherwise be lost."

PETROLEUM ENGINE—"To produce a small engine that can be operated by the combustion of petroleum is a problem that has received the attention of quite a number of our best inventors." In one of the latest engines, "the petroleum is stored in a tank containing one to two days' supply, as the case may be. A small pressure of air is put into this tank and the petroleum is forced out of it into a vessel in a vaporized condition, from which it is then drawn into the cylinder by the outstroke of the piston; and having been compressed on the instroke, the charge is ignited by means of a small electric spark."

STEEL PIPE—"It is reported by the Berlin *Eisenzeitung* that the new process for making steel pipes employed at Burbach is very successful. . . . As soon as the steel is cast into the round mould, a core is thrust into the steel, so that a tube is formed between it and the walls of the mould. In order to prevent cracking of this annular casting during cooling, the core is so made that it follows up the shrinkage of the steel. The steel cup thus obtained may then be rolled in an ordinary train."

DOUBLE DREDGER—"The engraving represents one of Priestman Brothers' double self-contained dredgers, and is taken from a photograph, in South American waters. The dredger is somewhat novel in its construction, being the first of the kind which has been made. A large steam hopper dredger has been fitted with four of Priestman's machines, made to the order of the Mersey Docks Board, and can be seen working in Liverpool or Birkenhead docks; but this particular dredger, although suitable for all kinds of dock and harbor work, was specially designed for exportation. It forms part of an order for the Brazilian Government for carrying out harbor improvements in the port of Maranham."



CRATER LAKE—"Captain C. E. Dutton, of the U. S. Geological Survey, has been recently engaged in making a study of Crater Lake, in Oregon, and the latest advices received from him show that he has discovered probably the deepest body of fresh water in the country."

WHITE PAPER—"Many believe the eyesight is impaired by the use of white instead of colored, or at least tinted, paper, and at times the subject comes up for discussion. So far as we have seen, no positive evidence has yet been secured to prove the injurious effect of white paper on the eyes, and some recent inquiries lead us to doubt if such evidence is to be had."

TORPEDO CANNON BALL—"The *Avenir Militaire* gives us some particulars concerning a torpedo cannon ball invented by Captain Coudray, of the navy. . . . The torpedo cannon ball . . . travels at the rate of 300 meters a second, and instead of rebounding on striking a ship, glides along its side, and never loses contact until it explodes. The last cannon balls constructed contain a charge of 40 pounds of guncotton, although 25 pounds is said to be sufficient to blow up the biggest vessel. It is stated that these projectiles can be fired to a much greater distance than the Whitehead."

THE NEW NORTH—"The country north of us is not all Arctic. Those who know best, hardly realize how vast is the new domain of arable land which has just been opened by the completion of the Canadian Pacific Railroad, and how much more remains yet to enter. A new north, vast in resources of all kinds, stands ready for occupation."

PAPER CLOTH—"The Japanese Government paper mill is manufacturing pocket handkerchiefs and clothing of paper pulp containing a mixture of linen threads."

# *Personalities in Industry*

DAVID SARNOFF

"IMPRESSIVE as the past and present of radio may be," says David Sarnoff. "those of us in close touch with its developments are infinitely more inspired with the prospects of its future."

The sentence is typical of the man who, at 45, head of the Radio Corporation of America, has already crowded several lifetimes of achievement into a single youthful career. Unlike the Alexander who mourned because there were no more worlds to conquer, Sarnoff envisages the day when radio's services of sight will parallel those of sound, and when every new-born babe may receive a life-assignment of an individual billion-cycle radio frequency.

These are not poetic fancies. They are the considered, well-informed opinion of an intensely practical man, one who has known poverty, hardship, and struggle, and has risen to direct the destinies of 25,000 employees and a world-wide enterprise.

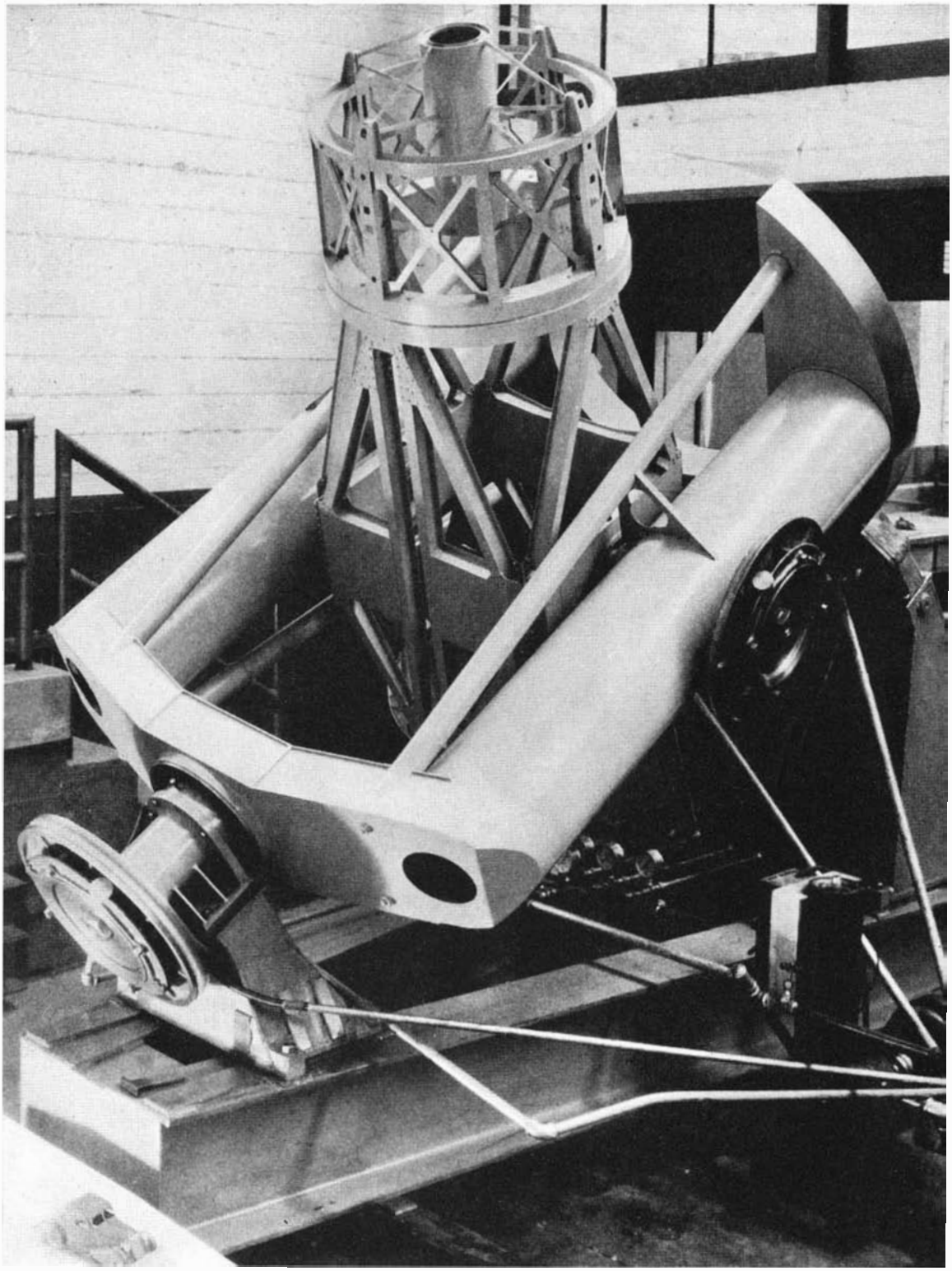
That "America, the land of opportunity" is no idle phrase is perhaps better proved by the career of David Sarnoff than by that of any other living man. Born in Russia in 1891, the eldest of five children, he was brought by his parents to the United States at the age of nine. At fifteen the death of his father necessitated his going to work. He got a five-dollar-a-week job as messenger boy with the Commercial Cable Company, and supplemented his earnings with a newspaper route. He bought a telegraph instrument, learned the Morse code, and on September 30, 1906, fascinated by the new-fangled wireless idea, entered the employ of the Marconi Wireless Telegraph Company of America as an office boy. The fascination did not wear off. He bought technical books, spent his week-ends in the experimental shop of the Marconi Company, and later took a night course in electrical engineering at Pratt Institute, Brooklyn.

Sarnoff soon became a full-fledged wireless operator, and in five years gained expertness and a practical store of technical knowledge in various posts, ashore and on shipboard. When the *Titanic* sank in 1912, Sarnoff stayed at his key in the Wanamaker station in New York for 72 consecutive hours, helping direct the ships that succeeded in rescuing a third of those on board, and obtaining names of the rescued.

The loss of the *Titanic* and the aid rendered by radio aroused public consciousness to the importance of this new service. Congress passed a new law making much stricter the requirements regarding equipment and operators on seagoing vessels. Sarnoff became successively: Chief Inspector, Assistant Chief Engineer, Assistant Traffic Manager, and, in 1917, Commercial Manager of the Marconi Company. In 1919, when the Radio Corporation of America was formed, it acquired the American Marconi Company and appointed Sarnoff Commercial Manager. He progressed steadily from Commercial Manager to General Manager, Vice-President, Executive Vice-President, and finally, in 1930, at the age of 39, to President of RCA.

Sarnoff's favorite hobby is good music; his favorite vice, a good cigar. He is a director and member of the executive committee of the Metropolitan Opera, to mention only one of a dozen or more affiliations with important scientific or civic bodies. A Colonel in the Signal Corps Reserve of the United States Army, he is keenly aware of the military and naval implications attached to every fresh advance in the radio art.

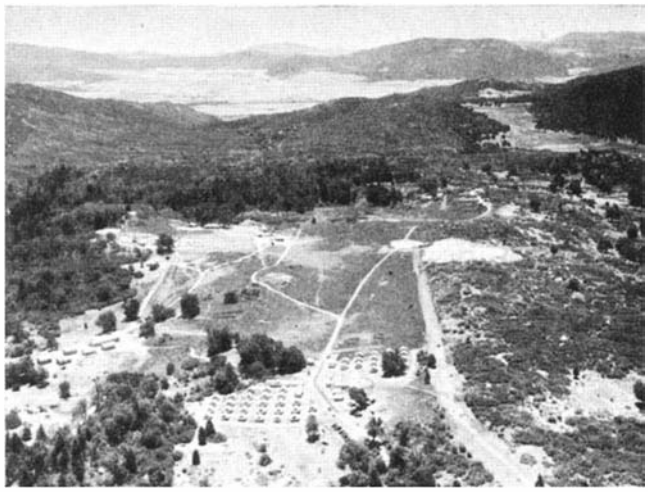
That the next conspicuous advance is to be the introduction of television on a commercial scale seems probable. Sarnoff has brooded over this troublesome infant through many years of laboratory development. In 1935 he obtained from his directors a million-dollar appropriation to take television out of the laboratory and give it the benefit of exhaustive engineering field tests under actual service conditions. Television is now moving slowly but surely through this phase of its progress toward its waiting public. Once it has arrived, the imaginative David Sarnoff can check off another dream come true.



## HOW THE BIG 200-INCH TELESCOPE WILL LOOK

BEFORE building the 200-inch telescope a "tenth scale model" has been constructed, and even this is a fairly large telescope—compare with the stair-railing in the background. But the toy car in the lower corner gives the scale of the future 200-inch telescope. The part designated in the article as the "yoke" is the large, U-shaped, sloping piece, and it rotates on its axis to counteract the earth's rotation. On the inner faces of the yoke are bearings on which the big tube (55 feet long in the 200-inch telescope) dips in declination. The pipes are for pumped oil. On the large telescope these will, of course, be hidden.

Scenery surrounding Mt. Palomar, where the great new observatory is being built. View looking in a southerly direction, showing the road which is being constructed up to the plateau—which is at 6125 feet above sea level



Looking in a northerly direction from the observatory site, which shows in the foreground. The dome for the 200-inch telescope will be in the small light-colored patch toward the right. Road makers' camp in foreground

# As the 200-Inch Telescope Develops

## Promise of an Instrument Better than the Dreams of the Astronomers . . . Construction Under Way . . . To be Finished in Four Years . . . 1,000,000 Pounds

By C. S. McDOWELL, Captain, U. S. Navy

*Drawings by Russell W. Porter*

As one stands today at the observatory site on Palomar Mountain there unrolls a vast, rugged, beautiful country—lesser peaks blanketed with tall, stately pines and oaks, gorges sharply threading their way between precipitous hills. On the gently rolling summit of this mountain, men are at work pouring concrete for the piers of the 135-foot diameter dome building and for the sub-base of the 200-inch telescope.

The readers of Scientific American have already had the general story of the 200-inch telescope in Dr. Hale's article in the May 1936 number. That article gave a history of the conception of this project and indicated some of the problems which had to be solved in bringing the new telescope to completion. We, who are working on this project, hope to make this telescope a true monument to the vision of Dr. George Ellery Hale, and the generosity of the Rockefeller Foundation. In his article, Dr. Hale states, "How to design an observatory, whether large or small, is a many-sided problem" and possibly I was chosen as Supervising Engineer on this project because the Observatory Council had an idea that Naval Officers are trained and experienced to handle, during the period of their careers, many varied and unique problems.*

We have been fortunate in receiving whole-hearted cooperation from a vast number of engineers and scientists scattered throughout the nation. This cooperation reminds me of that which was obtained during 1917-1918 on many war problems. Such assistance is very necessary in order that we may make the telescope and the observatory the best that science and engineering of today can produce. Taking the astronomical specifications which represent what the astronomers would like to have, and applying what has been developed in kindred fields, we find that we have promise of an instrument even better than the astronomers' fondest dreams. It is hoped that, 50 years hence, this instrument will still be considered modern, and that it will, to a certain extent, be an achievement of which all scientists and engineers of this decade, 1930-1940. may well be proud.

When the 200-inch telescope is finally completed and it begins its task of exploration, it will doubtless reveal new facts about which, at present, we have no clue. Beside these unknowns, however, at least three branches of astronomy will have immediately available new knowledge about the universe in which we live. First, the astronomical horizon will be pushed out. The volume of space whose contents can be studied will be approximately eight times larger than at present. Second, due to the great light-gathering power of this instrument, it will be possible to make large-scale spectra of the brighter stars and increase our knowledge of their atmospheres. Third, much new material will become available about our neighbors in our own solar system, namely, the planets and asteroids.

One of the first undertakings, after obtaining necessary funds for this project,

*The author has specialized in naval engineering and research problems, including the control of naval guns, and was "lent" by the United States Navy for this project.—*Editor.*

**The observatory site, looking about north-east. In the foreground are holes for footings for the steel columns for the dome. In the middle is a potential landing field (see front cover). Center background: power house and water tanks. Water is pumped from the canyon beyond, 500 feet lower. Right background: Officials' residences (near trees) and temporary workmen's camps**

was the investigation of various locations to determine the site for the new observatory. About five years were spent in the study of possible sites throughout southern California and Arizona, with parties under the direction of Dr. J. A. Anderson, in the field, taking data to determine the average "seeing" obtained at different places, as well as tabulating meteorological data. "Seeing" to an astronomer is a most important factor. If the "seeing" is good, the image of a star is of small diameter and free from local movement, but if there is turbulence in the upper air, the "seeing" becomes bad and the image may become so large and so variable in its position that no satisfactory observation can be made.

Other factors entered into the selection of a site, such as availability of water for the construction purposes and also for use at the observatory when complete and in operation, and it was necessary to have a site which could be reached by a road constructed with easy grades and large radius curves to permit the transportation of the tube and mounting and the various other heavy parts which would be needed for the dome itself.

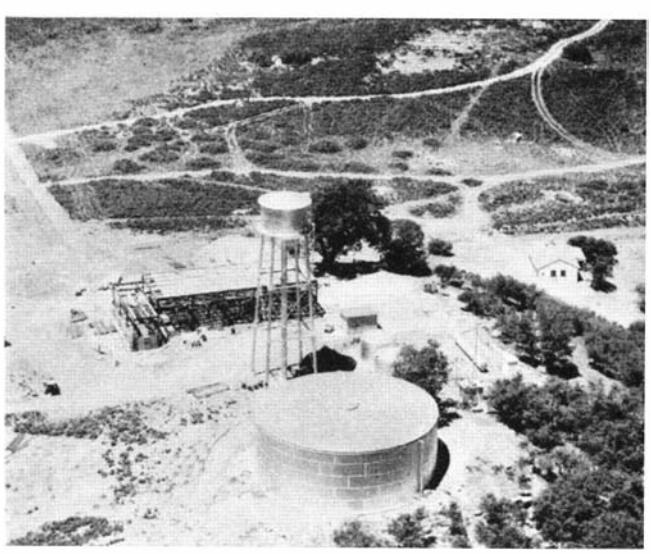
In order to have a suitable location which would be satisfactory now, as well as in the future, the site had to be remote from any probable development of urban population, and free from sky lights from such settlements.

All locations studied were eliminated with the exception of three or four, among which was a site on Palomar Mountain in San Diego County, situated about 90 miles from Pasadena by air line, and about 45 miles from San Diego by air line. This general location was studied by Prof. Hussey some 30 years ago, and covered in his survey report to the Carnegie Institution on "seeing" conditions in various localities. This report was the basis for locating the Mount Wilson Observatory. Prof. Hussey was apparently very favorably impressed with Palomar Mountain but he considered that it was too isolated to be satisfactory for use at that time.

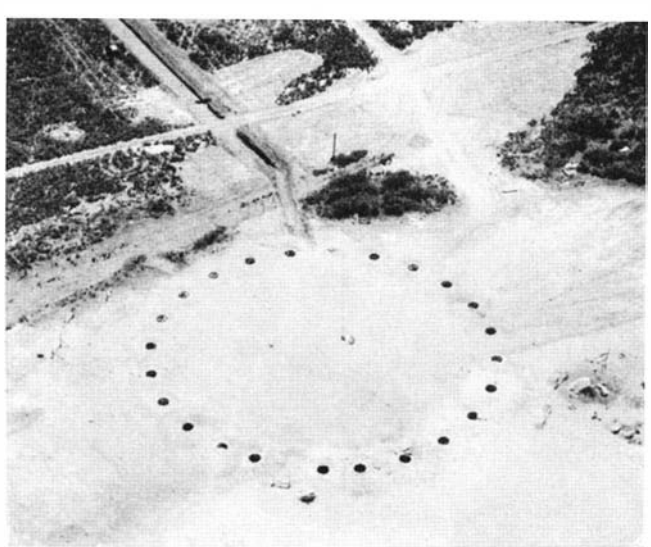
PALOMAR MOUNTAIN was finally chosen after the County of San Diego had volunteered to construct a new and satisfactory high gear road to the site, and it was found that satisfactory arrangements could be made to obtain necessary land. The air photographs, several of which are shown, give a rather good picture of the site as it is today, with construction of some of the buildings for the observatory under way.

The essential mechanical parts of every telescope are the tube carrying the entire optical system, the declination axis carrying the tube, and the mounting supporting the tube, by means of this axis.

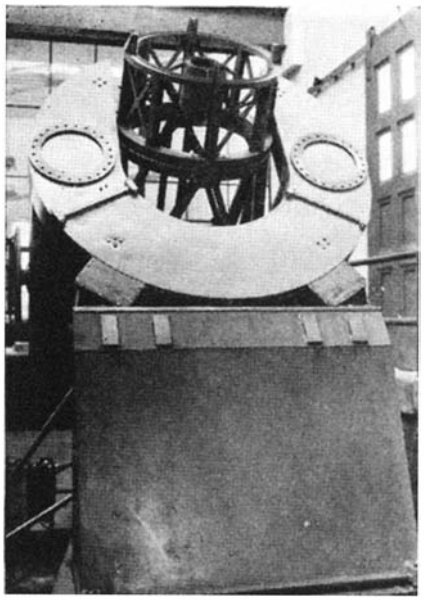
The 200-inch telescope is of the commonly employed equatorial type. This type of telescope permits observing at virtually any point of the heavens, by rotating the tube of the telescope about two axes: rotation of the mounting carrying the tube about the polar axis from east to west, called the right ascension, and the rotation of the tube on its decli-



**A close-up of the power house under construction, also 50,000-gallon pressure tank and 1,000,000-gallon tank**



**A close-up view of the beginning construction on the foundation for the great observatory dome: the footings**



**North end of the "tenth scale" model of the 200-inch telescope. Diameter of tube showing within the split ring bearing, 4.6 feet; but the 200-inch telescope will be 1000 times as bulky as the model. Note pier, two oil pads, and the horse-shoe which affords a broad bearing for the heavy instrument**

nation axis from north to south. After the setting on the star is completed, the instrument follows the star; that is, it continues to rotate in right ascension about its polar axis, being driven by a sidereal clock.

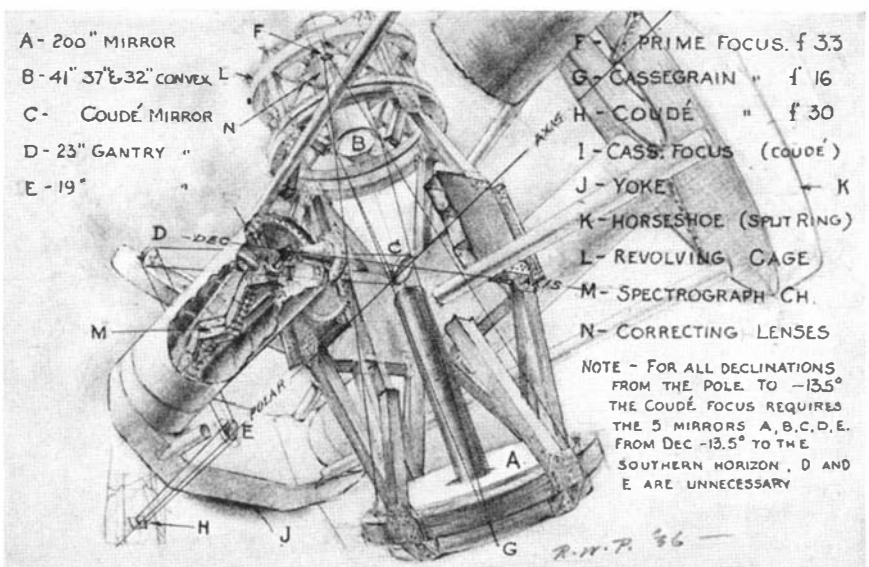
The mounting, or yoke, of the 200-inch telescope represents its polar axis. It is supported on bearings placed on two piers and points north and south at an angle of 33° 21′ with the horizon. This angle corresponds to the latitude of Palomar Mountain, and the polar axis is, therefore, parallel to the axis of rotation of the earth.

The yoke consists of two 10-foot 6-inch diameter tubular girders, spaced at 35-foot center distance, tied together at the south end by a crossbeam carrying the south bearing, and at the north end by a very stiff girder four feet wide, shaped as a horseshoe in order to permit the tube to be pointed as low as the North Pole of the heavens. The overall length of the yoke is 60 feet 6 inches and its total weight is approximately 600,000 pounds.

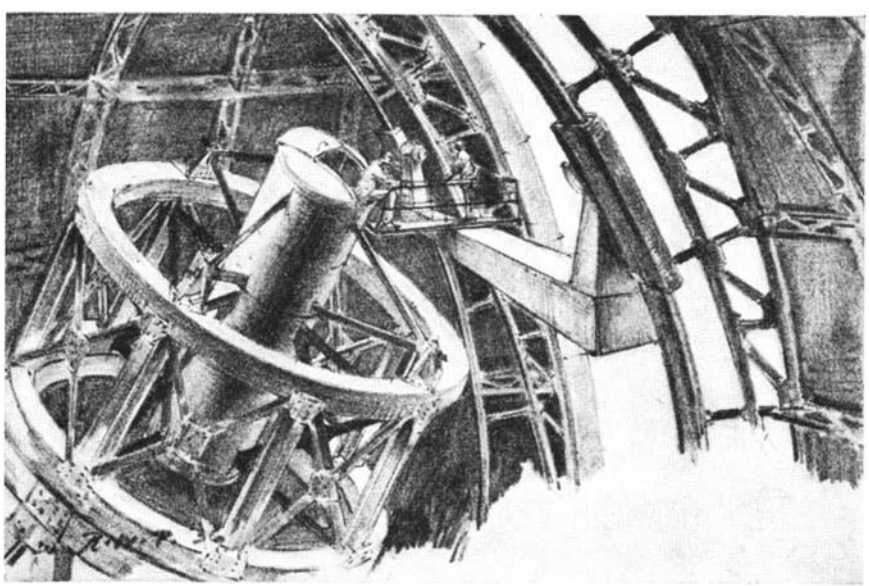
The entire yoke is built of welded steel sections, in order to permit shipping and handling during assembly. Individual sections of the yoke, the heaviest being about 60 tons, are bolted together. After welding, the sections will be thoroughly annealed in specially built annealing ovens, in order to relieve the internal stresses which otherwise may have caused undue distortion of the structure. The major problem arising in the manufacture of the yoke is the machining of the 46-foot diameter outside periphery of the horseshoe. This surface acts as a journal of the oil pad bearings at the north end, and it has to be machined slightly egg-shaped in order to compensate for the calculated deflection of the structure in its different angular positions.

One of the accompanying sketches, in Russell Porter's inimitable style, shows the tube and optics of the 200-inch telescope and how the mirrors operate in various combinations. The mounting is shown as viewed from the northeast, with parts of the yoke and tube cut away to better indicate the light paths. Salient features are lettered and described.

Let me first call attention to the rather



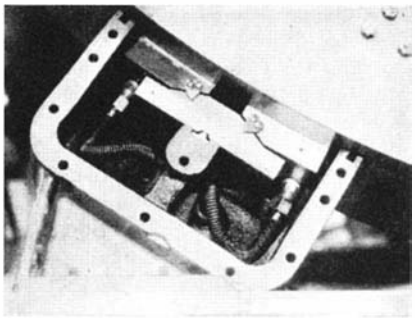

**A cut-away drawing made by Russell W. Porter, showing how the different auxiliary mirrors are used in various combinations explained in the text. How big this telescope will be is shown by the yoke at left—over ten feet internal diameter; there is room for the astronomers *inside* the telescope**



**Changing observers at the prime focus. Access to the prime focus unit chamber, where the astronomer will sit guiding the photographic plate, is by the platform which rides aloft on the shutter arches of the huge 135-foot dome**

unusual design of the tube. It is of welded construction, structural shapes being utilized to great advantage. The overall dimensions of the tube are 55 feet 4 inches long by 20 feet 3 inches wide. The approximate weight of the complete tube assembly is 250,000 pounds. Instead of the conventional octagonal lattice construction, the tube starts out with a hollow cube at its center, which carries the declination trunnions. The eight corners of the cube are tied in by beams to eight points on the circular rings at the ends of the tube, four at the upper ring carrying the revolving cage, and four at the lower which support the mirror cell. Tests of a tenth scale model indicate greater rigidity than required by the specifications demanded by the astronomers.

Above the 200-inch mirror, in the lower portion of the tube, are mounted the shutter and iris diaphragm mechanisms. In the center of the cage, and attached



**A close-up of one of the two oil pads shown at the top of the preceding page. Oil under pressure is pumped through each of these**

to it by means of four edgewise diaphragm plates, is located the 6-foot diameter prime focus unit chamber in which are housed the Cassegrain mirror, two Coudé mirrors and the Ross corrector lenses. Only one or none at all of these mirrors is used when different positions for observing are used. An elaborate but very compact mechanism is, therefore, provided for removing or placing each mirror in required position.

NO Newtonian diagonal is shown. It is intended to do away with this reflection and to use the prime focus directly from the big mirror. In this way considerable saving in light is effected, and freedom from the distortions liable to occur in a diagonal mirror is gained. Above the prime focus unit is located an observer's house permitting observations and photographic work to be performed at the prime focus. A special elevator platform mounted on the dome, permits access to the prime focus regardless of the position of the tube.

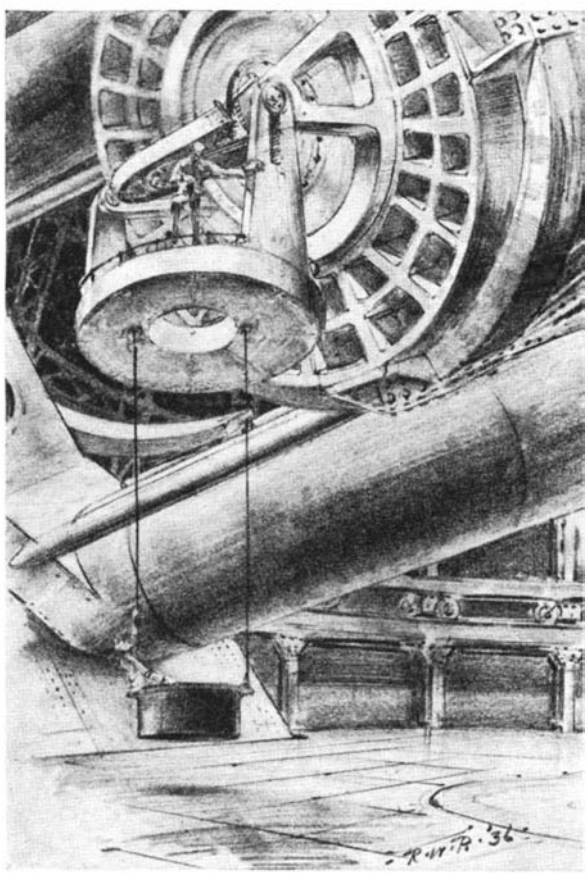
The Cassegrain focus is used either below the 200-inch mirror, or by using mirror *C*, it may be deflected through the hollow declination bearings to small spectrographs, housed in the lower chambers of the yoke cylinders.

For the Coudé combination, another convex mirror replaces *B*, and with the aid of *C* the light is carried to a slit in a constant temperature room below and south of the southern pier. Whether it travels by way of *D* and *E*, or directly down the polar axis (depending on the star's declination), it passes through a slot running lengthwise along the south side of the tube; so that this focus, which is *f*/30, requires three or five mirrors. When *D* is not in use, the gantry supporting it, mounted on the yoke and shaped much like a horseshoe, is swung down out of the way.

It is interesting to note that all these mirrors, other than the 200-inch, and six in number, are permanently attached to the mounting, and by electrical control may be made to swing in or out of place as desired.

At last, astronomers will "ride the tube." It is a new problem, heretofore impossible. They must be comfortable over long periods of time, in chairs, or on platforms that remain horizontal while the tube turns in hour angle. An astronomer must be provided with ready access and exit, and while observing, have a sense of absolute security and control over the entire mechanism.

The declination axis of the telescope



**Changing observers at the Cassegrain focus (near the bottom of the great tube instead of at the top, as shown on preceding page). The observer is raised 35 feet in a bucket, by means of a motor**

is formed by two trunnions mounted on ball bearings in the 10-foot 6-inch diameter tubular yoke girders and connected to the tube by means of flexible spoke gimbals. Flexibility of connection between the yoke and the tube is required in order to avoid imposing strains on the tube due to slight inaccuracies in mounting that may occur during assembly and due to deflections of parts.

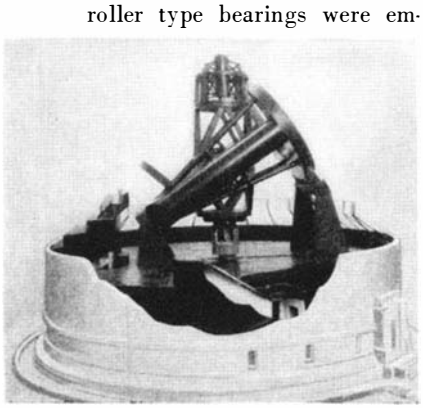
The gimbals on either side of the tube consist of two alloy steel flanges, one attached to the declination axis trunnion and the other to the tube, joined by 144 three-fourths inch diameter spokes. These spokes are arranged so that their extensions intersect in one point on the declination axis, thus forming a fulcrum. The gimbal spokes permit slight rotation of the tube about these fulcrums, at the same time restraining it against any other motions. There are six additional spokes connecting the gimbal flanges, arranged in a plane perpendicular to the declination axis, to resist the torque required to drive the tube in declination.

The enormous weight of the entire telescope, nearly 1,000,000 pounds, is carried by the north and south bearings of the polar axis. These oil bearings are of an unusual forced feed type.

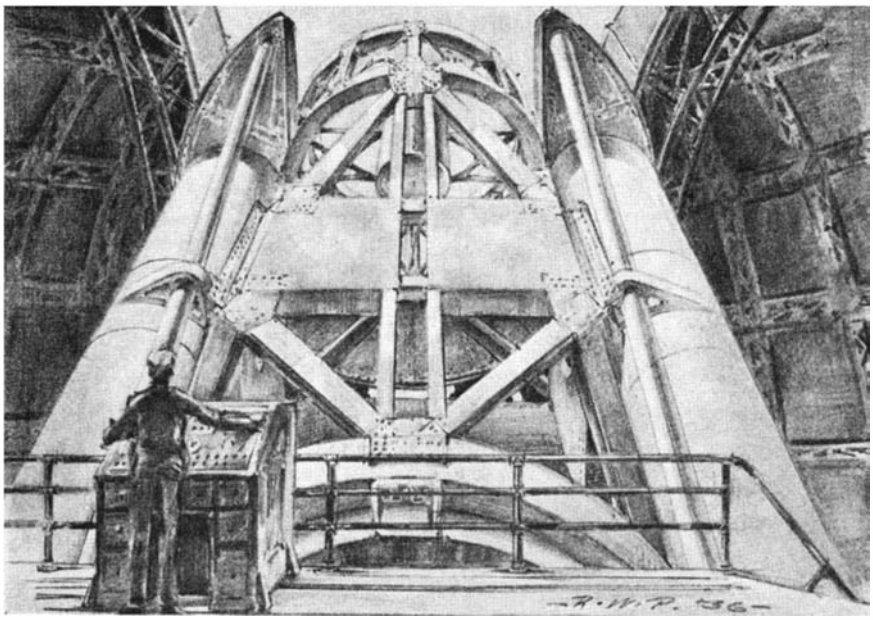
At the north end, the horseshoe is supported on two equalized pairs of oil pads spaced at an angle of 60°. The oil pads, 28 inches square, are babbitted and machined to the radius of the outside periphery of the horseshoe. When continuous flow of oil under high pressure is delivered through orifices to the surface of the pads, an oil film is formed between the pads and the horseshoe, thus floating the heavy load.

THE same principle is employed for the south end bearing, which is shaped like a spherical cup. Being a part of a 75-inch diameter sphere, this bearing is capable of carrying both the radial and the thrust loads of the polar axis. Careful distribution of orifices and recesses on the surface of the stationary part of the bearing are, however, required in order to carry the load properly and establish an oil film of uniform thickness along the entire surface of the bearing.

Since the normal rate of rotation of the telescope is very slow —one revolution per day—forcing the oil through the bearings obeys the laws of viscous flow, resulting in bearings which have a very low coefficient of friction. Consequently, less power will be required to drive the telescope in right ascension when equipped with the oil pad bearing, than if so-called anti-friction ball or roller type bearings were em-



**A small wooden model of the great telescope and section of the dome**

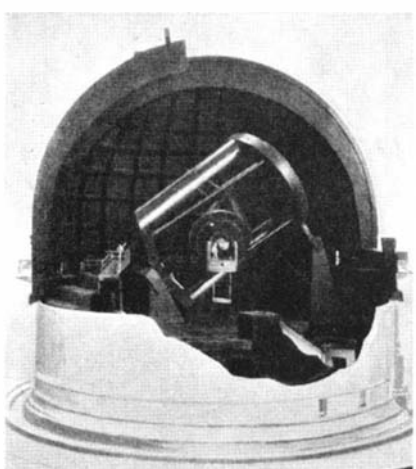


**Looking north from the control board—motor nerve center—of the telescope. The tube is shown nested in the split ring north bearing, pointing due north**

ployed; oil pads give smoother motion.

The drive of the telescope in right ascension and declination will be accomplished through extremely accurately cut worm gears and worms, driven by synchronous motors operating on alternating current of controlled frequency.

The declination gears will be mounted directly on the tube and the right ascension gears at the south end of the telescope. Setting speeds of the telescope or



**Small model of the telescope in the dome, which will be 135 feet diameter**

variable rate of motion required, for instance, during observation of planets, will be obtained by means of additional differential gearing.

The telescope will be housed in a dome (see the front cover) 135 feet in diameter and about this same distance from the ground to its top. The lower part of the dome will be stationary, with concrete exterior walls 30 feet high.

Dark rooms, instrument rooms, library, and rest rooms, will be on the ground floor. We are not forgetting a night lunch room, for an astronomer, bundled up like an arctic explorer, needs something hot after hours of stationary observing in the cold mountain air.

The upper part of the dome rotates on smoothly ground rails. This rotating dome will be of steel, hemispherical in shape, with an open slot 30 feet wide through which the telescope points. When the telescope is not in use this slot is closed by sliding shutters. The steel sub-base for the telescope mounting is supported on separate concrete piers, isolated from the dome foundations, so that vibrations from the dome will not reach the instrument. The observing floor is 29 feet from the ground floor. This is in reality an operating and handling floor from which the observer departs, by various contraptions, to one of the several observing stations. He must be raised to the observing house in the top of the tube at the prime focus, or hoisted to the observing platform swung below the mirror at the Cassegrain focus, or he may climb into one of the side cylinders, or descend to the Coudé room. The heights involved are rather unusual, the declination axis on which the tube swings being 65 feet above the ground floor.

THE story of the 200-inch mirror for the telescope is no longer news, its design, construction, and shipment having been thoroughly covered and reported. It seemed as if the whole nation waited with bated breath to see whether it would hit a rock or be too big to go through a tunnel on its trip from Corning, New York, to the Optical Shop of the California Institute of Technology in Pasadena. It was well and carefully handled and now reposes on the table of the large grinding machine. It is hoped that it, with the attendant auxiliary mirrors, will be correctly ground and polished within a period of four years. About four tons of glass must be ground off the big disk, a tedious but not difficult process, in itself. However, it will take infinite patience and care to shape it truly and exactly within the limits of one one-millionth of an inch over the entire surface.

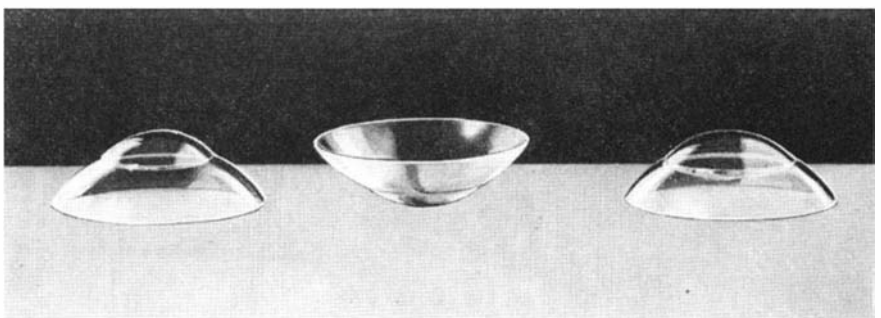
Investigations and researches are continuing on various details of the telescope tube and mounting, on the dome, and on the control and drive of the telescope. However, they are all well along, as some of the illustrations of models will indicate. We have every reason to believe that the telescope and the remainder of this project will be completed and ready for the mirror when the opticians working on the mirror finally say "finished."

**Dome for the (relatively) small 18-inch Schmidt telescope camera, which is being constructed at about 1000 feet distance from the main observatory dome**

# INVISIBLE LENSES

## Contact Eye Lenses . . . No Longer A Scientific Curiosity, But Improved During the Past Two Years . . . Now Being Worn For Longer Periods

By THEODORE E. OBRIG
Author of "Modern Ophthalmic Lenses and Optical Glass"



**Though very thin, the danger of breakage on the eye is almost non-existent**

WITH the recent announcement that over 3000 people in this country alone are already wearing contact lenses* regularly, the invisible, tiny, saucer-shaped lenses, shaped to fit the eye and worn under the eyelids, have now changed from a scientific curiosity to the eye physician's new substitute for spectacles.

Although the principle of contact lenses has been known for over 100 years, during the past two years improvements in the delicate manufacturing processes under which these lenses are ground have been perfected. They are now being worn for long periods by persons who have the usual visual defects of shortsightedness, farsightedness, and astigmatism.

The chief improvement of the past few years that has caused the growth in popularity is a refinement in the method of grinding the inner surface of the little shell so that it presents a continuous gradual curve where it is in contact with the eyeball, which has made for greater comfort. In addition, refinements have made it possible to grind the lenses to within limits of 0.05 millimeter, an accuracy hitherto considered impossible in this type of work.

By another recent development, where especially high corrections are needed in cases of bad eyesight, the added corrections may be ground into the lens itself.

These important refinements have made the use of contact lenses more general in the past few years. However, they were originally developed over a century ago by J. F. Herschel.

**Inserting the contact lens with a simple pick-up sucker of rubber**

Later researchers, realizing that practically all astigmatic errors in sight are caused by slight irregularities in the shape of the cornea, began to apply contact lenses to correct this condition. Where the cornea is irregular, the contact lens, filled with saline solution to form a homogeneous connection between glass and eye, establishes a perfect sphere. The center section and the solution together, refracting the light rays as would the normal cornea, give normal vision.

In line with these developments, about a dozen years ago Carl Zeiss of Jena began the work of refining the process of making these lenses so that they could be used for ordinary eye defects. In the past few years this has been accomplished, eliminating eye irritation and making it possible to wear them over a much longer period of time than was previously considered practical.

Contact lenses take more time to fit than ordinary spectacles, requiring as many as half a dozen visits to the oculist. With the aid of a trial set of lenses, the oculist determines the correct curvature to insure snug fitting and comfort by actually trying the lenses in the patient's eye, as well as determining the correction of vision by the optically effective part. Permanent contact lenses are then made according to the prescription.

While they are being worn, they are to all intents and purposes invisible. Moreover, since they lie in a protected position under the lids, they are to all intents and purposes unbreakable. (In fact, in one automobile accident where a man's face was badly torn by a corner post of the car, the contact glasses saved his eye.) They may be worn in many places where spectacles would be out of the question—in sports like swimming, skiing, polo and other games.

They provide a double, added safety feature for automobile drivers in that they neither steam nor have the disturbing and sometimes dangerous reflections that spectacle lenses have.

**So small and thin are the lenses that they are invisible when worn**

*See also page 191, March 1931, Scientific American.—*Editor.*

# OUR POINT OF VIEW

## 8113 A.D.

IF ancient man had only had the foresight—and the wherewithal—to preserve an accurate record of his life and times, what a vast expansion of our cultural knowledge would be available to us today! Since such was not possible, we must dig through antiquity's leavings for our knowledge of the past; dig, sort, theorize, always revising our knowledge as new finds come to light. Just because we are not favored in this respect is no reason why we, with our technical abilities, should not do the right thing for future civilizations.

On the two following pages Dr. Thornwell Jacobs, President of Oglethorpe University, Georgia, outlines a plan which, if carried to completion, will give to the world of 8113 A.D. a complete and thorough knowledge of the manners and customs, the pleasures and industries, of our part of the 20th Century. Here is a proposal that is at once inspiring and practical, thought-provoking and philanthropic. It is entirely possible to project ourselves, as it were, into a civilization as yet undreamed of, to bring to bear on future minds the influence of our knowledge and progress. Scientific American wholeheartedly endorses Dr. Jacobs' suggestions. Will you co-operate toward their fulfillment?

## Munitions

NO one wants war. At least no one in the United States does. Certainly our military forces have no jingoistic ideas; and our "big bad wolf" munitions makers have other and very much more profitable products to make. We are simply not an aggressor nation.

There are some Americans, however, who rant, write letters to the papers, petition Congress, and demand investigations (and sometimes get them) when they hear of the development of a new rifle, a new tank, a new explosive. "Nationalize Munitions," they demand, and the multitude, knowing not the facts, takes up the cry and yowls to high heaven regardless of sense or logic. Perhaps some "munition makers" have erred in exporting supplies for warfare, but present neutrality legislation has curbed this practice and further amendments to the law may effectively stop it. There still should be private manufacture of munitions.

Major-General William H. Tschappat, Chief of Ordnance of the United States Army, writing in *Army Ordnance*, says in no uncertain terms that such production must continue. He feels as do many other sensible Americans that, while we must do all in our power to avert war, we must keep our eyes wide open and be prepared for the possible thing which could force us into a contest of arms. "The War Department is convinced," he says, "that in the event of war, American industry must produce the major portion of the required munitions. Assuming this premise, it follows that so far as practicable industry should be prepared to perform its war mission. Therefore the War Department has consistently favored the participation of American industry in munitions manufacture and has encouraged the production of munitions . . ." The manufacturing arsenals of the Army in time of peace assist in the development of new designs and improvement of existing material, keep alive the art of manufacture of ordnance; that is practically their sole function.

We applaud General Tschappat's statement, which apparently is official. It clears the air a bit and is, in our opinion, a sound stand. The small government arsenals could do little in time of war; yet to maintain, at government expense, a great peacetime manufacturing establishment against the possibility of war would constitute an unconscionable drain on the already overburdened taxpayer. On the other hand if we do want to nationalize munitions and *do not* maintain that large peacetime establishment—well, how many hundreds of thousands more white crosses would we have left in France had our government had to start from scratch in 1917!

## Cotton

SPINDLES of metal—over a thousand of them, wet, probing through leaves and stalks—will take the place of nimble fingers to pluck the ripened fiber of southern cotton fields if a machine, recently demonstrated in Mississippi, fulfills the predictions of those who inspected it. As yet it is far from perfect. A ponderous machine, it is said to have picked in a day as much cotton as 70 or 80 men and women could have picked by hand. However, its picking spindles, while they did not harm the plant and unopened bolls, did pick up a green stain, some opened but unripe fibers, and bits of leaves and trash—all of which reduced the market value of the cotton.

The editors have watched the development of this machine of the Rust brothers for some years but, despite many promptings from readers, could not discuss it in its incomplete state. Now, because of the furore of prediction accompanying its demonstration, an evaluation of its possibilities is in order.

In its present state, the Rust machine will do a job much more cheaply than before but will turn out an inferior product. Even so, the economic advantage is there, and newspaper headlines would lead the hasty reader to believe that an economic revolution is in prospect immediately. This is erroneous, for the Rust cotton picker functions only on flat lands, is not suitable for the rolling, hilly country in several of the cotton states. Then, too, it is believed that the machine may prove too expensive for the small cotton grower. These limitations may later be removed, but in the meantime they may, slowly, teach the small farmer that he has been too long a slave to a "starvation crop." Cotton prices forced down by the big planters using the new machine may serve to do what the boll weevil did to farmers in the peanut belt of Alabama years ago—drive many cotton farmers to more profitable, land-saving crops.

The Rust machine will no doubt be improved. Even as it stands, it will, if enough of them are built and used, change the traditional economics of a vast section of the country. Perhaps its most important effect would be the ending of the poor southern farmer's slavery to cotton, as indicated above. It would deprive some few millions of people of their picking jobs, and many of these will migrate to industrial centers, but not 7,000,000 of the 9,000,000 tenant farmers will migrate, as the editor of one of our illustrious dailies predicts editorially. Young cotton must be "chopped" (thinned out) in the spring by hand, and this requires large numbers of workers on short notice for a very limited time. How that same editor figured that the Rust machine would also displace most of the 5,000,000 southern mules and horses is difficult to understand. Animals are not used at cotton picking time except to haul the loaded wagons and that job is but a minute part of the regular work they do.

The new machine *is* important. It will be more so with each and every improvement. Law makers who already are talking of laws to prohibit its use are shortsighted and lacking memory of the economic importance of other labor-saving inventions. They may as well proscribe the cotton gin—these modern King Canutes who like not the wash of progress upon their political thrones.

# TODAY—TOMORROW

## Archeology In A. D. 8113 . . . An Opportunity For This Generation . . . Preserving Records For Posterity . . . Co-operation Needed

By DR. THORNWELL JACOBS
President, Oglethorpe University

THE time is A.D. 8113. The air channels of the radio-newspaper and world television broadcasting system have been cleared for an important announcement. Suddenly all is activity again. The radio-newspaper headlines blaze forth a story of international importance and significance. The television sight-and-sound receivers in every home throughout the world carry the thread of the story. In the Appalachian Mountains near the eastern coast of the North American continent is a crypt that has been sealed since the year A.D. 1936. Carefully its contents have been guarded since that date, and today is the day of the opening. Prominent men from all over the world assemble at the site to witness the breaking of the seal that will disclose to a waiting world the civilization of an ancient and almost forgotten people. When the crypt is opened, there is revealed a mine of information regarding the science and civilization of A.D. 1936, conveyed by means of what those ancient people called phonographs and motion picture machines, models and books and photographs showing how far their civilization had progressed.

Thus projected into the future is a glimpse of what can be—what probably will be—if we of this generation seize the opportunity to preserve for the future a complete record of how we live, and to give to the generations of thousands of years hence a carefully thought out record of what we have accomplished up to the year 1936.

WITH the thought in mind that this is the appropriate time to preserve such records for future generations, on a scale never before conceived, Oglethorpe University in co-operation with Scientific American proposes to make available to some civilization now unthought of, and still far in the future, the running story of the life, manners, and customs of the present civilization. We propose to collect a complete set of materials which describe and represent our lives and labors, to bury these materials in a secure spot, and to preserve them under the guidance and advice of our greatest scientists. We believe that in this way generations as remote from us in the future as ours is from ancient Menes and the pyramid builders will be able to visualize what manner of men we were and what manner of life we lived in 1936 A.D.

**THE suggestions of Dr. Jacobs for the preservation of a record of our present generation for the assistance of future historians are heartily endorsed by Scientific American. If it is possible to secure the co-operation of industrialists and philanthropists, this project can undoubtedly be carried to a successful conclusion. All those who are willing to assist in this monumental work are urged to communicate directly with The Editor, Scientific American, 24 West 40th Street, New York City.**

It may be difficult for most of us to realize that our present civilization and all of its technical advances occupy only a few seconds, as it were, in the vast spread of geological time. We are living in a geological epoch just as truly as did the brontosaurus and the pterodactyl. Time will last just as long in the future as it has lasted in the past; our present-day civilization will eventually fall; our tall buildings and huge dams of which we are so proud will be reduced to ruins. This may not be a pretty picture to contemplate but it is one that will be just as true as the story of the downfall of the mighty empire of ancient Nineveh.

We may be able to appreciate this more fully when we consider the rapidity with which the records of any particular generation disintegrate and lose themselves as the years go by. Even knowledge of the life of the Middle Ages is already dimmed by time. Its reconstruction by present-day students is largely guesswork. Had it not been for such a natural catastrophe as the eruption of Vesuvius, the glories of Pompeii and Herculaneum would never have been revealed to our sight. Again, if it had not been for the happy circumstance that the world's oldest civilization was developed in Egypt, where excessive dryness made it possible for the structures to be preserved by nature, we would know very little of those times. We, however, are the first generation equipped to perform our archeological duty to the future without the help of natural phenomena.

In order to make more positive that any "treasure" which we may bury would be held safe from vandalism and pillaging, it is desirable that a date be fixed for the opening of the crypt. What could be more fitting than that the time be governed by the first fixed date in history? This is probably the year 4241 B.C., which marks the establishment of the Egyptian calendar. Since that first date 6177 years have passed. Adding this figure to 1936 brings us to A.D. 8113. The probability is that by that year the record of the present generation of citizens of the United States of America—except for that sealed in our crypt—will have been as completely destroyed as the record of the contemporaries of Menes.

WHAT we propose to do, then, is to provide for future historians an epitome of the life of an old generation—a generation in which *we* lived. Thus, for the first time in the history of a civilized land, future historians will have available a thorough and accurate record preserved for them. Such an epitome should include certain books—for example, encyclopedias—stored in the sealed crypt. Motion picture films would, of course, be included, picturing the world of today, and especially the physical features of our cities and countrysides, our industries and our social activities. There should be a phonograph or film record carrying a salutation from the President of the United States to the rulers, whoever and whatever they may be, of the year 8113 A.D. By means of the phonograph and the talking motion picture film, this future generation will be able to hear the voices of our President and King Edward VIII, of Mussolini, Stalin, and Hitler, of the Emperor of Japan and the President of China, as well as those of our greatest living scientists, archeologists, and historians.

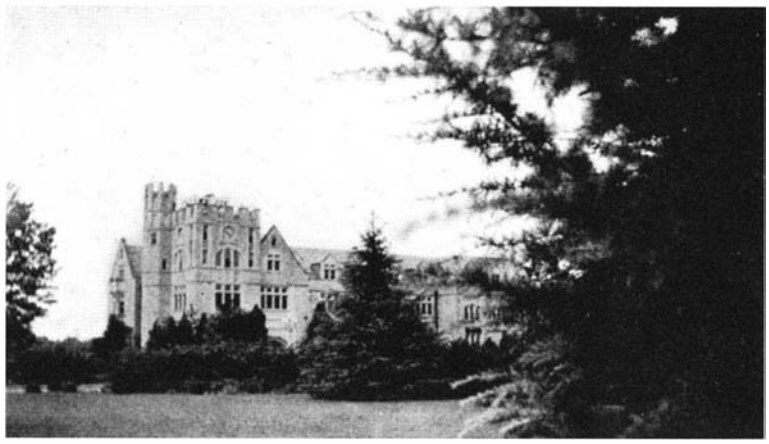
The subject of this proposal has been completely discussed with the editors of Scientific American, and they have indicated their willingness to co-operate in its fulfillment. Our conversations have covered the entire range of human activity. We must, of course, include such homely every-day things as the foods we eat, our drinks, even our chewing gum. We must describe and illustrate our sports and recreations, our buildings and their furniture, our engines, printing presses, automobiles, airplanes, typewriters, and so on. Models made of stain-

less steel or Monel metal, when preserved in a vault lined with similar materials, will no doubt last for at least 6000 years. Of course an illustrated encyclopedia, if it could be printed with an ink that did not carry self-destruction in its formula, and on a paper of the most permanent possible quality, and preserved in a vacuum or in inert gases, would be one of the most perfect ways to preserve permanently a description of the thought and content of our present civilization.

Perhaps one of our great metropolitan dailies would be willing to print a special issue with an ink and paper of the type mentioned above, showing the treatment of our "news" and possibly containing a message addressed to those living in 8113 A.D. Thus we can convey an idea of our news disseminating system and of our methods of advertising. Such a newspaper might be encased in a stainless steel receptacle filled with inert gases. On the other hand, several different newspaper editions might be photographed in miniature on motion picture film and included in the crypt, together with a projection machine and instructions for its operation.

IT is firmly believed that industrialists of this country can plainly see the tremendous cultural value of this proposal and that they will co-operate to the fullest possible extent. Doubtless one or more of our great automobile concerns would be willing to make miniature models of its finest products. Motion picture organizations could probably be induced to make a study of the very best possible way in which to preserve films for a period of 6000 years. Hundreds of our manufacturers would likewise cooperate in their own particular branches of industry. There should also be included a complete model of the capitol of the United States, which, within a half-dozen centuries, will probably have disappeared completely. It gives one something of a shock to reflect that by the year 8113 A.D. every building of every kind as yet constructed in the world may no longer exist. Such a reflection, however, emphasizes strongly the desirability of a project such as the one under discussion.

The principal difficulty, from a practical standpoint, in effecting this plan would not be the scientific one of preserving the objects selected for that purpose. It would be the danger that comes to all civilization sooner or later: vandalism, which involves the destruction of its monuments and the robbery of its vaults. Doubtless the safest place and the one which has the greatest promise of permanency would be a college campus, for universities have a way of living and surviving such things as changes in forms of government and dynasties. Oglethorpe University has selected an



**The beautiful fireproof building at Oglethorpe, under which it is planned to store a complete record of our present civilization for future historians**

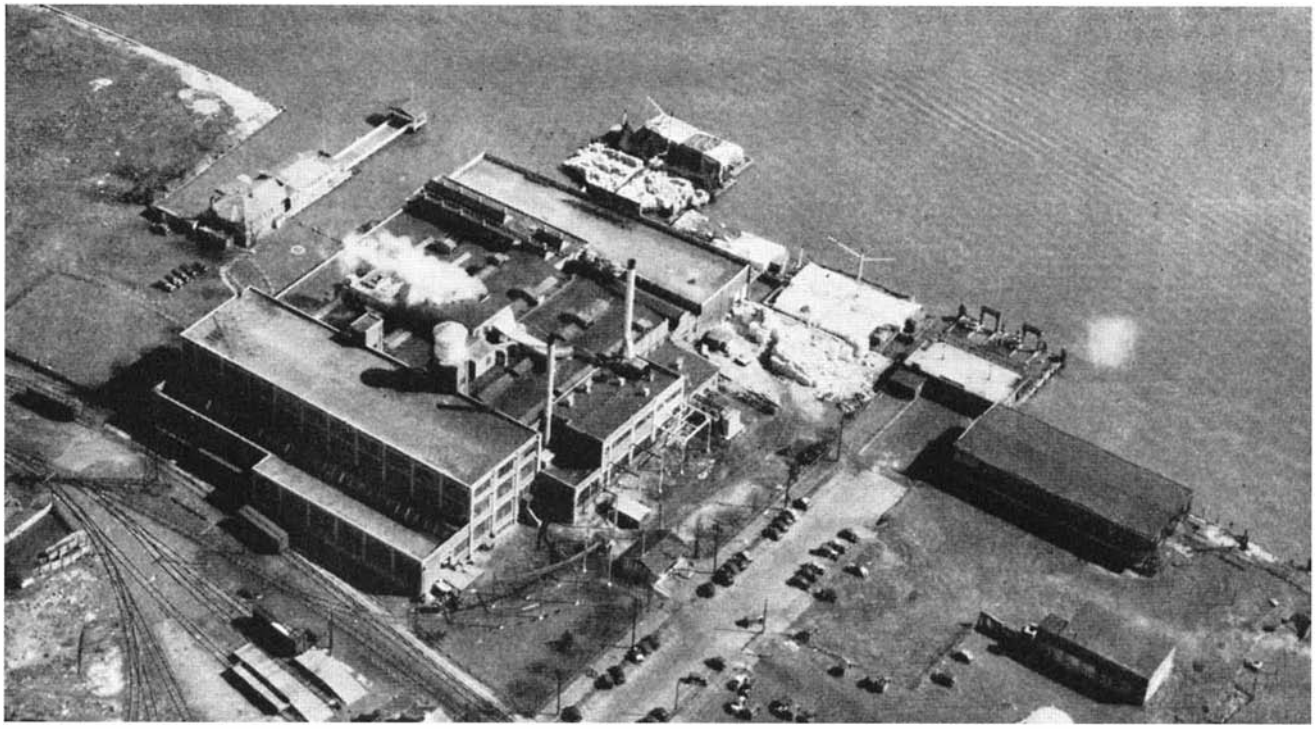
ideal spot for this purpose in the basement of a beautiful building which now houses its library and executive offices. The basement has already been rendered waterproof and, when lined with stainless steel, would preserve objects committed to its care over the period of time desired. The size of the crypt is quite sufficient for the purpose. It is contained in a building constructed of granite and covered with slates, with foundations resting on the granite bedrock of the Appalachian Mountains. This location is ideal for such a project, the bed rock being of very ancient geological formation which beyond doubt will withstand the ravages of time with little change. Further, as far as science can determine, there is little likelihood of earthquakes that might destroy the building or the crypt. Such a building should itself endure for the period of time desired, if properly repaired. There should, of course, be a tablet of stainless steel, requesting all future generations to leave its contents unopened until A.D. 8113. The vault and its contents should be deeded in trust to the Federal government, its heirs, assigns, and successors, and a penalty fixed by law for any tampering. A special feature of the plan would be the preservation of the names of all those persons who took part in the task. The expense of such a project would be considerable but surely there are enough philanthropists in America to make it possible. Nothing has ever been proposed which combines so much romance and usefulness and real service to future students of civilization as this.

The problem of preserving the various materials used in this project will require careful study and the complete cooperation of all of those interested. A carefully selected Board of Judges will be charged with the responsibility of drawing up a list of those things which should be preserved, and of deciding which can best be preserved by written description and photographs and which should be in model form. It will then be up to those who are far-sighted enough to see the implications of this project to begin the preparation of materials to be included and to start work on the crypt and its surroundings.

There is little definite data available upon which to base this interesting task. Similar suggestions have been made in the past, but none of them as broad in scope as the present. We may take a hint from the work of the Japanese who, shortly after the tragic earthquake of 1923, determined to preserve for 10,000 years the names of all those who perished in the disaster. After a vast amount of investigation they decided to write in Chinese ink upon the highest quality of Japanese paper the names of those who were lost. Some 548 sheets of paper were used. These were put away in four jars of fused quartz crystal, each five inches in diameter and twelve inches long. The bottles were then wrapped in asbestos and placed in a lead container which, in turn, was put into a fireproof cylinder of Carborundum. A Buddhist temple was finally chosen as the proper repository for the precious bottles.

SCIENTIFIC AMERICAN has consented to act as a clearing house for suggestions and offers of co-operation in our project. With the tentative plan outlined above as a starting point, we solicit suggestions and advice from scientists, publicists, and philanthropists. As the project proceeds, the plans will undoubtedly be modified in accordance with changing ideas.

During the last one hundred years, scientists, backed by philanthropists, have spent millions of dollars, digging here and there in the earth, endeavoring to find some old piece of pottery, some ancient trinket, some sun-baked brick, from which they might deduce the every-day manner of living of people whose names are forgotten, and of kingdoms long since perished. The record of each generation is full of interest and wisdom. Let us be the first generation to preserve, for the intellectual hunger of those who come after us, a complete record of our daily life.



A typical paper plant with an abundance of water and complete shipping facilities

# Paper Progresses

## New Technique in Paper Making . . . Yet Tradition Persists . . . New Papers . . . New Processes . . . The Rôle of the Laboratory . . . Increasing Efficiency

By PHILIP H. SMITH

THE most striking thing about American industry is the new products which have been developed under the spur of the depression, competition, and research. Well, the paper industry is different. You may learn that most ladies' handbags are now being made of paper, that paper is going into table tops and wall panels, and you may conclude that the industry is stepping out to seize all manner of markets; as a matter of fact the significant advances are to be found principally in the technique of manufacture.

It is hard to find an industry in which progress has been made so uniformly on so many fronts. Every unit which contributes to the job of turning the raw material into a finished product has been given attention, and the combined result makes an advance within the industry of great economic importance.

Another fact which sets paper making apart is its great antiquity and the persistence of traditional method. The use of cellulose fibers as a raw material and the practice of sizing and coating are Chinese arts centuries old. They have never been overthrown. The contribution of modern times has been to raise production rates and to lower costs through the application of science and technology.

The center around which paper making spins is the paper making machine. It is a gigantic combination of intricate mechanisms which takes in raw stock at one end and spins forth paper at the other. A full sized machine approaches 200 feet in length, weighs nearly a million pounds and costs in the neighborhood of a half a million dollars. Because it is a grouping of machinery one might say that there is a hazard every foot of the length. There are some 50 individual motors, about 25 pumps, thousands of feet of pipe and many miles of wire. Every unit must co-ordinate perfectly to deliver a product that is satisfactory.

THE raw material goes through an elaborate treatment before reaching this machine. The fibers, obtained chiefly from wood today, have to be thoroughly saturated and macerated or "beaten" in and with water as well as freed from impurities. They must flow onto this machine uniformly as a liquor comprising 99.5 percent water and 0.5 percent solid; then the machine performs the function of removing the water, first by drainage, then by suction and press action, and finally by heating. It reads like a simple process, but it is enormously complex. There are many variables which require control; there are endless points at which troubles may arise; by the same token there are opportunities to exercise scientific control and to perfect the functioning of the mechanism.

The raw materials used are primarily water and cellulose fibers. Good water in unlimited volume is an essential. There was a time when it could be had easily and used without treatment but today most supplies must be carefully purified. A mill may use as many as four or five million gallons a day and, for reasons of economy and avoidance of stream pollution, a beginning has been

**TABLE 1**

**Paper Making Fibers and Some Principal Uses**

**Wood Fibers**
- **Mechanical**
  - **Groundwood (spruce)—news, wallpaper, cheap book, and writing paper made in combination with sulfite**
- **Chemical**
  - **Sulfite (spruce)—bond, ledger, writing, tissue**
  - **Alpa (refined sulfite)**
  - **Soda (popular)—book and blotting**
  - **Sulfate, or kraft (pine)—wrapping, container lining (modified soda)**

**Seed Fibers**
- **Cotton (rags and clippings, linters)—writing, legal**

**Bast Fibers**
- **Jute, Manila —tag, some container**
- **Straw (wheat, corn, etc.)—corrugated board**
- **Esparto—used abroad**
- **Linen—currency**

made in using the water over again by installation of what amounts to a closed system.

There are many ingredients to paper and in Table 1 the fibers are classified with some of their principal uses. Wood sulfite cellulose is made by high pressure and temperature digestion, strong sulfite acid treatment, and purification with chlorine and calcium hypochlorite, followed by a final alkaline digestion and heat drying. The sulfate, or kraft, and soda pulps, are made by high temperature digestion, a concentrated cooking with a caustic alkali, and then a bleaching. The rag fibers are subjected to an alkaline digestion to remove such impurities as waxes and resins and are then bleached. The chemical wood and bast fibers are used both bleached and unbleached. Practically all papers are composed of at least two components.

The highest grade of bond papers are made with rag stock but today sulfite pulp can be used to make a paper equal in quality to one made with low grade rags. The use of alpha, a purified sulfite pulp, is a story in itself. Being highly refined it has special uses, many of which do not involve paper. Rayon is an example.

The raw material content of paper varies according to product. A high grade white paper can be made of sulfite pulp and old paper, provided the latter was made originally from sulfite. The paper these words are printed on, for example, contains some re-worked paper from old periodicals. Before old paper can play its part, however, it must be sorted to eliminate groundwood stock, screened to take out wire and string, and bleached and washed to remove ink.

If you examine a fiberboard container (shipping carton) you will find old paper used in another manner. Under the tough outer surface is a softer product made from mixed papers and if you look closely you can see foreign material scattered through it.

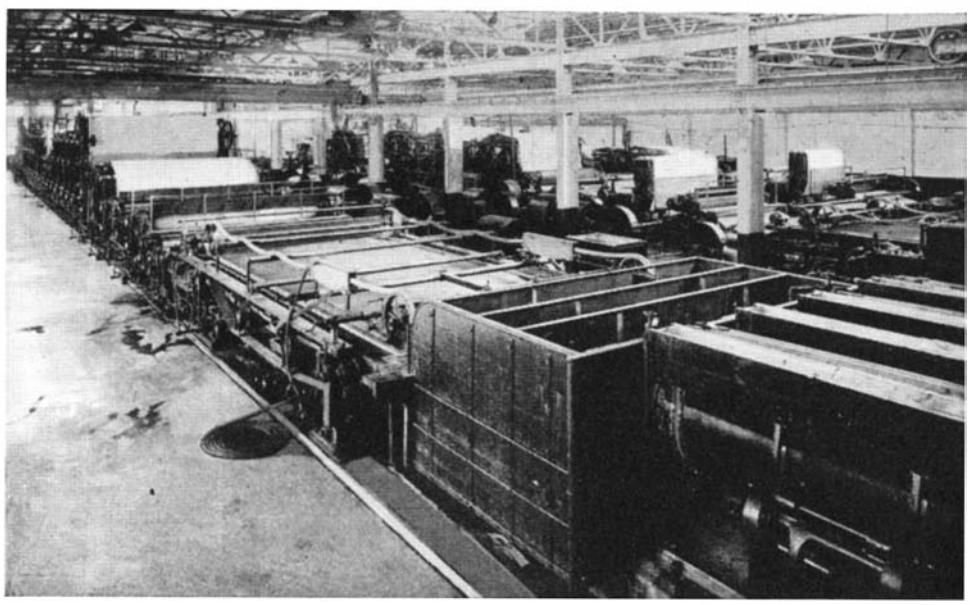
The outstanding advance in pulp has been the development of a new source of raw material. In the past 10 years the rise of kraft paper manufacture in the South has been phenomenal. Output of this tough, brown paper has risen from production of a few thousand tons to hundreds of thousands of tons, and new mills are springing up which will double present output. On top of this comes Dr. Charles H. Herty's development which makes possible the production of white newsprint paper from southern pine.

Dr. Herty's work has been told in these pages before.[1] What he has done in brief is to disprove the idea that southern pine was useless for sulfite paper making because of high resin content. First he found that young pine contains no resin, then he made paper from it. Commercial production is being attempted and watched with a great deal of interest because the proof of feasibility might lead to great development in the South. Proponents declare that such an industry would be self-perpetuating because young forests are used and could be re-planted to serve in a 10-year cycle and because essential raw materials are available. Others hold that, though possible, such a development is not probable. Sulfite pulp, they say, can be produced more economically on the northwest coast where even old wood can be used because it is free of pitch.

THE mixing of pulp with water to provide the vehicle with which to flow the fibers through the machine has always required an undue consumption of power and, therefore, has attracted the attention of research. First there are beaters which grind the pulp with water to hydrate it and then jordans are used to break the fibers down to a more uniform size. Newer methods aim at simplification and lower power consumption with greater control of the process.

From the moment the flowing begins, and the fibers are felted together, effort is made to remove the water with dispatch. And this is true whether the machine is a Fourdrinier or cylinder type. Improvements in the water-removing

[1] Scientific American, May, 1934, Page 234



**The long line of equipment which makes up one paper-making machine. The watered pulp goes in at the near end; completed paper comes out at the other end, goes onto a roll**

**Boring test samples from bales of pulp imported from Finland**

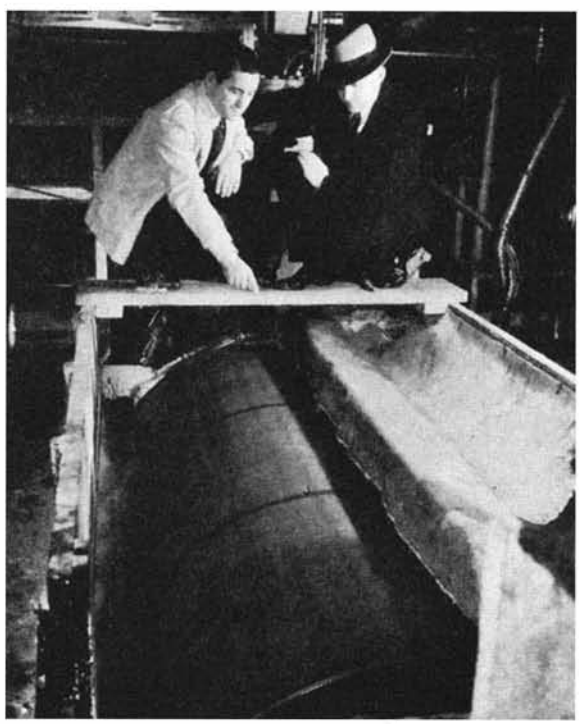
mechanisms begin with the Fourdrinier, which is a fine mesh bronze wire screen belt over which the wet material is carried while superfluous water is removed and the felting of the fibers is accomplished, sometimes with the aid of shaking. A new type of Fourdrinier can be slid out of the machine for restringing if a wire breaks, while lengthening of wires to give higher speeds is quite common.

Various devices are used to remove the water—suction boxes under the wire, rolls which apply suction and pressure, and finally heat. The correct degree of pressure is important. The heavier the pressures the quicker the removal, but at the same time excess pressure applied upon the wet web will ruin the formation of the fibers and weaken the sheet; likewise excessive pressure will mark the sheet. Nevertheless, if water is not removed adequately before the sheet leaves the press section and enters the dryers, more drying will be needed and heat is costly.

A RECENT improvement has been to cover the suction press roll with rubber. This permits lower pressures and prolongs the life of the felts which are used to carry the wet web before it can support its own weight in passing from press roll to press roll. Another innovation, the dual press, permits a contraction of the press section so that additional space can be given to forming or drying areas.

The final processing before the paper is wound up on a roll is pressing the web between heated rollers—a calender—and ironing to give it a smooth surface. It is recognized that slow drying makes for high quality, yet speed is demanded to maintain production rate and a compromise is required. A vacuum drying system just developed permits drying with diminished heat. The drying section of the machine is completely housed so that it can be held under 29 inches of mercury and since the paper must enter and leave the housing, it is an accomplishment of no mean proportion.

Hand in hand with the technological improvements which have enabled paper mills to manufacture a product of better quality at higher rates of speed and at lower cost, there has been research activity without which technological improvement would mean little and which has established precision control over operations. This brings uniformity of product and reduction of waste. The laboratory is now the right hand of the progressive mill. Here is where control of the pulps, then blending and processing are determined to give a desired result. Here is where the moisture content is watched as the paper goes through the machine. and where final tests for strength, opacity, surface and so forth are made to maintain uniformity.



**Final screening before the wet pulp flows on to the Fourdrinier**

At first sight the rôle of the laboratory seems overplayed, but after you have seen newsprint roll off a machine at the rate of 1400 feet per minute and come to realize what a mass of detail contributes to the achievement, no control can seem too great. Research is in steady demand to meet new problems. Consider, for example, the problem created by the acceleration of printing press operating speeds. Printers called for inks that would dry faster and the ink manufacturers turned to the paper makers for a product that would take the newer inks. Substitution of paperboard for wood in manufacture of shipping containers raised another problem. Paper had to be certain to withstand tearing and bursting and to get satisfactory results meant going all the way back to the pulps.

Research works for economies as well as for better quality and a notable example of this was revealed in a recent announcement that sulfite liquor, by-product of sulfite pulp manufacture, is being used for the making of yeast.[2] Until now it had the negative value of polluting streams. Sugar is a content of sulfite liquor and when treated with lime, yeast can work in it and use up the sugar. In Nova Scotia there is a paper mill with a yeast plant attached which is producing 20,000 pounds of yeast every week, at the rate of 40 pounds to a ton of waste liquor from the processing.

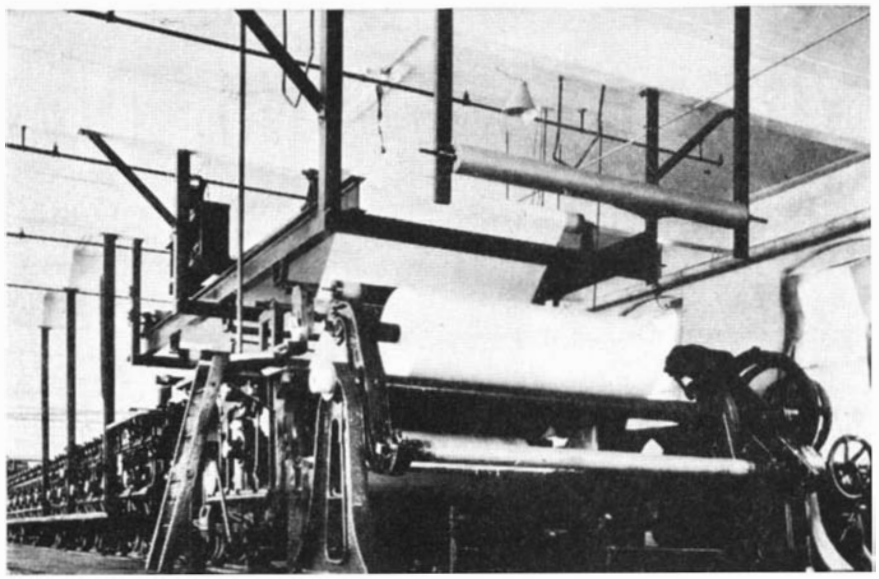
[2]Scientific American, September, 1936, Page 162

**Mechanical counting of sheets of toilet paper, perforated and packed on the roll at lower left**

In the West, commercial enterprise has approached the problem of waste and stream pollution from another angle. Finding that the liquor contains organic matter from the non-cellulose constituents of wood, which are lignin substances and carbohydrate materials, a precipitation process has been evolved which uses a caustic lime reagent and obtains three things thereby: calcium sulfite, used for the manufacture of fresh cooking acid; a solid from the lignin component which serves as a boiler fuel; and an effluent which is less harmful when emptied into streams. Out of the lignin materials, experimenters have been able to produce vanillin and other phenolic derivatives and to extract a substance for tanning leather. This last product is established commercially. It is now declared that other products can be obtained and that commercialization is not far off. What is now waste and available in ample quantities can thus be turned to value by sustained laboratory effort.

JUST to get an idea of the tremendous use of paper and the importance of the particular types, figures of last year's output are illuminating. The total production reached 10,307,000 tons. Of this grand total, paperboard represented 4,693,000 tons; newsprint, book, and cover paper 2,153,000 tons; wrapping paper 1,570,000 tons; and writing, tissue, and other papers more than 1,800,000 tons. The use of paper is increasing in two directions: existing use is being extended and new uses are being developed. It is no secret that wooden shipping boxes have lost ground to fiberboard containers ever since the industry succeeded in making a carton sufficiently strong to withstand blows and shocks. Nor is it a secret that containers are striving to annihilate the glass milk bottle. If a satisfactory paper can is developed for the shipment of oils there will be a like onslaught on tin cans. Paper lends itself to a variety of treatments. It can be made impervious or absorbent and the latter type has been making inroads in the towel business much to the discomfiture of those who live by textiles. A simpler use, but still a novel one, which illustrates diversity, has recently been projected for parchment paper. It is brought forward as a substitute for the glass upon which dentists and apothecaries mix amalgams and drugs.

Nowadays paper is being laminated with coats of synthetic resins to make it moisture proof. This is used for sealing containers when a chemically inert material is needed because of the character of the contents. Parchment papers are scarcely affected by water. They are made in the usual manner but treated after manufacture with strong sulfuric acid. Plastic sheets, used for table tops and wall panels, contain paper to give strength. More usually, the paper is alpha cellulose, the highly refined sulfite pulp. Similarly, paper is given waterproof qualities by coating or impregnating with rubber latex and artificial resins. Chemicals which must be kept absolutely dry in storage or shipment are now packed in impregnated bags or bags with liners coated with nitrocellulose or similar cellulose lacquers. Ladies' handbags which look like leather can be made from impregnated paper, coated with lacquer and embossed with a leather grain. They haven't the wearing qualities of good leather but even the cheap ones will last the season or as long as the costume they are intended to match.



**Delicately adjusted steel rollers pass the continuous sheet of paper through many intricate turns to dry and surface it and discharge it at this point ready to use**

Perhaps the most startling developments in paper making have yet to come. Science has only recently begun to play its proper rôle because paper making was too old and too well established an art to yield with grace, but today the industry works singly, and jointly with its Institute of Paper Chemistry. We are seeing now a period of transition when what has been fact for centuries is up for reconsideration, when ground is being retraced to search out facts which escaped the artist-producer. To understand the reasons for physical and chemical phenomena and to establish control for re-creating them at will is the aim of the progressive mill. This is exemplified by the study made of fiber structure and the effect upon it of chemical treatment, the determination of hydration by instruments rather than by reliance upon the finger tips of an individual. Imagine testing the appearance of a sheet of paper by means of sound! It's coming out of the laboratory. Research everywhere in the mills is voiding the old rule-of-thumb to replace it with accurate measurement and positive control.

Manufacturers will admit that the present system of making paper seems antiquated for this age of simple and direct processes. It requires too much machinery, too many processes and too great a capital investment, yet no one has found a better way. Simplification is always sought and a good example has to do with the coating of paper. Coating in the manufacturing process is now an established fact; one step replaces two. Mills are getting into operation with the new process, but as yet details are lacking. Enough is now known of this process as it gets underway to indicate that the seemingly impossible in paper manufacture has been accomplished. Further perfecting should make it applicable to the coating of a wider range of papers.

The basic idea of paper making is the most irritating one of all to those engaged in manufacture. Why, they say, should we go to so much effort to hydrate fibers and then labor even harder to remove the water a few minutes later? It seems inefficient and so it gives rise to a pipe dream—the finding of a cheap and recoverable solvent that will serve as a vehicle for the fibers.

MEANWHILE, lacking a revolutionary change in the fundamentals, the paper industry goes on increasing the efficiency of unit operations. Water filtration costs are being lowered, power consumption is being cut, wastes are being eliminated or put to profitable use. The industry takes on slowly the appearance of a self-contained unit instead of one which passes through its system millions of gallons of water daily, consumes endless power and chews up whole countrysides merely to produce smooth sheets to convey some facts like these.

Photographs courtesy Beloit Iron Works, Byron Weston Paper Mills, Fitchburg Paper Co., Robert Gair Co., and Scott Paper Co.

# More About the New Lyttleton

## The Older Encounter Theory is Fortified . . . Removes the Last of the Dynamical Difficulties . . . But the Whole Problem is Still Far From Solved

THE story was told last month how Lyttleton has advanced one of the perplexing problems of cosmogony by suggesting a way of origin for the planets which avoids the hopeless dynamical difficulties which obsess the older theories. If the sun had originally another star revolving around it—perhaps at about the present distance of Uranus or Neptune—and a third star, passing by in space, collided with the companion, or at least passed exceedingly close to it, it is quite possible that both stars might fly away into space in different directions leaving masses of ejected matter under the control of the sun's gravitation to condense into the planets. Later encounters between the embryo planets might account for the formation of their satellites. The "encounter theory" of the origin of our system has thus been revived and strengthened just as it appeared to be fatally weak.

This should be as gratifying to the Americans who originally proposed the idea as to the Englishmen who have expanded and improved upon it. Before we leave the subject, however, it is only fair to point out that certain serious difficulties still remain which make it far from safe to announce that this great problem has been finally solved.

The great difficulties regarding angular momentum have apparently been finally escaped. The worst one depended on the angular momentum per ton, and demanded that planets moving in their present orbits could never in the past, since they became separate free-moving bodies, have passed nearer the sun than half their present distances, and hence that they were not born from the sun. The new theory, which puts their birthplace far out and deprives the sun of its parental relation, accepts the hostile argument and makes it a part of its own case; but it is not itself altogether free from dynamical objections.

The new-born planets, starting as they must all have done close to the point of collision and moving with very different velocities and periods, must have had highly eccentric orbits—though not so extremely eccentric as on the old theory of origin from the sun itself. How did their orbits become rounded up into their present nearly circular shapes? The explanation which was suggested in the earlier encounter theories is still available. The great cataclysm of the encounter must have caused the ejection of much more matter than eventually consolidated into the planets. Some of this may have cooled and solidified into small solid particles like Chamberlin's planetesimals, but a great deal of it must have been composed of hydrogen and other "permanent" gases if the composition of the stars was in the least like that of the sun or of other stars in general. These gases would fly away, each atom or molecule separately from the scene of the encounter: some molecules would be moving fast enough to escape altogether from the sun's attraction and join the homeless swarms which thinly pervade interstellar space. But great numbers would be going too slowly to escape and these would circulate about the sun in orbits and form a vast diffuse envelope surrounding it, though not a true atmosphere since the orbital motions, rather than the gas-pressure due to molecular collisions, keep it from falling into the sun.

THIS great cloud of gas and dust forms an ideal resisting medium. The relative motions of its separate constituents would soon be equalized by collision, leaving the mass rotating in practically a circular fashion. The heavy planets would plow through this and be subject to friction. Both the outward and inward motions of a planet would be slowed down. The forward motion would be slowed if it was moving faster than the medium, which would happen in the part of its orbit nearest the sun, but speeded up when the gas particles, moving in their circular orbits, overtook the planet, which would occur at or near the latter's aphelion. All four of these influences operate to diminish the eccentricity of the orbit. Given time enough and resisting medium enough, very great changes might be produced. The resisting medium produced by the encounter which Mr. Lyttleton postulates is exactly in the right place to do the most effective work. There is still trouble, for a planet big enough to hold an atmosphere should be "sticky." A gas molecule or meteorite which entered its atmosphere would never get away again but be added to its substance. Now, if the outward and inward motions of such a body are to be slowed down to a small fraction of their original speed, the total quantity of matter picked up from the resisting medium must greatly exceed the original mass of the planet. There is very strong reason to believe that most of the ejected material was hydrogen, which is far more abundant than anything else in the outer layers of the stars. We should then expect all good-sized planets to have extensive hydrogen atmospheres. This fits very well for Jupiter and Saturn, but not at all for the earth, since even the whole quantity of hydrogen in the ocean is far less than a thousandth of its whole mass. We cannot escape this difficulty by assuming that the earth was too hot to retain hydrogen in its atmosphere, for the changes in the orbit would take far longer than the planets would require to cool. The attractive hypothesis of a resisting medium is, therefore, inadequate.

One naturally asks: "Could not the mutual attraction of the planets themselves have gradually altered their orbits into the present condition?" Not many years ago it was believed that this would be impossible, for the classical methods of the planetary theory indicated that if the orbit of our planet became more nearly circular, those of some other or others would necessarily increase in eccentricity. Recent researches by Professor Brown have shown that this conclusion, though very approximately true, is not absolutely exact. Over a moderate interval, say of a million orbital revolutions, no great and cumulative changes in the orbits of the planets will be produced by their mutual attractions. But when it comes to hundreds of millions of revolutions, we can no longer be sure of this and great changes may occur—though to predict just what they would be is obviously impracticable. It therefore appears to be possible, in the light of modern analysis, that the present orderly arrangement of the solar system is a result of planetary attraction—a sort of settling down into a quiet and long-enduring, though not eternal, state. Whether this has actually happened must remain in doubt; but this very uncertainty removes the last of the dynamical difficulties which seemed such fatal obstacles a decade ago.

The really disturbing unsolved problems that still beset planetary cosmogony are physical. The material ejected from the sun's former companion must

# THEORY OF PLANETARY ORIGIN

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. President of the American Astronomical Society.

have been excessively hot. To get an idea how hot, we may for the moment assume that this companion was similar to the sun in size and mass.

Suppose that Jupiter could be put back into the sun. What pressure would the weight of the added matter exert on the former's surface? An even distribution all over the surface will give the lowest result, for unevenness will raise the pressure at some points though lowering it at others. A very simple calculation shows that if Jupiter's mass were thus spread over the sun's surface, there would be 31,000 kilograms per square centimeter. The sun's surface gravity being 28 times the earth's, the weight of the layer would be 870,000 kilograms per square centimeter and produce a pressure of 840,000 atmospheres. The average pressure in the layer would be half as great. Now, in the interior of a star similar to the sun, the radiation pressure is a small but sensible fraction of the whole. Eddington's investigations show that, even near the surface, this fraction is probably more than 1/1000; that is, in the average of our layer it would be some 400 atmospheres. The corresponding temperature is 630,000 degrees.

INSIDE a smaller star the temperature might be lower, but the conclusion seems unavoidable that the material which now forms the planets, if it once was part of a star, must, before its ejection, have had an average temperature of several hundred thousand degrees, Centigrade. If the matter was pulled out of the star by tidal action, its initial temperature must have been of this order; if expelled by collision, it would have been far hotter, for the stars would have passed one another with a velocity of the order of 500 kilometers per second, and the conversion of the corresponding kinetic energy into heat would produce a temperature of millions of degrees.

The ejected matter, when first exposed to space, would lose heat very rapidly by radiation—mainly of X rays at first, then of ultra-violet light—while at the same time it was expanding furiously in all directions. This would again tend to cool it; but it is not at all easy to see how it could get cold enough for even the most refractory compounds to form and to condense from vapor into liquid until it had expanded so far and reached so low a density that only scattered drops of molten metal or lava would form. A mass as great as Jupiter's might be able to hold itself together but one as small as the earth would have great difficulty in condensing at all. For smaller masses the case is hopeless, and Jeffreys, years ago, concluded that bodies much smaller than the moon could not have formed independently, but must have arisen from the disruption of larger masses.

To follow even roughly the possibilities that may arise in so complex and turbulent a process will tax the utmost resources now available to investigators. But we know enough already of the properties of matter to make a further attack upon the problem attractive. Upon the results of such investigations the progress of cosmogony in the near future seems likely to depend.—*Jamestown, Rhode Island. September 1, 1936*

## Everywhere, Eyes Pointed Skyward

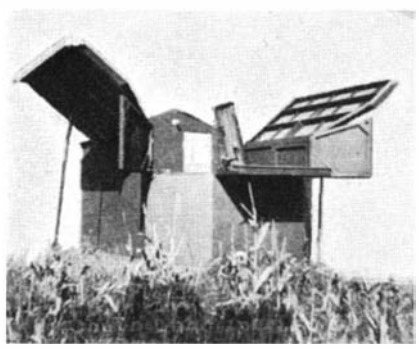
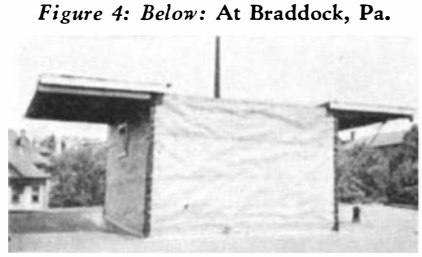


*Figure 1:* **At Potsdam, N. Y.**

*Figure 2:* **At Atlanta, Georgia**

*Figure 3: Left:* **At Davenport, Iowa**

*Figure 4: Below:* **At Braddock, Pa.**



FROM back yards and rooftops in every state and doubtless every county of the nation, amateur astronomers are nightly pointing homemade telescopes toward the skies. Four small observatories cheaply and simply constructed are shown above. Figure 1 is a housing, nine feet square, made by Frances H. Reynolds, of Potsdam, N. Y. It opens like the two lids of a box and, its owner says, "suits its purpose admirably." Figure 2 is a dome built on a rooftop in Atlanta, Georgia, by three enterprising amateur telescope makers, Williams Scott, Louis Mobley, and Glascock Reynolds. "It cost us 25 dollars," they say. Figure 3 houses a 10-inch telescope and was made by Arthur De Vany and B. A. Nordblom of Davenport, Iowa, while Figure 4 is a square observatory with roll-off roof built on a roof-top by Charles B. Wigels, of Braddock, Pa. Within these simple observatories are home-made telescopes of the reflecting variety which is considerably easier to make, size for size, than the more familiar refractor. Amateurs usually begin with reflectors of six-inch aperture, later making larger sizes.

# TAKING THE GUESSWORK

## Definite Paths of Operation . . . Pilots Exchange Information on Conditions . . . Trained Meteorologists . . . What the Dispatcher Does

OPERATORS of American air transport planes, from pilots down to the least important of the ground personnel, are rapidly learning how to avoid flirting with dangers in the air; they are also charting definite paths of operation which in recent months have removed more than half the guesswork which formerly attended the dispatching and flying of air transports on scheduled operation.

Let's take this case: Two pilots stand in the operating office of an airline at Oakland, California. One has just arrived from Los Angeles, 330 miles distant; the other is due to leave in 20 minutes for Los Angeles. Together they study two charts: One is a trip log made by the former during flight showing locations and types of clouds, altitude at which he flew, and any other pertinent information, including temperatures at various altitudes; the other is an analysis, based upon latest weather information, of the next projected flight. The second pilot checks the former's report as an aid in arriving at his flight forecast, and soon takes off, knowing precisely at what levels he should fly and what conditions he will encounter en route.

Looking into the cockpit of a transport plane. The pilot is communicating by radiophone with the ground station, receiving instructions and up-to-the-minute weather information

Although we have omitted one man from this brief picture, in the background stands the division dispatcher. Upon him rests the responsibility of actually deciding with the pilot whether a given trip shall take off under certain weather conditions. He, as a combination dispatcher and meteorologist, is the man who is doing the most to remove guesswork from flying.

THE location of all flying equipment on a specific division of an airway is made at the discretion of the dispatcher on duty. In this case such a man is the division dispatcher, who exercises full authority for the clearance of all trips within his sector. This makes it necessary for dispatchers at outlying stations within the division to request approval of contemplated clearances before actually dispatching trips from their respective stations. This is done so that the division dispatcher, the senior authority on such matters, particularly in regard to meteorological and operating problems, may hold the final authority before any dispatching from an outlying station is done.

To illustrate, let us assume that a trip is to be cleared from Fresno, an intermediate station of the coastwise run from San Diego to San Francisco. Conditions may be such between Fresno and San Francisco that it will be necessary to fly on instruments part of the distance, and fly over the top of the overcast for the remainder of the distance. In this event, the Fresno dispatcher notifies the division dispatcher at Oakland that he intends to clear the trip on instruments for the distance indicated and over the top for the balance of the trip. If, in the opinion of the

From the radio dispatch room constant communication is maintained not only with planes in the air but also with the other ground stations of the system

# Out of Flying

By T. L E E, Jr.
General Manager, Boeing School of Aeronautics

division dispatcher, meteorological conditions are such that this seems a practical and safe clearance, he will authorize the Fresno dispatcher by radio as promptly as possible that the trip may be dispatched by that station.

He acts not solely upon personal judgment, but in accord with regulations established by the operating company and the Department of Commerce, Bureau of Aeronautics, which require that certain minimum ceilings must prevail, both at the point of departure and the destination, and that conditions prevailing between those points must permit flying. Also, it is necessary under these regulations to specify alternate fields where landings may be made in the event the weather changes during the flight to such an extent that landings cannot be made according to the minimum prescribed.

Having determined that the flight may be made in safety, in the face of an overcast condition prevailing from Fresno to Tracy, the dispatcher hands the pilot his clearance.

"Flight is authorized from Fresno to Oakland, with San Francisco stop, on instruments from Fresno to Los Banos, over the top Los Banos to Tracy with alternate fields Sacramento and Livermore."

This assumes, of course, that conditions prevailing at Sacramento and Livermore will definitely permit landings there in accordance with Department of Commerce and company regulations. The clearance sheet also indicates what the ceilings are at various points of observation en route, as well as temperatures, wind velocities and directions, dew point and visibility, and any other pertinent information regarding the weather. Also, at the top of the clearance, space is provided for vital information relative to gas supply and cargo and passenger load.

After the trip has departed from Fresno it is then under the complete control of the division dispatcher at Oakland. Any changes in either the route or method of flying which may subsequently alter the weather conditions will be authorized by the division dispatcher by radio directly to the pilot in flight. The Oakland dispatcher is in constant communication with the United States Weather Bureau at the Oakland Airport. This supplements the customary hourly and three-hourly service rendered by the Weather Bureau on the teletype system directly to the station.

Dispatcher communicating with plane and second observer to aid a pilot flying over a fog bank

THE dispatcher is required to consult the government weather authorities in his sector as frequently as is necessary in order to safeguard the operation. This he is expected to do, irrespective of his own desire to rely solely upon his decisions, in order to secure their forecasts, advices, and interpretations to avoid overlooking any pertinent factors which may have a bearing on the flight but which might be missed through individual analysis on the part of the dispatcher.

In the earlier days of air transportation, relatively little consideration was given to the importance of dispatching, especially from the standpoint of meteorological observations. Consequently, most of the responsibility for determining weather conditions rested with the pilot.

Now we witness an important change. At all terminal stations there have been assigned meteorological experts who function as assistant dispatchers. These meteorologists are assigned with a view to building up in the dispatching personnel a more thorough understanding of theoretical meteorology. All the dispatchers have a thorough practical understanding of the weather situations and are now acquiring additional theoretical knowledge which will make them better fitted to handle their work. The meteorologists are also available to discuss weather situations and to assist in the analyses with dispatchers and flying personnel.

The meteorologist naturally must have a thorough background of tech-

Calculating the proper cruising speed and altitude for a scheduled flight. Forecasts of flights are made before taking off, using the best available weather data

**A pilot and co-pilot receiving the latest weather information from a United States Weather Bureau teletype receiver before starting on a scheduled flight**

nical training in order to understand the scientific elements concerned in weather interpretation. It is his duty to act in an advisory capacity both with pilots and the dispatcher under whom he functions. After completing his training at some institution such as Massachusetts Institute of Technology or California Institute of Technology, where he has taken a thorough course in engineering and advanced study in weather phenomena, he receives further indoctrination in airways weather analysis at the Boeing School of Aeronautics. The course in dispatching and meteorology given here combines instruction in these two subjects, is based on information gathered over a long period relative to weather problems encountered in flight operations, and requires for entrance a four-year course in aeronautical or mechanical engineering. By this means the men who will control all flights, assisting pilots in making flight decisions, will be versed in meteorology, air law, avigation, communications, instruments, meteorography, aerodynamics, psychology, and safety.

TAKING the guesswork from flying today begins not in the operations offices of the airlines, but in the preliminary instructions given to student pilots and young men training to become dispatchers, as well as to mechanics, radio operators, traffic employees; in fact, to all who will hold jobs connected with aviation.

The Boeing School of Aeronautics pioneered in starting flight instruction "under the hood." Here in a dramatic way is guesswork removed. For periods up to 20 hours, selected students receive flight instruction in a darkened cockpit by instruments and radio, never once being permitted to see the earth.

Today's crop of pilots learns, in the course of 20 hours, to believe their instruments and not to trust their feelings, they acquire some facility for locating and following radio beams, and they learn to apply a scientific attitude toward the handling of airplanes.

When one of these boys completes his school course and becomes co-pilot on the airline, he finds further proof that nothing is left to chance. He finds the dispatcher-meteorologist, acting as division dispatcher on day duty, supervising all scheduling of crews. He finds that superintendents of flying (chief pilots) give advanced instruction in avigation, instrument flying, and other subjects in order to keep all flying personnel equally proficient. Further, he learns that the dispatcher makes sure that all operations are conducted within the reliable limits of aids, abilities, knowledge, and experience.

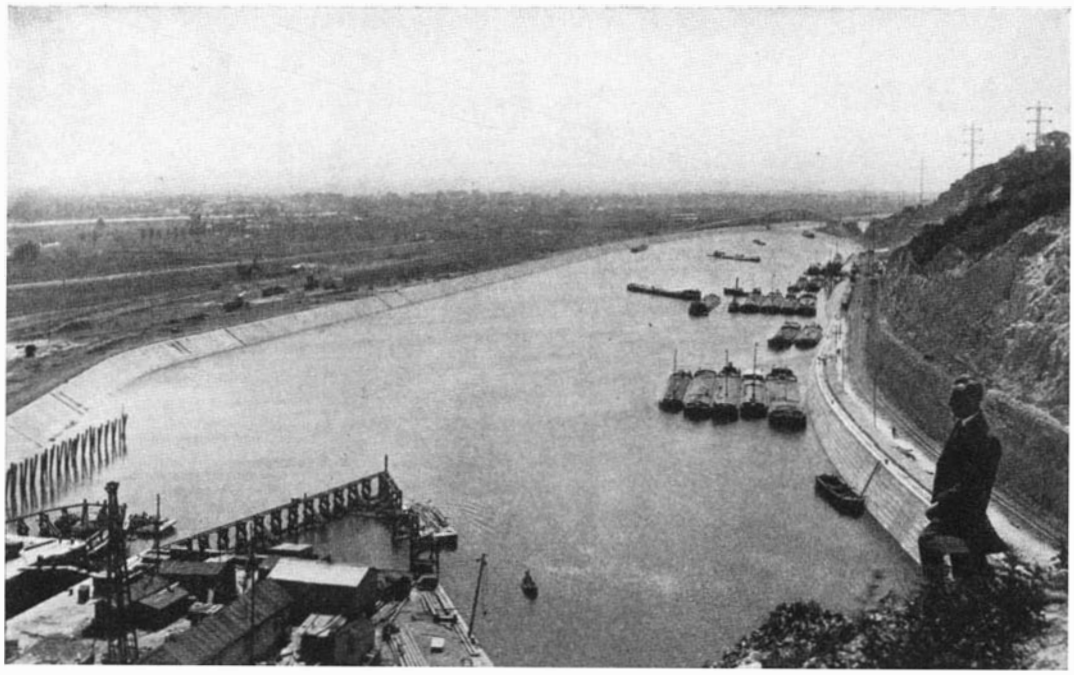
Further, the dispatcher takes the guess out of a scheduled flight because he knows the personnel and weather conditions, and also because he is familiar with the terrain over which the flight is to be made. To achieve the latter knowledge, each dispatcher makes periodic flights at least every 90 days over all sectors controlled by his authority. On these trips he occupies the co-pilot's seat on a regular scheduled flight, and makes a close inspection of all intermediate landing fields and terminals en route.

WHILE this type of dispatching is new, there have been several instances where it has given positive control from the ground over ships in flight. Such control commences with the working out of flight analyses, previously mentioned. These analyses are based upon the direction and velocities of existing winds and predicted weather situations, distances between stations, and upon the speed the pilot plans to maintain at various altitudes according to cloud conditions.

Usual operations are, of course, far more simple. After the pilot "draws the picture" of his projected flight, he and the dispatcher agree upon the plan. During flight, the pilot draws a second picture, this revealing his actual flight and conditions encountered. This practice helps make control more positive and guides pilots taking off later.

Proper dispatching and accurate prediction of conditions aloft has done more to take the guesswork from flying than any recent development. Furthermore, older pilots find that, knowing exactly what they will encounter, they not only complete their schedules with less fatigue than formerly, but usually arrive at their destinations at the scheduled time or slightly in advance. Thanks to the dispatcher, who is now becoming a meteorologist as well, schedules can be run in safety and with a precision heretofore impossible.

**Dispatcher and pilot checking the weather map. In the background are diagrams that show the weather conditions encountered during recently completed flights**



A rather large basin of the Albert Canal below Liége at Lanaye. Note the way in which its banks are concrete-lined and the manner in which the hill at right has been cut away to avoid a sharp turn

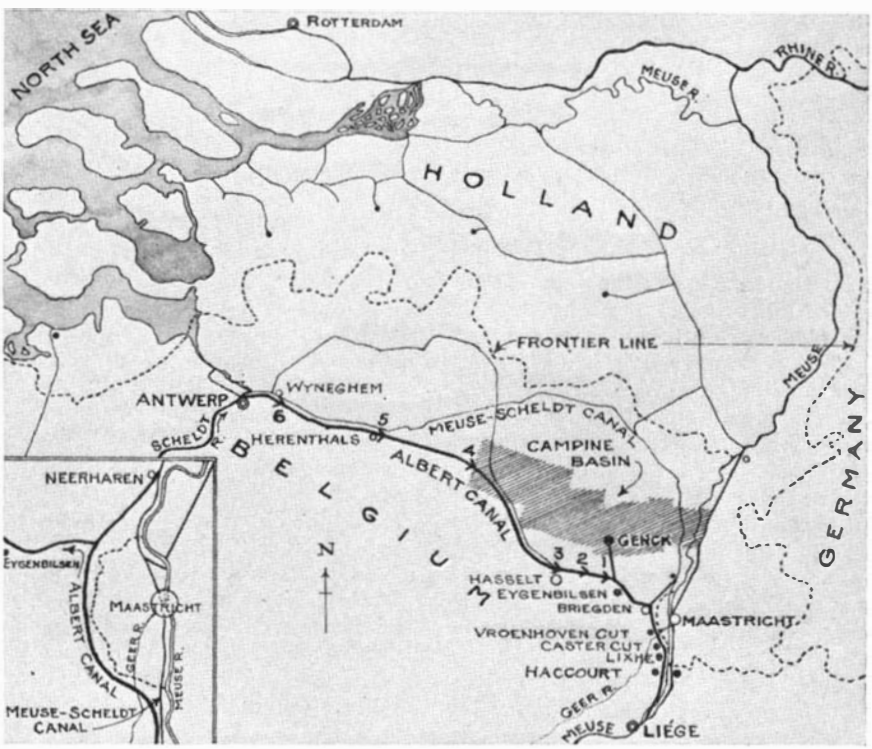
# An All-Belgian Canal

## Albert Canal . . . Started 1930 . . . Will Cost About $80,000,000 . . . Be Completed Next Year . . . Gigantic Engineering Job . . . Economically Significant

By R. G. SKERRETT

CONSTRUCTION of the Albert Canal across Belgium, linking the great Port of Antwerp with the nation's industrial center at Liége, is the outstanding task now engaging the engineers and contractors of that enterprising country. When completed next year, as scheduled, the project will have entailed outlays totaling about 80,000,000 dollars. The potential benefits, which will be many and varied, will richly compensate for the money spent upon that waterway. Building of the Albert Canal has called for the mastering of numerous monumental difficulties; yet, despite the obstacles interposed by nature, the work has gone forward steadily and even rapidly since it was started in the first half of 1930, thanks to the wide employment of typically modern machinery wherever time could thus be saved.

Belgium's extensive network of railways and natural and man-made waterways have long been used intensively in handling commodities for domestic consumption, for export, and for incoming products originating abroad. Low-cost water transportation plays a prime part in enabling Belgium to hold her own in international commerce; one of the principal reasons for the Albert Canal is to help domestic industries to make the most of the nation's natural




The old Meuse-Scheldt Canal passes through Holland but the Albert Canal avoids Maastricht (note inset). Numerals on the route of the new canal mark locks

**The Vroenhoven Cut, 186 feet deep, through which a large volume of canal traffic is already moving between Liége and the coal fields of the Campine Basin. Note reinforcement of banks**

resources, to improve her position in world trade, and to aid her otherwise in meeting the changed conditions of the last two decades.

From end to end, the Albert Canal will be about 76 miles in length. Its route traces a generally southeast course from Antwerp until it nears the River Meuse in the vicinity of the Dutch frontier city of Maastricht, where the canal swings abruptly to the south and follows the left or west bank of the Meuse to the terminal point at the Monsin Basin, close to and downstream of Liége. The course of the canal is entirely within Belgium, which is not the case with the canal that has linked the Meuse with the Scheldt at Antwerp for more than three quarters of a century. Craft bound between Antwerp and Liége have had to pass through a bottleneck, 5.28 miles long, in approaching and leaving Maastricht; and that run through alien territory has involved many sharp turns, the opening of numerous swing bridges, passage through several tunnels, moving through three locks at changing levels, and dealing with officials at no fewer than four customs houses.

DEPENDING upon the volume of traffic threading the bottleneck, the stage of water in the river, and other circumstances, that part of the trip has taken from three to eight days, while the entire run between the two terminal Belgian cities in question has averaged not less than 12 days. Certain controlling conditions have denied the use of the old canal to vessels carrying more than 450 tons of freight, while Liége has been accessible to much larger German and Dutch barges traveling upon the canals and the canalized rivers of Holland and the Rhine, with the Dutch Port of Rotterdam as their contact with seaborne trade. To this extent Antwerp has been placed at a disadvantage in handling trade between Liége and the markets of the world. Moreover, the old Belgian canal draws its water from the Meuse River at a point on the eastern frontier where an agreement between Holland and Belgium has for many years limited the diverted flow—the restriction being especially hampering to canal traffic at low stages of the Meuse.

The Albert Canal will obtain its water from sources in the valley of the Meuse and wholly within Belgian territory, so there is assured at all times an abundance of water not only for the canal but for the irrigation of hitherto undeveloped sections of the country and for supplying the collieries of the Campine Basin with essential water for industrial purposes. The old Belgian canal circles too far to the north of the Campine coal fields to serve many of the collieries in that part of the Province of Limburg, but the route of the Albert Canal has been arranged to aid that area and therefore prospectively lead to a tremendous industrial upbuilding of that region. Liége owes its industrial supremacy to its great local deposits of coal; the availability of that fuel and iron ore in the valley of the Meuse upstream of Liége has brought about the industrial growth of Seraing, Huy, Namur, Charleroi, and lesser communities noted for their metallurgical, glass, and other manufactures dependent upon large supplies of raw materials.

Belgian statesmen and leaders envision a duplication in the Campine Basin, contiguous to the Albert Canal, of what has taken place at Liége and elsewhere in the busy valley of the Meuse. Furthermore, they count upon the Albert Canal to strengthen the bonds between Flanders and the Walloon country of the Meuse by promoting closer relations and by breaking down those differences that have long existed because of the two languages in use and the contrasting historical backgrounds of the peoples of the eastern and the western sections of the land.

The new canal is of dimensions that will accommodate barges of even 2000 tons capacity; and the banks of the waterway are so formed and so reinforced as to permit vessels of 1350 tons to travel at full speed without endangering the flanking structures of the canal. When finished some months hence, this splendid artery of trade will make it possible for craft to cover the run between Antwerp and Liége in less than four days. The Albert Canal has but six locks while the old canal has 24 locks; the new route is actually 20 miles shorter than the old one, but in effect it will be 75 miles shorter because the passage of each lock is equivalent to the time required to make a clear run of 3.10 miles. It is estimated that the annual volume of traffic on the Albert Canal will be not less than 15,000,000 tons—three times as much as is now carried in a year by the old water route between Liége and Antwerp.

IMPROVEMENTS made in canalizing the Meuse, from just below Liége and extending upstream for a considerable distance, totally altered the problem for the engineers when the building of the Albert Canal was authorized a few years later. Those changes established at Liége a water level nearly 184 feet above the normal water level at the Port of Antwerp. That head of water has enabled the designers of the Albert Canal to traverse far easier high ground along the route chosen and has been especially helpful in carrying the canal across the dividing ridge that lies between the basins of the Meuse and Scheldt rivers. There is no intermediate crest at any point along the canal; the water flowing into it from the impounded Meuse at the Monsin Basin just below Liége flows thence until it is discharged into the Scheldt, making six drops in its course at the six locks that successively step down the water level about 33 feet at each change, with the exception of the lock just upstream of Antwerp, where the change is 18.7 feet. The usable chamber length of each of the several locks is 446 feet, with a width of 52.5 feet and an available depth of water over the sills of 11.5 feet.

Unquestionably, the most difficult stretch of the Albert Canal is that covered by the 35 miles from Liége northward and westward, along which the new waterway follows the valley of the Meuse and then cuts through a ridge and reaches the eastern limits of the basin of the Scheldt. A considerable part of that section of the canal is carried at a water-level elevation 32.8 feet above the normal nearby ground surface. To hold the canal aloft there, the engineers have had to resort to a form

of wall-dike of massive structure, and along one side, at least, to add an expansive reinforcement consisting of a backfill of many millions of cubic yards of earth. The new canal for some of this part of the run follows the course of the old canal but envelops the latter and submerges it more than 23.75 feet. Within a comparatively short distance of one another and but a few miles northward of Liége, the line of the Albert Canal crosses two ridges where tremendous cuts, respectively 213.25 feet and 187 feet deep had to be excavated through difficult ground—one known as the Caster Cut and the other called the Vroenhoven Cut.

The Caster Cut is through high ground lying between the Meuse and the Geer. The formation is basically of tufa stone overlaid with a deep stratum of gravel, most of the cut, however, being through stone which stands up well when exposed. The Vroenhoven Cut presented more of a problem, because the upper half of the excavation was in the much less stable gravel, and the cut had to be much wider in that material to prevent slides. The cut involved the removal of a total of 23,540,000 cubic yards of rock and gravel, which is three times as much material as had to be dug and disposed of in the case of the Caster Cut.

THE heaviest and hardest work on the Albert Canal has carried that waterway in a single reach all the way from Liége northward and westward to the vicinity of Genck, a distance of 23.61 miles. Genck, at the southern edge of the Campine coal fields, is now linked by a branch canal, 10.56 miles long, with the new trunk route. Liége and its adjoining industrial region are thus connected with the vast fuel resources of the Province of Limburg by an unbroken water route 34.7 miles in length. All bridges crossing the Albert Canal are high fixed structures that assure the free movements of shipping, and some of these structures are entirely welded and represent a distinct advance in the art of bridge engineering.

The first lock on the new canal, after leaving Liége for Antwerp, is about three miles westward of Eygenbilsen, whence the waterway follows a course generally northwest to Antwerp. Locks Nos. 2 and 3 are at intervals of approximately three miles; and between Lock No. 1 and Lock No. 3, which is at Hasselt, the change in the canal level is virtually 100 feet, this pronounced step down occurring where the canal leaves the valley of the Meuse and reaches the eastern area of the Scheldt basin. After leaving Lock No. 3, bound for Antwerp, a vessel has a clear run of 18.64 miles before entering Lock No. 4, there descending 33.13 feet to make the run of 9.5 miles to Herenthals, where Lock No. 5 is located. A lateral lock at Herenthals permits inter-communication between the old and the new canals. Between Herenthals and Wyneghem, the canal reach is 16.2 miles long; and through Lock No. 6 at Wyneghem a barge enters tidal waters five miles upstream from Antwerp. The foregoing details should make it clear that most of the reaches on the Albert Canal are of considerable length and will permit traffic to move onward at a good and steady speed. At five of the locks, the average change in level is slightly more than 33 feet, while at the Wyneghem lock the lift is but 18.7 feet. Depending upon the change in level, the locks can be emptied and filled in from eight to ten minutes. At each station, there are twin locks, so that upbound and downbound traffic can be handled simultaneously.

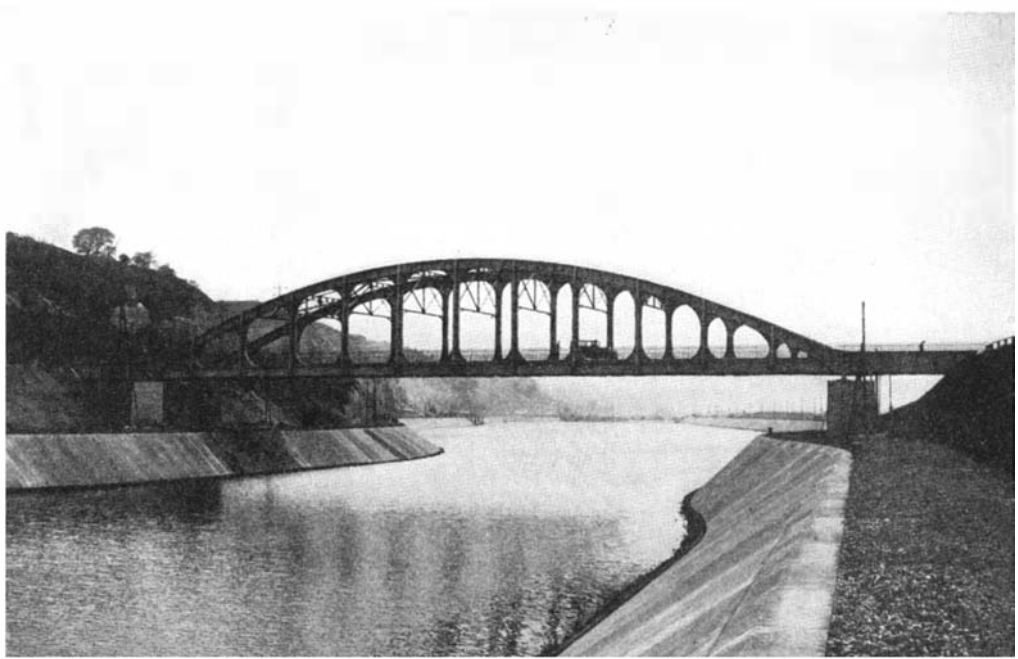
The twin chambers are interconnected so that water can be discharged from an emptying chamber into a filling chamber, thus economizing in the use of water. All the locks are typically up to date, and are operated electrically so that passage through them is rapid.

At Eygenbilsen, the canal crosses the final ridge between the basins of the Meuse and the Scheldt, and the cut there is through high land that was excavated to a depth of nearly 98.5 feet. The course taken was the shortest and entailed less digging than elsewhere. The task, nevertheless, taxed the ingenuity of the engineers because the ground to be traversed contained beds of clay and sand near the surface that varied in thickness from 16 feet to 45 feet and were saturated with water. That unstable ground rested on soft clay; and the ground had to be freed of that water to consolidate the formation and to permit the excavation to be carried to the prescribed maximum depth without fear of the slopes slipping into the cut. Without dealing with the technicalities of the problem, it is enough to say that the responsible engineers devised unusual and effective means of progressively draining away the troublesome water and of radically altering for the better the capacity of the ground to stand unmoved after the cut was completed and the canal filled with water.

In digging the Eygenbilsen Cut, as elsewhere on the undertaking, American machinery has been employed to advantage. The Belgian engineers have done numerous things by which engineers elsewhere may profit; those technicists have been equally alert to what has been done abroad in carrying out great public works. As might be expected, the Albert Canal has been linked by large modern locks with some of the Dutch canal systems tributary to the Meuse and the Rhine, so that both Antwerp and Liége will be accessible to the largest of the German and Dutch barges. This will improve commercial intercourse between Belgium and the interior of central Europe and will widen Belgium's trade in both raw and manufactured commodities, incidentally providing additional outlets, at low cost of transportation, for the coal mined in the Campine Basin.

THE Albert Canal was taken in hand by Belgium largely as a means of affording employment directly and indirectly to tens of thousands of her people in a period of economic stress. The money thus spent on the canal will not be of fleeting benefit but will have given Belgium a lasting monument to her foresight and a means of contributing to the prosperity of her people for many decades to come. Both Antwerp and Liége will register immediate gains, while Antwerp will possess added advantages over Rotterdam in world trade, through the broadening of her water links with an immense hinterland, which includes the eastern part of France.

**Modern to the last degree: the latest in canal construction and a novel type of bridge of all-welded steel which spans the canal in the vicinity of Lanaye. The clean lines are noteworthy**



# New Aids For Criminology

IN the apartment of a criminal suspect, two operatives from the Los Angeles sheriff's office found a finger print on a mirror set into a door. Unable to remove the mirror and not wishing to leave any indications that they had visited the place, one hurriedly took from his pocket a glass tube and began blowing against the print. Quickly a brown image formed, whereupon the other officer pressed a small square silver plate against the image, carried the plate to a window where he exposed it momentarily to sunlight, and as quickly the officers departed from the premises.

Again, in Los Angeles, counterfeit coins were taken from the tool box of a suspect's automobile and from his daughter, and raw metal resembling that contained in the coins was found on the gas stove in his home. Were they alike or different? Later that day spectrographic analysis was made of the elements contained in the three specimens; the pictures projected on a screen from a projection comparator, a new device, which permits rapid analysis of spectrograms, proved them to be alike.

Seemingly unrelated, these two incidents mark a new phase in the unceasing war on crime. They had their beginnings in Pasadena, California, where a few months ago was formed a scientific committee to advise with and aid the police department in criminological investigations. On that committee are scientists who have had extensive training in chemistry and physics.

Two problems particularly were submitted to the members of this committee. These were: The development of latent finger prints, so necessary for identifying criminals long after the commission of a crime; and the identification of various materials found at the scene of a crime, such as metals, ceramics, cosmetics, paint, and glass. By proving that the elements in a cosmetic smear on an ether mask were identical with powder carried in the patient's vanity case, for instance, a given practitioner might be connected with an illegal operation. Moreover, a speedy method of comparing these substances was needed.

The scientific advisers on this committee, inaugurated by Lt. A. R. Sears, are John McMorris, Ph.D., chemical consultant, and William W. Harper, consultant in physics. Individually, they focused the facilities of their respective fields on these problems.

**Blowing iodine fumes against a finger print on a paper surface. Dr. John McMorris looks on. *At right:* A finger print "raised" from a mahogany surface by the use of this method**

Dr. McMorris recognized that commonly practiced methods for developing finger prints have individual defects which forbid the use of certain methods in particular cases; further, that it has been difficult, and usually impossible, to develop latent prints on greasy surfaces, such as polished table tops, mottled backgrounds, and printed pages. More prints, he contended, have been ruined by the powder method than have been saved, particularly when more than a few hours old; likewise, the well-known silver nitrate method not only is technically difficult, but also is applicable to only a small number of surfaces.

He recognized that the iodine technique possessed certain advantages, but to date had been impossible of application in the majority of instances. In the past, finger prints have been "fumed" by placing the object within a box and filling the box with fumes. This brought out the image, but too often destroyed the evidence itself.

Dr. McMorris applied well-known chemical principles and has developed a method which makes use of the conventional iodine method, but in a new way. Since most objects which could bear a latent finger print are too bulky for enclosure in a container of iodine vapor, he developed an instrument for fuming *in situ*. This consists of a 4-inch length of glass tubing, constricted at one end for a rubber tubing connection. Into the large opening he stuffs a pad of glass wool, pours in a half-teaspoonful of iodine crystals, and pushes in another pad of glass wool to hold the crystals within the tube. The breath can be blown through the tube, carrying iodine fumes out the large opening, the iodine being warmed by the hand if greater efflux of vapor is desired.

AS stated, the instrument has its widest use on latent finger prints, particularly on greasy objects. (Latent prints consist largely of skin debris from which the oil has dried away, and possibly some chemical residue from perspiration.) Fuming is simple.

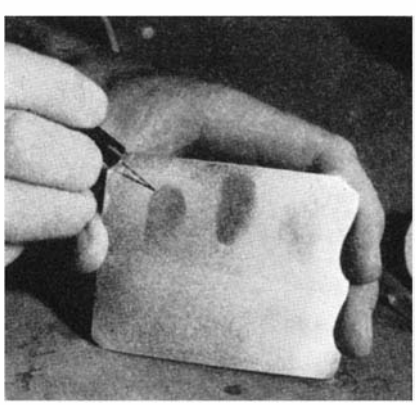
"The large opening is swept over the surface being examined," Dr. McMorris explains the technique, "very much in the style of a painter spraying a surface with lacquer. Holding the instrument about half an inch from the surface will give a good fume density and also good coverage. In actual tests, both sides of a sheet of letter-size paper were 'prospected' for prints in less than one minute.

"When a latent print is discovered,

the area where it resides can receive a more liberal fuming to yield the maximum of contrast. The amount of time required for fuming a single latent varies from one second to a fraction of a minute. Condensing of mist on glass and metallic objects is avoided by pouring a teaspoonful of anhydrous calcium chloride into the tube before introducing the iodine crystals and separating the two substances by glass wool to prevent mixing. In this way dry, warm air is forced through the crystals."

Given the developed finger print image in a beautiful iodine or brown sepia, then what?

By Dr. McMorris' method, the image is then "transferred" to a small sheet of silver, very smooth and free from scratches but not mirror-polished. Mirror-polished silver sheet pickled in sulfuric acid, which produces a silver gray matte surface, is now being used. The sheet is pressed against the image for one to 10 seconds, the time depending upon the amount of iodine taken up by the latent print. Following this "printing" process, the image on the silver is developed by exposure to direct sunlight for 30 seconds or so, or exposed at close range to a Photoflood bulb. Ordinary electric bulbs have been found to be too weak to be useful. Either the silver sheets may be preserved, if protected against strong light, or the images photographically preserved by copying the prints as they appear on the silver. Prints may be removed from the silver by polishing with silver whiting or opticians' rouge. As many as five transfers have been made from one latent image, and the last



was as good in all details as the first.

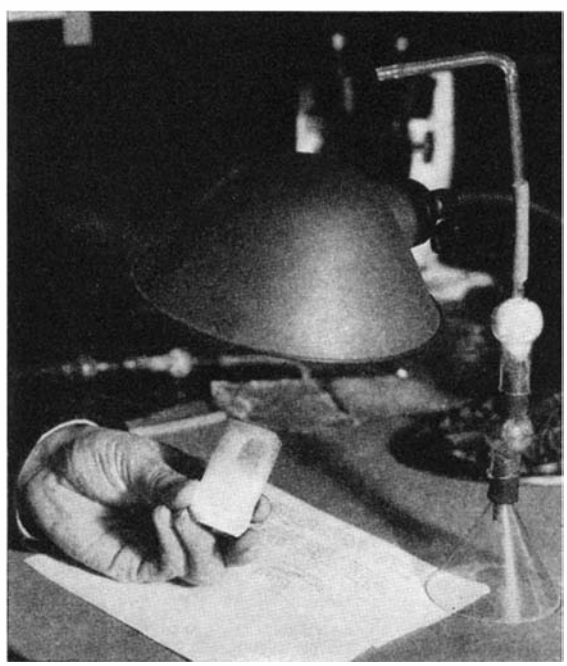
Many types of surfaces have yielded prints to the new method—waxed and polished furniture, greasy enameled kitchen stoves, cotton and silk cloth, several kinds of hardened paper (not newsprint), glass, and mirrors.

The iodine-silver method has the advantage of producing a number of prints without destroying or marring the latent

# Finger Prints "Raised" With Iodine . . . Spectrographic Analysis of Materials . . . Tiny Traces Yield Evidence . . . Contribute to Conviction

By ANDREW R. BOONE

image. In a darkened room, as previously explained, an image may be "lifted" from a mirror without removing any part of the latent and without disturbing the surroundings. The secret of its success lies in the fact that the iodine combines with the silver to produce an image in silver iodide, and on exposure the silver salts are decomposed by actinic light. What the operator then sees is the decomposed silver, for the iodine has now disappeared.



**"Developing" a finger print after pressing a silver plate against the iodine fumed surface. *At left:* Three finger prints registered on a silver plate, after a short exposure to light**

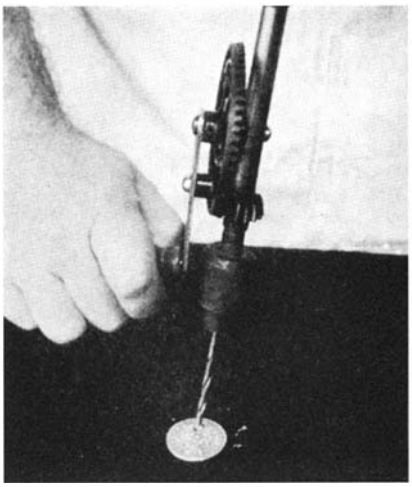
While this method is quite new, it already is being used by seventeen California sheriffs' and police departments, as well as in Honolulu.

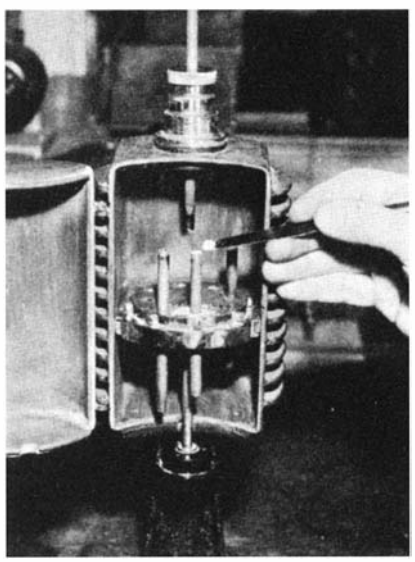
Finger prints are, however, only one form of evidence left by a criminal. Often other materials connect him with a crime. Analytical application of the spectrograph to industrial problems has led the Applied Research Laboratory of Los Angeles to the development of a special grating type of instrument. In addition a dual projection comparator was developed by means of which spectrograms of both metallic and non-metallic elements can be analyzed in a few minutes. This method not only increases the speed with which identifications can be made, but it also supplies a permanent record and removes the necessity for repeated qualitative chemical analyses, which at best often are in error. With these instruments, Mr. Harper, in association with the Applied Research Laboratory, has developed valuable new technique in the spectrographic identification of criminal evidence.

Recently a Los Angeles man faced a murder charge after a patient succumbed following an alleged illegal operation. He denied having performed the operation. In his rooms, however, was found a crude ether mask made by fitting gauze into a sink strainer. On the gauze were found red splotches, apparently rouge from the cheeks of some individual. An analysis of 12 contaminated fibers, each one inch long, proved the contamination to have come from cosmetics. Dustings from the deceased's compact checked exactly, except for the additional presence of nickel and tin. Examinations of the compact showed the surface worn away and explained the presence of these two metals. Four similar types of powder were purchased and analyzed. These showed no similarity. Thus the patient's presence under the ether mask, ownership of which was admitted by the accused, was proved.

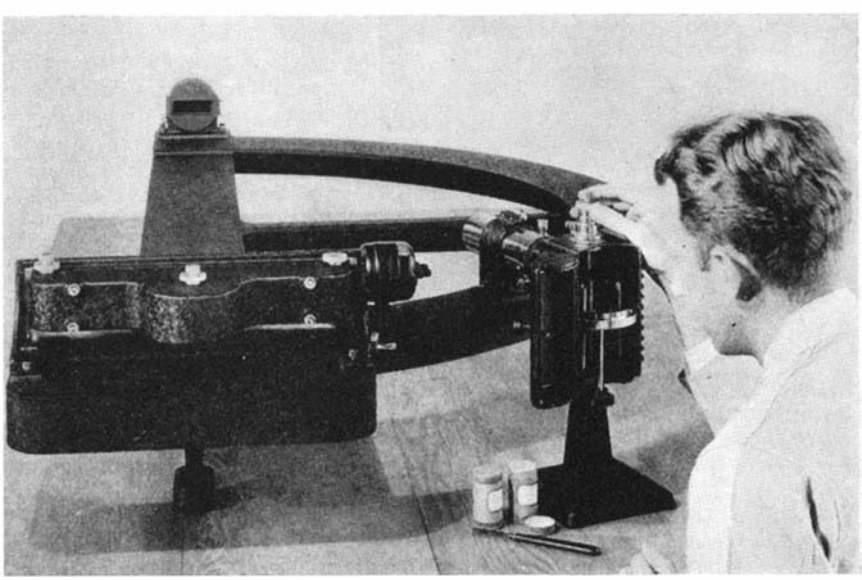
The method of heating the materials and photographing their spectrum is of interest. In the case of small amounts of metal, such as borings from a bogus coin and minute traces such as the cosmetics, small quantities are placed in cavities of a number of the lower graphite electrodes of a multiple electrode arc unit. Each electrode is successively arced for one minute, the opening in the grating through which the light reaches the film being adjusted for correct exposure. Between every two exposures iron electrodes replace the sample electrodes and an iron spectrum is photographed. In five to ten minutes, several spectrograms of sample and calibration iron may be made. Film is developed and fixed in another five minutes, after which it is dried.

"After obtaining these spectrograms of the samples to be analyzed," explains





**Taking borings from a bogus 50-cent piece. The scraps of metal are to be analyzed spectrographically. *Right:* Placing the metal on one of the electrodes of a multiple unit arc, where it is vaporized and emits light characteristic of all the elements present in the metal. *Below:* The grating spectrograph ready for use, the arc unit being in the right foreground. The semicircular arrangement permits photography of various regions of the spectrum by moving the slit and the arc**



Mr. Harper, "a method of measurement and interpretation must be employed to extract from the film the greatest amount of information in the least time. To facilitate this the dual projection comparator has been developed. It employs the well-known fact that certain lines of an element's spectrum are the most sensitive and that the identification of a few of these lines is a certain method of detecting the presence of that element in the sample. This premise is used in the preparation of a master film consisting of an iron spectrum and three or four lines of each of the elements detectible marked thereon and designated according to element. Thus a total of some 210 designated lines appear on the master film.

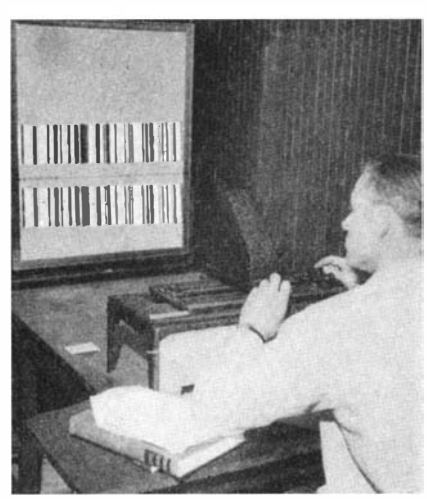
"By dual projection a small portion of the film bearing the sample's spectrum is shown directly over a portion of the master on a 24 by 30 inch screen, at a magnification of 48 diameters. After aligning these two films by means of the iron spectrum on each, the operator, in making an analysis, merely notes coincidences between lines in the sample spectrogram and lines on the master film. To observe and tabulate the elements found in an ordinary metallic alloy requires from fifteen to twenty minutes. Doubtful coincidences occur only rarely with an instrument of high resolution and always may be checked at other lines.

"In general qualitative work the intensities of the various lines are weighted visually to furnish an approximate quantitative estimate of the amounts of the elements present. In more accurate quantitative work the length of the space between line endings is read on a vertical scale at the same time the qualitative check is made. Thus with a single instrument all tedious measurements have been eliminated with a consequent reduction in the personal element. In this manner analytical speed and accuracy have been increased many fold.

"Before considering the question of the multitudinous applications of a complete set of instruments of the above type, a discussion of the sensitivity of the grating spectrograph would not be amiss. Since no quartz-air interfaces are used in the spectrograph proper, stray reflected light does not limit the sensitivity as is often the case in Littrow mountings. Also, the higher resolution and dispersion affords greater general operational sensitivity.

"IN dealing with metallic alloys, often no indication is given as to the alloy type, and the chemist must start at the beginning and make a tedius and accurate qualitative analysis before attempting quantitative separations. Often in making these separations interference occurs between various elements present, especially in complex alloys, and unless extreme care is exercised, minor constituents may be easily overlooked. With spectrographic equipment of the above type available, the first step is to make an arc analysis of the material. In examining the spectrogram with the projection comparator, the operator prepares a list of all the elements detectible. At the same time he notes the intensities of the various lines used for identification, and from a table of factors calculates the approximate quantity of each element present."

Such qualitative spectrographic analyses are of great assistance to the police, both because of their accuracy and the fact that results may be obtained and compared within 30 minutes. In the case of the counterfeiter, the method withstood cross-examination, was admitted in evidence, and contributed largely to his conviction.

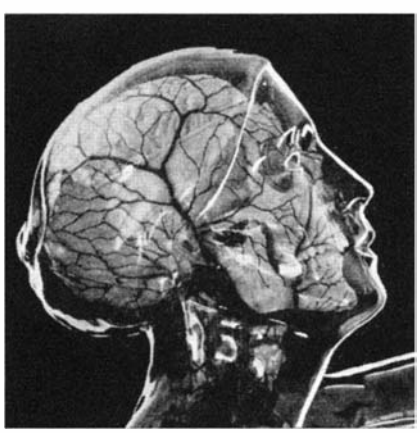


**Dual projection comparator throws two spectrograms on a screen where they may be accurately compared**

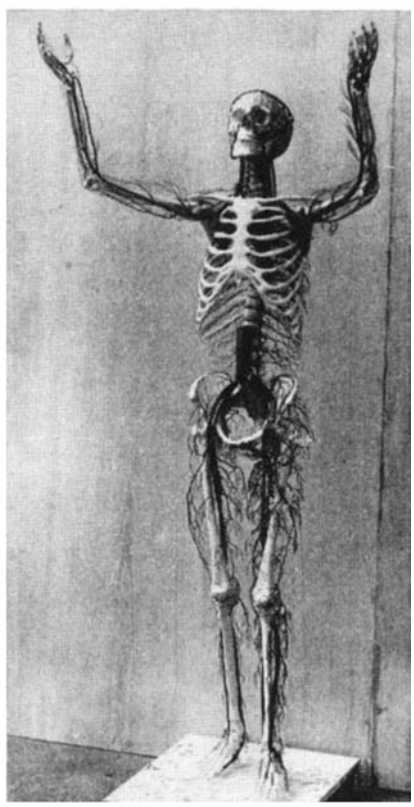
# A Woman You Can See Through

THOSE who have observed the exhibition of the Camp Transparent Woman at the New York Museum of Science and Industry at Rockefeller Center state that they are amazed at the ignorance of the human anatomy displayed by visitors.

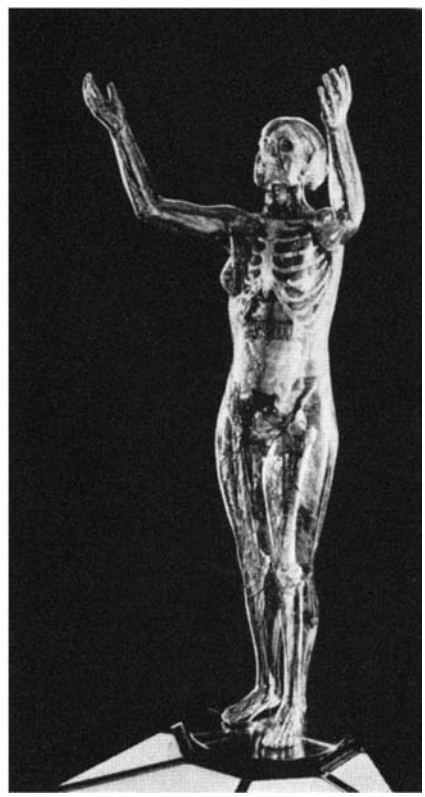
This figure was constructed in Germany, brought to this country by Mr. S. H. Camp, and, after the present exhibition, will make an educational tour of 100 cities in this country over a period of more than two years. Showing details of body structure, position of organs, blood vessels and the like, it is made of a new transparent material called "cellhorn." Lights are included in most of the organs so that a lecturer may easily call attention to their location. Four such human figures have been constructed, this being the first female figure. It required 23 months to make and employed the services of many people, including medical authorities and scientists, artists, sculptors, laboratory workers, wood carvers, etc.



**The modeling of the skull and the position of the principal blood vessels are shown in this view of the head of the transparent woman**

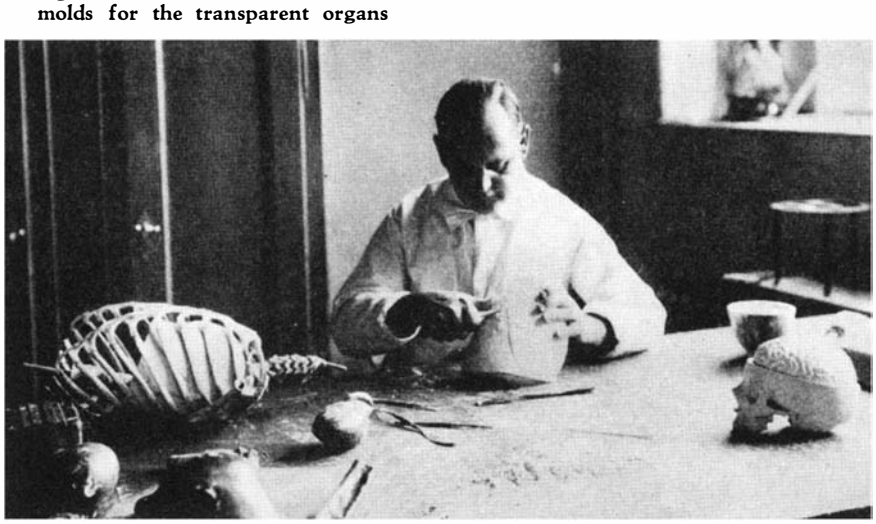


**The completed figure, with its arteries and veins, before the various organs are attached. When complete, the figure will be covered with a transparent "cellhorn" shell**



**The completed figure in its "cellhorn" body-outline shell which is made in two pieces so that it may be opened for replacing lamps or for minor repairs. The shell was made from a plaster cast that was, in turn, made from a living model**

**One of the many specialists working out in careful detail the master molds for the transparent organs**



**Perfect reproductions in "cellhorn" of the organs of a woman's body. These include several of the glands, the brain, liver, kidneys, heart, there being a total of 21 organs**

# A Find That Did Not Ring True

## A Problem Solved, Though Solved Negatively... The Story Is a Naïve One... Mr. Brennan's Quick Irish Imagination... Practical Joke, WPA Workers

By ALBERT ERNEST JENKS
Professor of Anthropology, The University of Minnesota

**A FEW scientists of the old school were said to lack a sense of humor, but today science is no longer on the defensive, and so it feels it can see the point of a joke as well as "the next fellow"—for example, as well as an editor!**

**An Oregon Irishman hoaxed a local amateur archeologist in Minnesota and the amateur archeologist reported the find to this magazine. His article—a brief one of one-page length—was published in the June number, and it asserted that the dating of man's sojourn in America had been pushed back to more than 20,000 years ago by the Minnesota finds described. The author was a superintendent of schools and a doctor of philosophy, which appeared to lend credibility to his article.**

**Just what happened afterward is told in the accompanying sequel, written by a noted anthropologist-archeologist who uncovered the hoax. Let us not "pick on" Mike Brennan, the villain of the plot, for his prank—unless we are sure we would ourselves resist a similar temptation.—*The Editor.***

THE documented history of the find reported in Scientific American, June, 1936, begins December 27, 1935, when Mr. Oscar B. Larson, Village Clerk of Biwabik, wrote a letter to the Minnesota Historical Society. The Larson letter follows:

"You may be interested in the fact that a number of Indian relics including arrow heads, spear heads, and one tomahawk head made of flint, jasper, and obsidian have been found in a peculiar geological formation south of Biwabik.

"I would estimate that about 20 or 30 of these have been found to date.

"They were dug up by WPA road workers while cutting through a hill. They were found approximately eight feet under the top layer of soil. The top soil is of clay and the relics are found in a sandy ground mixture that lies directly beneath.

"Those who are familiar with Indian mounds in this vicinity definitely claim this is not a mound."

Mr. Larson's letter was forwarded to me December 30 by Mr. Willoughby M. Babcock of the State Historical Society, who wrote that the discovery sounded like an interesting one and that he passed the information on for our files.

On January 3, I acknowledged the Babcock letter and wrote Mr. Larson the following letter:

"A copy of your letter written December 27, 1935, to the Minnesota Historical Society, Saint Paul, has been forwarded to me by Mr. Willoughby M. Babcock, Curator of the Museum and Archeologist of said Society.

"At this time I do not see how we can come to Biwabik, though the most strenuous effort would be made to do so if conditions seem genuinely to be what they appear.

"Perhaps you can help during the next three days in getting us some accurate information. Did you see the flints in place or can you give names of the best educated and most reliable persons who did see them in place? Can you get the information as to what became of the flints, etc.? Also, was the position in which these '20 or 30' flints were found entirely obliterated by the digging of the road workers or does it extend into undisturbed gravel at one side of the road cut? Also do you know if any surveys were made to ascertain location; also whether any photographs were taken so the relation of the clay and the sand immediately beneath shows?

"Any other more detailed information that you can give regarding it we will greatly appreciate."

Mr. Larson made no immediate acknowledgment of my letter and later told me he had turned it over to Superintendent C. E. Hagie of the public schools of Aurora, a neighboring town. Superintendent Hagie wrote me regarding the matter on January 13. Thereafter a few letters of no significance in the history of the case passed between us. Later he twice visited the Departments of Anthropology and Geology of our University.

On March 27, 1936, with Mr. Lloyd A. Wilford, Department of Anthropology, University of Minnesota, I visited the site with Dr. C. W. Bray and Mr. Oscar B. Larson, both previously mentioned.

During the winter of 1935 and '36 and still on, a WPA project employing local men has been getting gravel for nearby roads from an extensive deposit of sand, gravel, and clay in a section of a future highway in Biwabik township of St. Louis County, Minnesota. close to the eastern end of the world-famous Mesabi iron range.*

The WPA men were at the site on the date of our visit. Men who had rescued the artifacts in December fortunately were present March 27 and verified the three different loci, some 12 or 15 feet apart, from which the artifacts had been taken.

The site of the find is in the St. Louis drainage. The cut in the roadway clearly shows the superposition of the Keewatin till over older outwash of the Wisconsin glacier.

THE several workmen who found the "flints" reported them as immediately beneath a layer of red clay (Keewatin drift, stained red by the local iron ore) some two to three feet thick, and as in the upper few inches of a layer of sand and gravel (apparently the earlier Patrician drift of the Wisconsin glacier). The "flint" artifacts therefore seemed to be datable, and datable, probably, with greater precision than any now reported of glacial age—that is, provided they had been left by their original, prehistoric owners where reported as found.

On our March visit, excepting where men were working, the ground was covered with snow, and was frozen many feet deep. Sand and gravel removed by the crew were blasted loose with dynamite. Within three feet laterally of the spot from which most of the recovered flints had been secured, we broke loose a piece of frozen matrix weighing about four pounds. This we took back with us.

*To be more specific, the site is some seven miles southwest of the village of Biwabik and in the roadway between the S.E. quarter of the S.E. quarter of Section 28, Town 58, Range 16 (on the north side of the roadway) and the N.E. quarter of the N.E. quarter of Section 33, Town 58, Range 16 (on the south side of the roadway).

Again, June 5 to 7, I visited the site with my colleague, Dr. George A. Thiel, geologist. The gravel crew was again working. All the information we then secured was confirmatory of our earlier information. Samples of till were secured by Dr. Thiel and taken back to the University. Their chemical and petrographic analyses showed the clay overlying the level bearing the "flints" was Keewatin drift and the sand and gravel immediately beneath the clay showed many characteristics of the Patrician drift. Geologically the setting of the find seemed to be both clear and of unique importance.

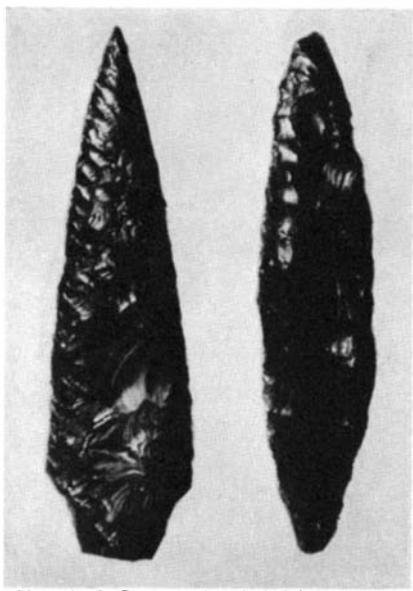
Archeologically the find did not ring so true. To be sure, extremely interesting aspects of the problem lay in the fact that all the artifacts obtained by the WPA men are obsidian—which material is not known to have been found in Minnesota except rarely in the form of isolated artifacts. Most of the Biwabik artifacts are patinated and a few are so completely obscured by patina that their nature can not be determined by eye or glass. Again, several of the artifacts carry the scars of the typical Yuma-type of diagonal chipping. The spear head shown at the left in the accompanying illustration reveals clearly the diagonal scars.

BUT, though the first "flints" we saw from the site were large, one a knife and the second a spear head, 14 of the 17 I have now seen are of types known as "arrowheads" (most of them are illustrated in the June article of Scientific American). Arrowheads! Nowhere in the world is the bow-and-arrow invention dated as early as in Paleolithic time. How, then, could one consider "flints" in the form of arrowheads as of glacial age? But the problem was unsolved and demanded solution.

Then came Superintendent Hagie's article in the June Scientific American, which contains this statement:—"Mr. Hill, my research worker, and I, are convinced that the coarser sand represented the filling material of a burial in the stratified sand, at a date before the last glacial period."

With such definite interpretation of the site, the solution of the problem now assumed even more importance.

With Mr. Wilford and six advanced students of the University of Minnesota, I was at the site from June 18 to 24. While further working out the interesting geological stratification at the site, we were on the lookout for any evidence of ancient man at the place. None whatever was discovered. We found no other "flints." There was no evidence of any kind of artifacts. Neither were used objects discovered, such as hearthstones, crude hammer stones, or flint flakes slightly modified by use. There were no flint chips and no broken rejected pebbles, such as are found in all major Minnesota archeological diggings. There was no evidence of camp fires. Not a single piece of food refuse was discovered, whereas at habitation sites and in mound dirt in Minnesota animal bones typically broken in food preparation, but unconsumed, are common. We found no evidence of burial pits. Archeologically, nothing looked as if the find was due to habitation, mound, cache, burial, spring site, trail, or place of rendezvous. There were too many artifacts to be considered typical of the frequent isolated surface finds. What other explanation was there which seemed to fit the facts?



Photos by P. Dittis, Anthropological Lab., Univ. of Minn.

**Obsidian artifacts "discovered" at the Biwabik site in late December, 1936; believed to have come originally from Oregon. About 2/3 size**

During our days at the site I talked with all the WPA workmen, purchased a number of the artifacts which they had found in December at the pit and along the roadway where gravel had been dumped, and followed up rumors which came to me. As a result of our research we quit work at the site at noon June 24, with the assurance of a problem solved, though this time solved negatively.

The story is a naïve one. It came to me directly from the wife of Mr. Mike Brennan who, in December, 1935, worked at the gravel pit. Mr. Brennan had lived some time in Oregon and was there an employee of the Weyerhauser lumber interests. In Oregon he had picked up numerous obsidian artifacts and brought several of them back to Biwabik during a period of lumber inactivity. In December word came from Oregon that Weyerhauser work was available. So Mr. Brennan got his trunk down preparatory to packing it for his trip westward. In it were the obsidian artifacts from Oregon. What was he to do with them? Here entered a bit of ethnic psychology!! Mr. Brennan's quick Irish imagination saw a joke in the offing. He and his wife's brother, Gust Steckman, also a worker on the gravel project, hid the artifacts in several places at the pit for their fellow workers to find. All plantings were in the sand and gravel close beneath the clay. They could not be elsewhere, since the crew was loading only sand and gravel loosened by blasting.

Mr. Brennan was among the fortunate finders, workmen telling me that he found at least one of the artifacts, gloated over its discovery, and put it safely away in his pocket. Gust Steckman also found one and gave it to Clifford Goldsworthy, a fellow worker, from whom I obtained it.

Within a few days following the find Mr. Brennan returned to Oregon. His brother-in-law has also gone there to work, so I have not consulted either of the men said to have done the actual planting. However, I have no doubt the "flints" were planted substantially as here recorded. I quote from my note book of June 24, written shortly after consulting Mrs. Brennan.

"Today I saw Mrs. Mike Brennan in Washington School building, Biwabik, Minnesota, where she cooks lunch for the neighborhood children attending a Nursery School in said building.

"She told me she was very glad I came to her, because she wished to tell someone about the plant her husband had made as a joke on his fellow workers at the gravel pit.

"She said she had no idea the matter would go so far and of course had no idea it would be considered of scientific importance."

In an effort to allay further disturbance by Indian ghosts of the past, Mrs. Brennan's signed statement regarding the plant by her husband follows:

Biwabik, Minnesota
June 26, 1936

"This is to say that I know personally my husband, Mike Brennan, put the obsidian 'flints' into the gravel near the common corner to Sections 27, 28, 33, and 34, 58-16 at Eshquaguma Lake, St. Louis county.

"It was done solely as a practical joke on Mike's fellow WPA workers at the gravel pit.

(Signed) Mrs. Mike Brennan"

To the June article the Editor of Scientific American appended this note: "Only time and detailed investigation will permit the exact significance of the finds described above to be assessed." Evidently sufficient time and investigation have followed the find to warrant the conclusion that the artifacts are of Oregon origin and were planted at the Biwabik gravel pit as a joke—but not as a vicious joke and with no intent to mislead archeological interests.

# Frog Farming

Frogs living in ideal surroundings

TO all the other myriad kinds of farming, one must now add bullfrog farming. Raising the deep-voiced bullfrog is rapidly coming to the forefront as an important and sizable industry, especially in the southern states.

To the hundreds of frog hunters scattered throughout the South, the full-throated bass voice of the leather-lunged bullfrog always conjured up visions of delicious frog legs frying in hot butter. But now the sound of the nocturnal singers' mellow call opens up visions of profits to be easily made, and the spear, the rifle, and the light have given way to strings of ponds, with lily pads galore and a bullfrog with a tremendous area of back legs sitting on every pad.

There seems to be plenty of profit in this comparatively new industry, if properly conducted. Costing but a couple of cents or so to raise each of the creatures to maturity, they are sold to hotels, cafes, restaurants, and clubs in the larger cities for anywhere from one to eight dollars the dozen. And since government surveys* of the frog industry recently brought out the fact that the supply at present rarely equals the demand, there is plenty of reason for the enthusiastic attitudes of the frog farmers.

SO great is the interest being aroused in bullfrog farming that a leading farm magazine not long ago devoted an editorial to the subject, commenting somewhat humorously on the importance of Louisiana's frog industry and the fact that Mussolini, through his agricultural bureau, has imported 40 large frogs from California, instead of Louisiana, to bolster up his own country's waning stock of bullfrogs. The magazine said:

"Casting an omniscient eye over his sunny peninsula not long ago, Premier Mussolini noted with cold disapproval that Italian frogs were spindling, unprolific creatures with little meat on their hams. This, of course, was not as it should be. To win even the casual approbation of Il Duce, one fancies, a frog would have to have the heart of a lion and a chassis at least as broad as a dinner plate. Certainly it would have to sing bass.

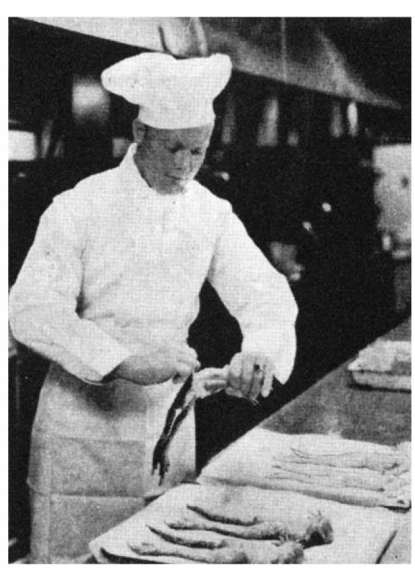
"At any rate, it was the premier's will that his country should become, at all costs, nationally self-sufficient in frog legs. Promptly, upon executive order, a couple of tubsful of selected breeding stock were brought to Mediterranean shores—from California!

"Louisiana folks, of course, will see in this the villainous work of the Los Angeles Chamber of Commerce, or perhaps the sly hand of Mark Twain. Is it possible that Il Duce swallowed whole Mark's mischievous tale of that celebrated California amphibian, the jumping frog of Calaveras County? Has no one told the Italian premier about the incredible wheel base of Louisiana frogs—frogs whose hindquarters have to be sliced off in steaks to fit into a frying pan? Has he never heard that there are patriarchal green-backed monsters in the bayou country the thunder of whose voices rattles the windowpanes in dwellings five miles distant? Why, for years it has been a toss-up whether Louisiana's chief state pride was the Mardi Gras festival or the phenomenal size of its croakers."

In raising bullfrogs, any piece of bottom land, marsh, lagoon, or pond, well shaded and with an abundant growth of aquatic life and vegetation, is suitable. Many farms are enclosed with boards standing upright or with wire, set deep enough to keep out enemies of frogs, among which are snakes, alligators, hawks, rats, cats, and even the larger frogs of the same or other species. Because of the cannibalistic trait of bullfrogs and because disease follows overcrowding, it is necessary to separate the three different sizes—tadpoles, young frogs, and mature frogs.

IN some sections of the South rice fields are used for frog farming operations. Willows and other shade trees are planted along the banks and the water is never permitted to get any deeper in the areas than is necessary to protect frogs and tadpoles from excessive heat in summer and from freezing temperatures in winter. The depth usually runs from two to six inches in summer. This is also a good average depth for natural frog foods to thrive in. Of course, there are parts of the frog pond in which deeper water is found, due to natural depressions.

The problem of supplying food to frogs after they had reached the adult stage was, for a long time, the main drawback to successful commercial frog



Skinning frogs

**UNSCRUPULOUS individuals are quick to take advantage of new situations of which little is known. The frog-raising industry has been no exception; breeding stock is being offered at exorbitant prices to gullible would-be "frog magnates," who are baited on with glowing promises of huge profits. The National Better Business Bureau is coping with the situation; careful investigation is urged wherever frog farming is being considered as an investment.—*The Editor.***

*"Frog Culture and the Frog Industry," Department of Commerce, Bureau of Fisheries.

## Natural Supply Rarely Equals Demand . . . Italy Imports Breeding Stock from California . . . Problems of Feeding . . . Farming Replacing Hunting

By FRANK A. MONTGOMERY, Jr.

A large bullfrog of the type grown commercially on many frog farms

farming. This problem was due to the fact that frogs, after they leave the tadpole stage (during which period they will eagerly eat any sort of soft vegetable or animal matter), absolutely refuse to eat anything but live food, or food that moves. As soon as legs develop, bullfrogs leave the water and perch on lily pads or on a shady bank, where they immediately begin an intensive search for small insects and the like. As they increase in size they snap at increasingly larger forms of animal life, until in full adult size, they do not hesitate to take a 3-inch fish or a young turtle or terrapin.

THE Japanese, who have for many years engaged in intensive frog farming, solved the problem of feeding the adult frogs in a simple manner, and their methods have, to some small extent, been introduced into frog farming operations in the United States. The pupae of the silk worm is the food utilized in the feeding operations devised by the Japanese; they are placed in long, shallow, wooden trays containing about half an inch of water and anchored close to shore. There the trays are kept in a sort of rolling motion, and as long as this motion is continued the frogs greedily devour the grubs.

Strong lights along the shores of the rearing ponds are also used on frog farms for attracting insects, especially in the early part of the night. Large incandescent lamps attract many June beetles and medium-sized moths, food greatly relished by bullfrogs. Arc lights attract even larger insects, and as they circle the powerful lights they become exhausted and drop to the frogs waiting below. In another method of obtaining live food for the bullfrogs, various sorts of flowers are planted along the borders of the ponds to attract insects.

Up until the past few years, during which time it was determined that bullfrogs really could be grown successfully on a commercial scale, almost the entire supply for the United States was furnished by frog hunters who hunted their quarry at night. These hunters spotted their prey with lights, and either shot the bullfrogs with small rifles or speared them with small gigs. At one time there were reported to be over 3000 of these hunters who placed on the market close to one million pounds of bullfrogs annually.

THERE are still hundreds of these commercial frog hunters scattered about the country, and they still produce a goodly portion of the country's supply of frog legs. But due to the uncertainty of the wild supply, it is said that the trade is showing an increasing preference for the bullfrogs produced on farms.

According to food experts frog legs compare favorably with beef, chicken, veal and fish, in food value, although not quite as high in protein content. A characteristic of frog meat is that it has very little fat or carbohydrates, which is credited with the source of its delicious flavor. But the greatest appeal which this sort of meat makes is due to its delicacy and palatability, which places the dish in the front rank of epicurean luxuries.

By-products of frog farming hold interesting possibilities. In France and Japan they yield a good return to frog raisers. In these countries the skins are made into glue, one large skin producing three ounces of the finest glue, which is said to be especially good for mending crockery and the like. The skins are also utilized as leather for binding small books, lining purses, and for similar uses.

Capturing frogs for market, on a modern frog farm

# THE SCIENTIFIC AMERICAN 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


## How Do You Read?

FOR a better understanding of reading problems and for improving visual efficiency in reading, the Ophthalm-O-Graph and Metron-O-Scope have been developed. The Ophthalm-O-Graph is a portable camera which photographs and records eye movements while reading. The Metron-O-Scope is an automatic and extremely flexible instrument for correcting inefficiency in reading and establishing efficient reading habits.

**The Ophthalm-O-Graph in use**

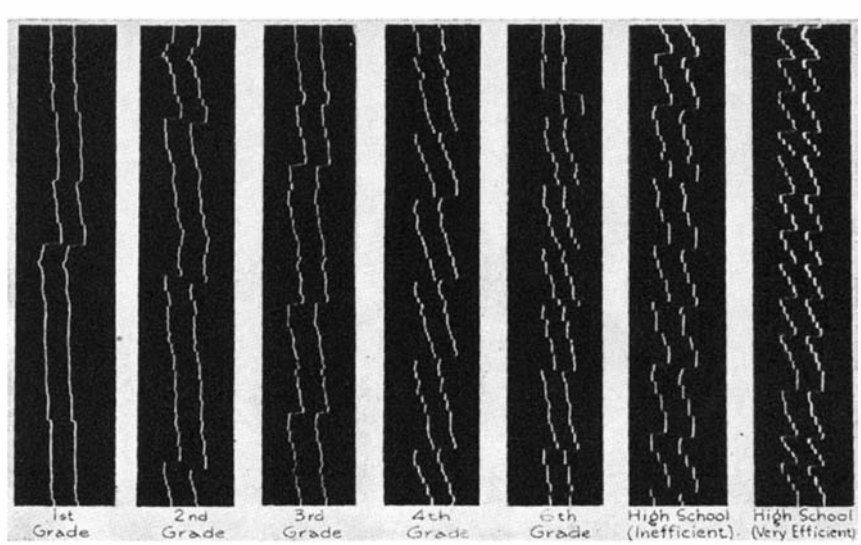
In order to secure a photograph of the eye movement with the Ophthalm-O-Graph, tiny lights are focused on the eyes and reflected from the corneas. The reflections, magnified more than four times, are readily seen in the camera view-finder. These pencils of light move with every movement of the eyes. Turning a switch starts the film moving, and while the subject reads a card placed on the instrument, a permanent record of the eye behavior is secured in a few moments. Standard 35-millimeter film is used. The findings of the Ophthalm-O-Graphic records can be used advantageously in conjunction with the usual reading tests. The film shows how effectively the reader attacks the lines of print and a set of questions checks his comprehension. If the eye movements are not in rhythmic manner from left to right, but are jerky and backward, these conditions are recorded on the film and can easily be diagnosed; so can faulty co-ordination between the two eyes.

An accompanying illustration shows photographs of typical eye movements of school children. Instead of making the steady yearly improvement which these records show to be desirable, many pupils do not advance without special help. It is not unusual to find college students still using the amateurish reading technique they used in the third or fourth grades. The eye-movement photograph points out the fault and in many instances indicates the necessary steps for improvement.

The Metron-O-Scope is used for both teaching and remedial measures in reading. In operation, it presents words or phrases in a rhythmical progression from left to right across a horizontal line, and the subject is thus encouraged to perceive larger thought units with each fixation and to make his fixations in the smooth effective manner of the efficient reader.

In actual practice, the instructor sets the instrument at the desired speed, inserts the selected roll of printed material, and starts the motor. After the class has finished reading the selection, a series of questions appears for discussion and complete check on comprehension.

Instructors in several prominent educational institutions have found this technique very satisfactory and say that it answers many reading problems.




**Photographs of eye movements made with the Ophthalm-O-Graph**

### WORLD'S LONGEST

**FROM the Texas Panhandle to the plants and homes of Detroit, the world's longest gas line has just been completed to supply southern gas to the northern city. The line is 1580 miles long.**

## Liquefied Gases as Fuel

BUTANE, propane, and pentane, recovered as liquids from natural gas by compressing them, are rapidly becoming important fuels for both industrial and domestic use. In the liquid form these hydrocarbons can be shipped to points of use under pressure. When the pressure is released they boil at the temperature of the

atmosphere and may be used for fuel in the same way as other gases. In 1935, 76,855,000 gallons of these gases were used as fuel, 62.3 percent being consumed by industries. Their widespread use is indicated by the fact that 29,516 consumers in 163 communities in 29 states were supplied with such fuel by 68 companies.—*D. H. K.*

**CYCLOTRON**

**TWO more cyclotrons have been ordered from a noted steel company, one for the Franklin Institute and the other for the University of Chicago. Important research is expected to be accomplished by this new scientific tool developed by Professor Ernest O. Lawrence.**

## Shocking Elm Borers

ELM borers infesting the trees of Victor H. Schmidt, of Kansas City, were dislodged in a manner literally quite shocking, reports *Science Service*. Mr. Schmidt, weary of digging them out one by one with a pocket-knife, drove in a couple of nails a few inches apart, attached wires, and "turned on the juice" from a small magneto he had rigged up for his children to play with, and which they had previously been using to get angleworms out of the ground. Out came the borers in a very few seconds. Subsequent digging with the knife showed that the electric method had forced a 100 percent evacuation of their dugouts.

In a report to the weekly journal, *Science*, Mr. Schmidt suggests that perhaps a more powerful current might be used to advantage by nurserymen and orchardists.

## America's First Patent

THE first patent ever issued in America was granted in the Colony of the Massachusetts Bay in New England to Samuel Winslow for a chemical process, the manufacture of salt, on the second day of April, 1641. The wording of the patent shown in the accompanying illustration is as follows:

"A GENERALL COURT OF ELECTIONS, HELD AT BOSTON THE 2th, 4th Mo., 1641.

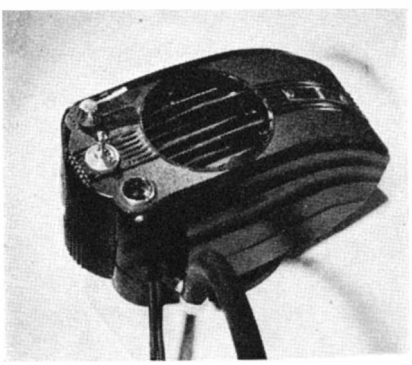
Whereas Samu: Winslow hath made a pposition to this Court to furnish the countrey wth salt at more easy rates than otherwise can bee had, & to make it by a meanes, & way, wch hitherto hath not bene discovred. It is therefore ordered, that if the said Samu: shall wthin the space of one yeare, set upon the said worke, hee shall enjoy the same, to him & his assosiats, for the space of 10 yeares, so as it shall not bee lawfull to any other pson to make salt after the same way during the said years; pvided, nevrthelesse, that it shall bee lawfull for any pson to bring in any salt, or to make salt after any othr way dureing the said tearme./."—*D. H. K.*

## Growth of Yeast

UNDER ideal conditions at 30 degrees, Centigrade, yeast will double its weight every two hours. This means that a pound of yeast started to grow at 8 o'clock on a Monday morning would by 6:30 A.M. on the following Monday have grown to a weight equal to that of the earth ($6 \times 10^{27}$ tons). Before entering the yeast business on the basis of these figures it is worth while to consider that the yeast would have consumed many times its own weight in food during the week of growth.—*D. H. K.*

## For Safe Driving

A NEW defroster fan to clear the automobile windshield of ice and sleet, steam and dust is driven by a vacuum motor



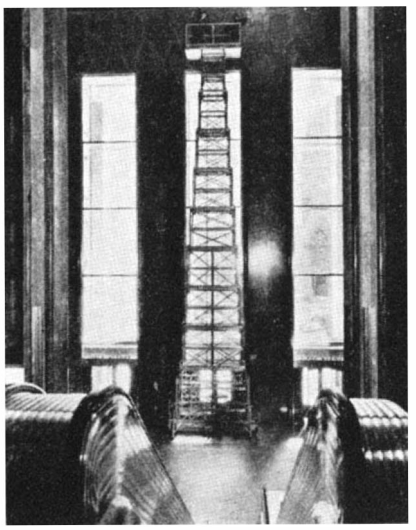
**Fan-type windshield defroster**

operated from the intake manifold. Operation of this device does not, therefore, drain the battery.

This new defroster, built by the Babcock and Bishop Manufacturing Company, may be installed on any car. The entire unit (see illustration) is in a modern Bakelite case.

## Up and At 'Em

LIKE the enthusiast who built a boat in his basement and had to knock a hole in the side of the house to get it out, Rockefeller Center had to devise a means whereby The Great Hall in the International Building, with its 56-foot high ceilings, could be kept clean.



**Nine telescoping aluminum frames for reaching 56-foot high ceilings**

Setting to work, Rockefeller Center architects and engineers, plus the Economy Engineering Company, evolved the world's highest telescopic tower for cleaning purposes and it is believed to be the first made of aluminum. Consisting of nine concentric telescoping frames rising out of the base, the tower rises 49 feet. The base itself is less than seven feet high to permit its being moved through the doorways. The electric motors can hoist 500 pounds to top height in four minutes and nine seconds.

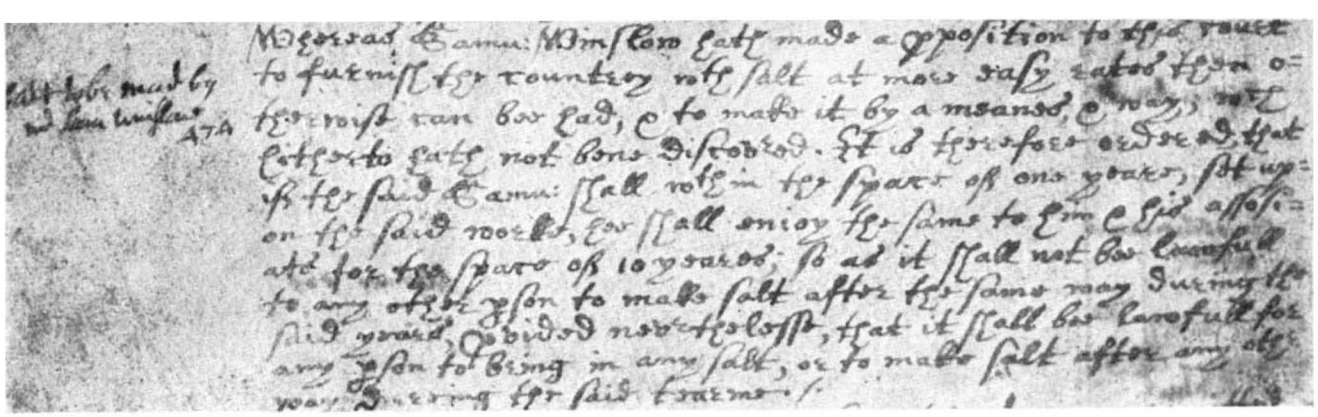
This modern electric jack-in-the-box weighs 3900 pounds, which includes 1400 pounds of aluminum.

## Ozone is Poisonous

CHEMISTRY is shattering the popular fallacy that ozone is a bounteous source of human health and vigor. Ozone is confined chiefly to the stratosphere, has proved ineffective against tuberculosis, and were it not for excessive costs and instability it could be used as a war gas, scientists find. It is now believed to have no place in air conditioning.

The latest investigations in this field were reported to the ninety-second meeting of the American Chemical Society by Prof. H. B. McDonnell of the University of Maryland. In Prof. McDonnell's experiments, low concentrations of ozone shortened the lives of guinea pigs. Even those which had been inoculated with tuberculosis died sooner than they would have otherwise.

Ozone, according to Prof. McDonnell, is extremely poisonous when inhaled in higher concentrations. "It is a violent irritant



Courtesy Arthur D. Little, Inc.

**Try to decipher this reproduction of the first U. S. patent; then refer to text above**

of the mucous membranes and reacts chemically with the mucous forming a thick froth which, when using the higher concentrations, stops the air supply to the lungs almost completely in a minute or two. There is no indication that the ozone is absorbed and acts as a systemic poison. In lower concentrations the result is pneumonia and bronchitis which may or may not result fatally.

"It is impossible, of course, to say just how much a lethal dose of ozone is. Certainly 0.1 milligram per liter of air is highly dangerous if inhaled for as long as one hour. For daily routine a concentration of one part per million, by weight, is undesirable, and probably dangerous. One-tenth of this amount would, probably, be harmless.

"Ozone has been suggested as a war gas and its high toxicity and specific gravity are in its favor for such use. However, the great difficulty and expense of preparing it in pure condition and its instability, making it impossible to store it under pressure, at once rule it out for such purpose."

## Flame Sculpture

CHARACTERS from the famous "The Wizard of Oz" books, "The Arabian Nights," and the legend of St. George and the Dragon have been sculptured in metal by means of the oxy-acetylene process. The Pumpkin Man with a hollow head and wearing a swallowtail coat, the Patchwork Girl dressed in a patched dress and pantalets, the Scarecrow Man with a straw hat, and the Castle of Oz have been fashioned in metal by means of the flame. The dragon that St. George fought rears its ugly head once again and bares wicked fangs of steel while its scaly serpent's body writhes in ensnaring coils. Dancing girls and houris garbed in gossamer metal costumes entertain a metallic Satan while butterflies flit about among steel tamarack trees. Thus do the artistic abilities of one skilful welding operator, L. E. Haybarker, Coeur d'Alene, Idaho, find expression.

Some of the accompanying illustrations of the completed work scarcely show the infinite pains that went into the fashioning of these interesting figures and models.

The vases and trees were fabricated from various pieces of pipe cut to the desired

length by the cutting flame. In order to produce the bark on the metal trees the cutting flame was again used to cut away the indentations and the welding blowpipe to build up the bark and develop the final effects. The butterflies and flowers were formed from sheet metal and all carefully painted in natural colors when completed. Similarly were the dancing girls shaped and built up to completion.

The mummy face seen on one of the vases was executed by first making a mold of fire clay. Over this, steel welding rod was carefully applied until the shape of the head was complete and then finished off by skilful manipulation of the welding flame. Finally it was welded to the vase.

The figures from "The Wizard of Oz" books were built up by free-hand work entirely. To complete the details of this work sheet metal was used to make the dresses and collars.

Different sizes of pipe were used in fabricating the dragon. The largest pipe used was 2-in. As the body becomes less in size other smaller pieces of pipe were utilized by progressively splitting the pipe sections.—*Oxy-Acetylene Tips.*

### WETNESS

**ONE of the world's wettest spots is the top of Mt. Waialeale, in the middle of the island of Kaui, Hawaii, where the average annual rainfall piles up to 451 inches. Some years it totals as much as 600 inches.**

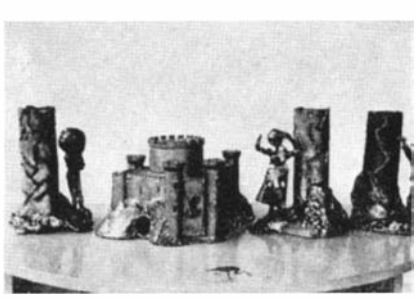
## Classifying Coal

ACCURATE classification of coal from soft lignite through bituminous to anthracite has been accomplished by measuring its oxygen absorption. A new method of test depending upon the action of boiling potassium permanganate solution on a sample of coal allows coals from different sources to be compared more accurately than has been possible in the past.—*D. H. K.*

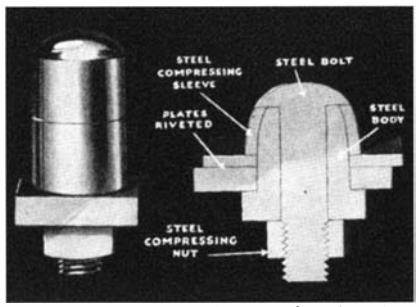
## One-Side Rivet

A MECHANICAL, all steel rivet that is inserted and operated with a wrench, from only one side of the job, gives the strength of a regular bolt or rivet. Riveting jobs that are not accessible from both sides can now be accomplished with this new rivet, by inserting it and drawing down on the nut, to form a solid steel rivet head on the inside.

The steel mechanical rivet is made of a one piece steel body consisting of a heavy steel cylinder with a square head at one end. The other end has a taper valve seat, which sets in a steel expansion and compressing ferrule. A steel bolt goes through the center with its head under the steel compressing ferrule, and the nut at the other end compresses and expands the steel ferrule when turned down.



**Examples of sculpture with an oxy-acetylene torch. *Upper left:* Flowers and butterflies from sheet metal. *Above:* Scenes from "The Wizard of Oz" books. *Right:* St. George's dragon rears its welded steel head. *Courtesy of* Oxy-Acetylene Tips**




**A new steel rivet that can be placed and set from one side of a job**

The product is used for riveting steel girders, sheet metal of all kinds, machinery, boiler seams, metal castings, plates on metal containers, pipes and various manufactured products, and is of importance to steel construction, railroads, steamship lines, tunnel construction, outdoor sign companies, and so on. They are used for maintenance work to fasten plates on cracks or holes in fire boxes as they are not affected by heat or pressure; also for replacing loose rivets.

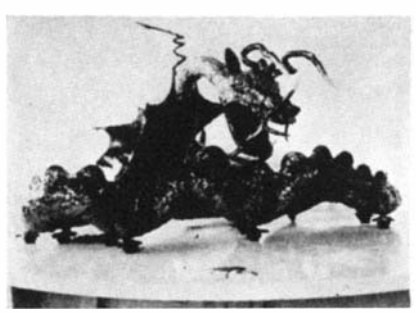
## Air Streams Gone Wrong

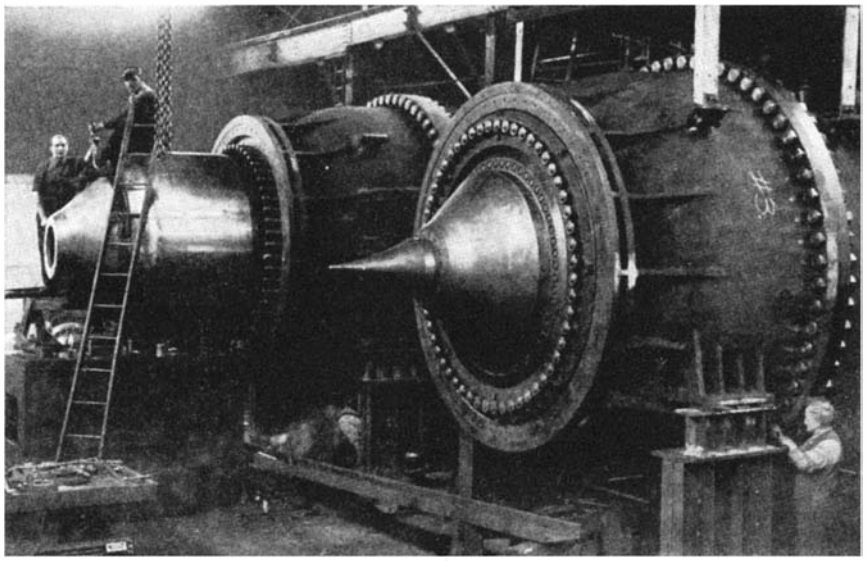
THE heavenly set-up during the past summer has been all wrong for adequate rainfall between the Rocky and Appalachian Mountains, according to C. L. Mitchell, forecaster for the Washington, D. C., district of the Weather Bureau. From the first of June till the latter part of July the air streams that make weather persistently followed abnormal paths. Unchecked by polar air, a great current of tropical air went 'round and 'round in a vast irregular circle—up the western part of the Great Plains and the Rocky Mountain and plateau regions, across southern Canada, down the eastern part of the central valley region, and back across the continent.

There was no lack of moisture aloft, Mr. Mitchell says, but the machinery for squeezing it out was lacking. Nature produces rain by bringing together two air masses—a cold mass and a warm, moist mass. When the two opposing masses meet, the warm air is forced up over the cold, denser air. The warm air is soon cooled to a point at which it can no longer hold all its moisture.

To keep the United States cool and moist, cold air masses ("highs") must either come down from Canada or they must come in from the north Pacific Ocean. This year the "highs" have been in the south and the "lows" in the north—a situation that makes normal summer weather impossible.

Mr. Mitchell ascribes the summer's unusually high temperatures, in large part at least, to the failure of "highs" from the





**Twelve 72-inch 60-ton needle valves such as those shown will be used in the outlet works at Boulder Dam to regulate the amount of water by-passed from the Dam to the Colorado River. When open, 25,000 gallons of water will pass through each valve per minute, at a velocity of 80 miles an hour. The needle in the foreground fits into a nozzle similar to the one shown in the background**

north Pacific to move often enough inland over Washington and Oregon and thence eastward over Montana, Wyoming, and the Dakotas. These polar air masses from the Pacific effectually interrupt the northward movement of tropical air over the western half of the United States, and, if they occur at least once every six days, prevent the development of a heat wave over northern areas west of the Mississippi River.

## Percheron Pullman

MANKIND'S nobility has always traveled in deluxe transportation, but it took the ingenuity of the National Breweries Limited, of Montreal, to introduce the first streamlined "Pullman of the Highways" motor van to transport its 32 thoroughbred percheron horses, used for exhibition purposes, to and from fairs and expositions in every part of the Dominion of Canada.

Count Alexis de Sakhnoffsky, six times winner of the Monte Carlo Elegance Contest Grand Prix, a prize awarded for designing the most beautiful motor cars for the nobility of Europe, is the man who styled the new van, the chassis of which was built by The White Company Limited, of Montreal.

The van accommodates four horses, each in a separate stall so arranged that all the horses face the front, four men to care for them, and two drivers, a weight in all of nearly 10,000 pounds. Known as the Dawes Black Horse Pullman, it is built on the tractor-trailer system. The trailer is specially slung for easy riding with the least possible vibration. The entire unit is 39 feet, six inches long.

The Tack Room at the front end of the trailer is spacious enough to provide sleeping quarters for overnight trips for one driver, while the other is on duty, and there is a system of communication between the trailer and the active driver.

The purebred percherons, known throughout Canada as the Dawes Black Horses, are used to advertise Black Horse Ale, brewed by National Breweries Limited. The horses are entered in horse shows, fairs, and expositions in every part of the Dominion and have walked off with many blue ribbons.

## New Method for Treating "The Bends"

AN improved method of treating compression illness, or "the bends," which frequently occurs when divers and others who have been working under high atmospheric pressure return to normal atmosphere, was recently described by Louis A. Shaw of the Harvard School of Public Health.

In this disease, nitrogen absorbed in the blood from the air pumped down to a diver forms bubbles in the blood if the diver rises to the surface too fast. If these bubbles are not dissipated they will stop the blood circulation. For this reason the diver is usually returned slowly to the surface and to atmospheric pressure. Sometimes, however, in spite of this preventive measure, symptoms of the disease appear several hours after the worker has been decompressed or returned to normal conditions.

Recompression, or the process of putting the patient back under high pressure, is the method generally used for treating recurrence or late appearance of the bends. Mr. Shaw suggested that instead of this, the patient should be put in an atmosphere of no more than 30 pounds pressure to the square inch, for two to three hours.

Then the pressure is lowered to 20 pounds for an hour and a half during which period the patient breathes pure oxygen instead of air. This method will promote the absorption of the nitrogen bubbles.

Mr. Shaw reported studies on dogs which showed the value of substituting oxygen for ordinary air in treating compression illness.—*Science Service.*

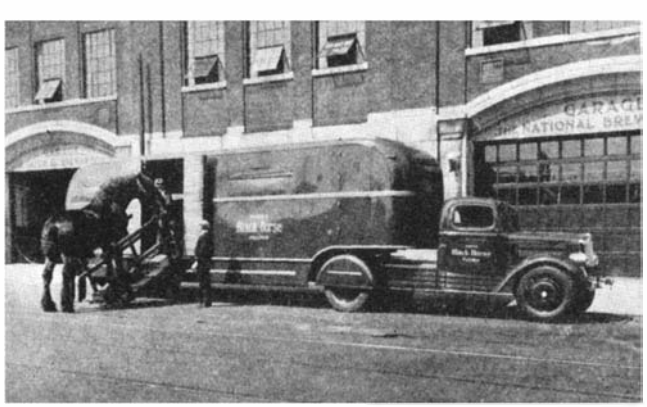
### DURABILITY

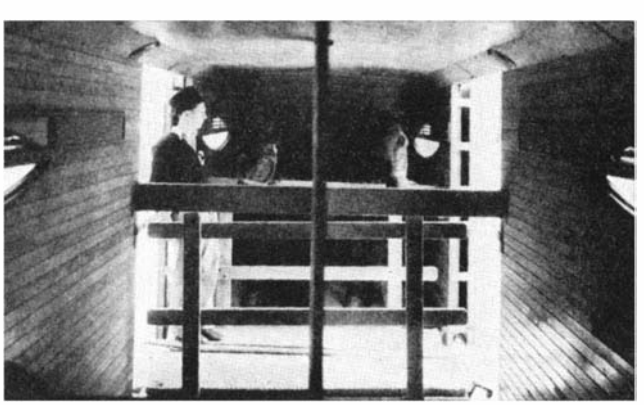
**A CARBOLOY-TIPPED drill, just over a half-inch in diameter, in General Electric's Fort Wayne Works, established a combination durability and speed record recently by penetrating approximately 2¼ miles of cast iron at a feed rate of about 10 inches per minute before wearing out. The drill cost was approximately $0.00019 per hole.**

## "Warmed Up" Ice Better for Vegetable Shipping

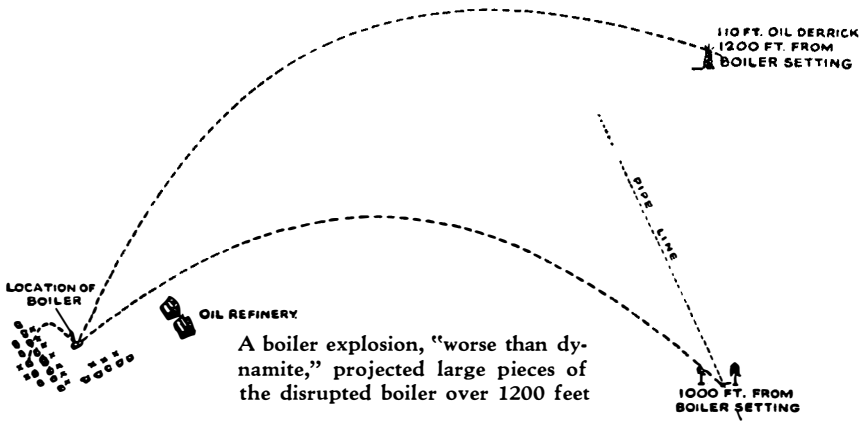
TWO blocks of ice may look alike, but one may be much colder, if from a colder storage room. Ice melts at 32 degrees, Fahrenheit. Below this its temperature follows closely that of the surrounding air.

Failure to let ice of low temperature "warm up" before using it to cover shipments of vegetables may freeze some of them in transit, investigations by the Bureau of Plant Industry, United States Department of Agriculture, show. It found considerable head lettuce and carrots damaged in transit during the warm months last year by crushed ice—generally used now in top-icing lettuce and carrots. The





**Exterior and interior views of the "Percheron Pullman"**




A boiler explosion, "worse than dynamite," projected large pieces of the disrupted boiler over 1200 feet

ice is crushed in the packing house and immediately blown over the load without much loss of temperature. Chunk top-ice, when used, is placed over the vegetables as they are loaded in the car and has a better chance to warm up to a temperature which does not cause freezing injury.

Freezing damage can be prevented easily by allowing the ice to "warm up" before it is crushed. If there is any doubt about temperature the ice should be allowed to stand until it begins to melt.

## Worse than Dynamite

NOW that we are in the internal combustion engine age, and steam boilers are not so plentiful as once they were, many of the present generation have forgotten or never had occasion to learn what tremendous latent forces are pent up inside steam boilers, even small ones. A regular, first-class, all-wool-and-a-yard-wide boiler explosion is something not to be forgotten.

In *The Locomotive*, house organ of the Hartford Steam Boiler Inspection and Insurance Co., a brief description shows what a boiler explosion can do:

"Eight persons were injured and property over a wide area (as shown in the sketch) was damaged when a locomotive type boiler exploded at a Texas oil well location. The accident, clearly a case of over-pressure, tore the boiler into several pieces and resulted in damage to property as far distant as 1200 feet from the boiler setting.

"Surrounding the boiler house were buildings as shown in the sketch. The negro huts and other buildings marked with an 'X' were damaged. One piece of metal passed over a two-story hotel and crashed into a hut behind it, the metal falling in such a way that a negro woman was pinned in bed, but was not seriously injured. Other pieces hurtled over the refinery building, one whole course passing through the top of a large pine tree 1000 feet distant, cutting a six-inch oil pipe buried about two feet underground, and making a deep gash in a second tree. Another piece of the boiler broke off the top of a 110-foot oil derrick which was 1200 feet from the boiler."

## Value from Distillery Waste

A NEW method for completely disposing of the waste of distilleries, developed by Buswell and LeBosquet of the Illinois State Water Survey, not only purifies the waste so that it can be safely dumped into streams, but at the same time yields a by-product of gas of high fuel value which pays for the process. The treatment consists of anærobic fermentation (without air) by bacteria which produce from each pound of solids in the waste 11 cubic feet of gas containing a high percentage of methane; this is followed by further fermentation and purification on an open trickling filter. The first fermentation takes place in closed tanks which are kept warm (130 degrees, Fahrenheit) and all odorous compounds formed are burned with the fuel gas. The fermentation on the trickling filter (an open vessel with a false bottom on which rests blast furnace slag in broken pieces) has little or no odor, and thus the objectionable smell usually accompanying such operations is completely avoided. The waste is fed to the fermenters without dilution to secure high efficiency in this part of the process and for similar reasons the effluent from the fermenters is diluted with already filtered and purified liquid before being run onto the trickling filter. After this double treatment the waste can be dumped into streams without harm.—*D. H. K.*

### GLYCERINE

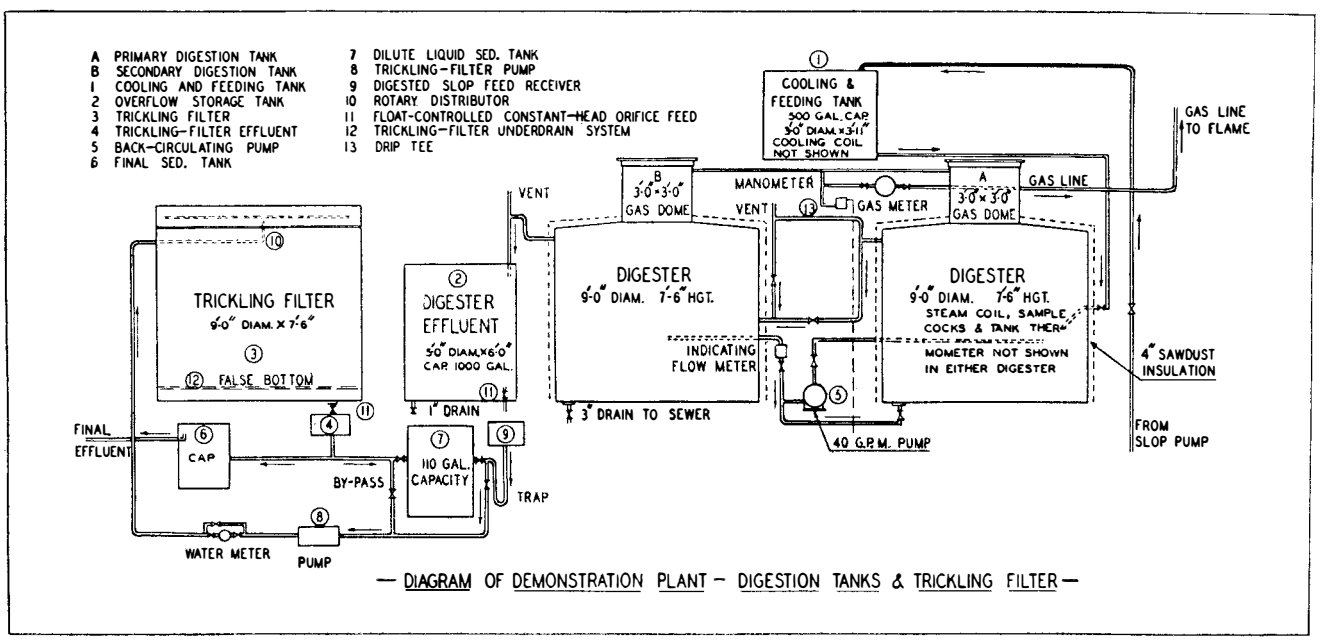
**NEXT to water, glycerine is the most extensively used of all liquids in medicines. It stands far ahead of alcohol.**

## Ornithological Parasite

"PARASITE" is the designation applied to Iowa's ringneck pheasant hens by Dr. Logan Bennett of the United States Biological Survey stationed at the University of Iowa. As the result of recent studies of duck nesting in Iowa, Dr. Bennett has found that this exotic game bird is "ducking" her maternal duties by laying her eggs in the nests of neighboring ducks, according to a recent note from the American Wildlife Institute, Washington, D. C. Four and seven tenths percent of the duck nests studied by Dr. Bennett were so parasitized by pheasants and in a number of cases several pheasant eggs were found in one duck nest.

Ordinarily a parasite is considered as something to be treated with pyrethrum, oil, Black Leaf 40, or perhaps a fine tooth comb. Not so this parasite, however. One must broaden his interpretation of the term to get the proper meaning. The habit of "horning in" on the maternal instincts of the ducks makes the frivolous hen "Chink" a parasite in a social sense.

But the Iowa pheasant should use more discretion in the matter of selecting a substitute mother for her offspring. Race




— DIAGRAM OF DEMONSTRATION PLANT — DIGESTION TANKS & TRICKLING FILTER —

# *For* MEN *who want to become independent in the* NEXT TEN YEARS

IN the Fall of 1946 two business men will be sitting in a down-town restaurant. "I wonder what's going to happen next year," one of them will say. "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 1936," 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 the United States and Canada 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:

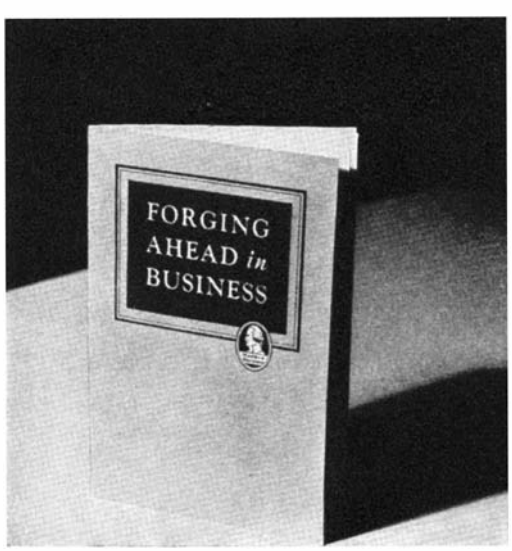
*"I wish I had those years back."*

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 book that has put 400,000 men on the road to more rapid progress?

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

●

**ALEXANDER HAMILTON INSTITUTE**
*Executive Training for Business Men*




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

*To the* Alexander Hamilton Institute,
840 Astor Place, New York City.

Send me without obligation the newly revised edition of "Forging Ahead in Business."

*Name*_____

*Business Address*_____

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*Business Position*_____

• • •

**CONTRIBUTORS TO THE COURSE**

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

Alfred P. Sloan, Jr., *President,* General Motors Corp.

Thomas J. Watson, *President,* International Business Machines Corporation.

M. H. Aylesworth, *Chairman of the Board,* Radio-Keith-Orpheum.

J. S. Tritle, *Vice-President,* Westinghouse Electric and Manufacturing Co.

Clifton Slusser, *Vice-President and Factory Manager,* Goodyear Tire and Rubber Company.

Fred. W. Pickard, *Vice-President,* E. I. duPont de Nemours & Company, Inc.

suicide might seemingly be the result of her present heedlessness in this respect. For Dr. Bennett tells us that the pheasant chicks follow their foster mother and her legitimate ducklings to water, and being unable to swim, they quickly drown in this unusual element. But while the duck is certainly an ill-suited mother for pheasants, there is apparently little likelihood of race suicide from this cause as natural checks and balances prevent such a disaster.

## Varicose Ulcers

A NEW method of treating varicose ulcers which appears more satisfactory than any treatment hitherto suggested is described in the *Journal of the American Medical Association.*

Twenty-six persons have been treated by the new method for this chronic condition after from one to 37 years of suffering during which time all recognized forms of treatment had been tried on one or more of them. All except three were healed after treatments extending over periods of from one to 12 weeks.

Dr. Leslie Saylor of Topeka, Kansas, and Drs. Joseph Kovacs, A. Wilbur Duryee, and Irving Wright, of New York City, make the report, states *Science Service.* Their experimental work was done at the vascular clinic of the New York Post-Graduate Medical School and Hospital of Columbia University, aided by a grant from the Josiah Macy, Jr., Foundation.

During the new treatment none of the patients was put to bed or sent to a hospital. They continued their daily occupations of washing, ironing, cooking, chopping wood, and selling real estate.

In treating the varicose ulcers, the doctors saturate a reinforced asbestos paper with a 0.5 percent solution of acetyl-beta-methylcholine chloride and wrap it around the patient's foot and leg as high as the knee. A metal plate is placed over the wet asbestos paper and connected to the negative pole of a galvanic machine. The current is then turned on.

Half-hour treatments are given two or three times a week. The metal plates are never applied over the ulcerated area.

This form of treatment has especial value, the four physicians assert, in cases in which ulcers do not heal after the injection treatment for varicose veins or in cases in which injections are not to be recommended as, for example, with diabetes or phlebitis.

## Scientific Weather Cycles for Concrete

RESEARCH engineers, in comparatively short periods, are successfully duplicating many years of the effects of time and weather on concrete in the laboratories of the Portland Cement Association in Chicago.

Specimens of concrete of various sizes and shapes are taken from tropical warmth to the middle of a hard winter and back again, each 24 hours. Thus far, more than a thousand cycles of freezing and thawing have been completed.

These tests are deemed important because the reaction to severe winters is one of the measures of the durability of a structural material exposed to the weather.

The specimens to be tested are immersed in water containers and placed in a freez-

ing room where it is always 20 degrees below zero. Then they are thawed in a tank where the water is kept at 80 degrees.

After 20 or 30 cycles, the specimens are dried and weighed to determine whether there has been any deterioration or spalling off of the surface. The original weight of each specimen is carefully recorded and periodical weights are determined as long as the tests continue, which may be for years.

## New Paint Pigments

SINCE the destruction of paint films has been shown to be largely caused by ultra-violet light, a new type of pigment which is opaque to this destructive radiation is attracting special attention. The compounds of various metals, particularly zinc, lead and titanium, with phthalic anhydride, a coal tar product important in plastics and dyes, have been found particularly opaque both to visible light and to ultra-violet radiations. Henry A. Gardner in describing the new pigments in *Industrial and Engineering Chemistry* states that they should be especially valuable in extending the life of cellulose compounds, used in lacquers and many plastics, by reducing the action of destructive radiation on them. At the same time the new pigments may be useful in lengthening the life of rubber, in increasing the light resistance of viscose films —more familiarly known as Cellophane— and in preventing change of color through fading of colored pigments.—*D. H. K.*

## Chance for the Elm

THOUGH Europe may have given up hope of saving its elms from the Dutch elm disease, America need not despair of saving its trees, in the opinion of Lee A. Strong, chief of the Bureau of Entomology and Plant Quarantine.

The American elm's chances for surviving the infection, Strong says, are better than 50-50, if men and facilities are available to continue the intensive eradication campaign by the department now under way.

Strong bases his opinion on the results of this year's scouting. In the first three weeks of June, 1437 scouts found 607 trees in which the disease has been confirmed by laboratory test. In the same period last year, 200 scouts found 443 such trees. With seven times as many scouts in the field, an increase of less than half in the number of diseased trees affords good ground for believing that the campaign will first stop the spread of the Dutch elm disease in this country and finally stamp it out.

The only practical way to fight Dutch elm disease, according to Strong, is to destroy every sickly elm in the areas where the disease occurs.

## Reducing Corrosion

NUMEROUS chemical compounds added to water reduce the rate at which it corrodes metals. Among these, the so-called organic amines, chemical compounds similar to ammonia, have been found to be particularly effective even in very small proportions. Professor Charles A. Mann and his co-workers at the University of Minnesota have investigated the reasons for this effectiveness and have found that the electrically charged ions formed by amines in

(*Please turn to page* 301)

# THE AMATEUR TELESCOPE MAKER

**Conducted by ALBERT G. INGALLS**

FIRST, this month, we take a little trip: India, Japan, South Africa, Manchukuo, New Zealand, then home.

Figure 1: India, Calcutta, 28 Gangadhar Babu Lane, Hari Charan Datta. "It was an auspicious day indeed when I chanced upon the advertisement of your book 'Amateur Telescope Making.' The book was a god-

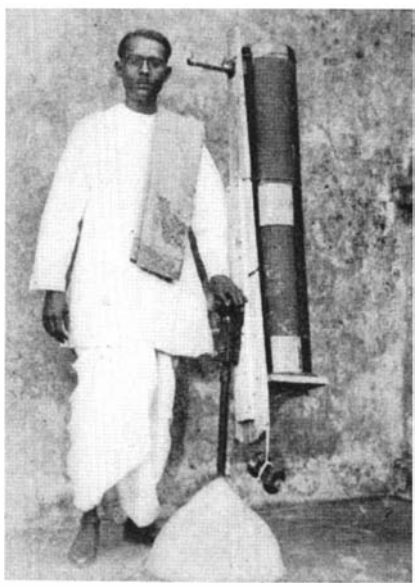


*Figure 1:* **Datta, India**

send to me. Please accept my sincerest thanks and salaams.

"The mirror was ground from a disk of plate glass ¾" thick and 5.65" in diameter, on a similar glass, using the inverting device of Mr. Porter, as illustrated on page 288. Time consumed, about 18 working hours using Carborundum powders. The mirror was polished on a rosin and beeswax lap. The best proportion, after many trials here at Calcutta at that time (middle of October), was found to be 1 in 20 and the best method of cutting the channels was found to be sawing, as advised by Mr. Pierce. The hack saw blade was kept rubbed on soap. It took me about 40 hours to polish and 10 more to parabolize. I made all the tests, including the Ronchi test, which was done by 8 strands of hair spaced one tenth inch. The total cost of my instrument was about 24 rupees [about $9.—*Ed.*]. My sincerest thanks and salaams for distributing the knowledge by means of which a novice like me on the other side of the globe has made a telescope."

Figure 2: Japan, Yokohama, 140 Mameguchi-dai, R. M. DeMuth. The capstan for turning the head of the tube is interesting. No other data were received.

Figure 3: South Africa, Capetown, Mowbray, Clifton Road, "Tircrevan," W. C. Andrews. "I was able to get 6" disks in Capetown but could not get Carborundum grains till I mentioned it at the Astronomical Society, when I received any amount. It was only after the mirror had been finished that I discovered that I had been using paving asphalt, but had not the slightest trouble with the lap. I had been reading in 'A.T.M.' about the many different figures I might strike but had beginner's luck, as almost the first test was paraboloid; so, to see them, I rubbed several holes in the mirror, and then I did see them! It took several hours to get it parabolized again. The 2¼" finder was salved from a wreck in False Bay. The total cost was under £1."

Figure 4: Manchu-kuo, Harbin, Slaviansskaya St., P. Ramensky. "The mirror is of 6" diameter and gives magnifications up to 300 diameters. The mounting is from Ford rear axles."

Figure 5: New Zealand, Auckland, W. 2, Grey Lynn, West End Estate, 161 Garnet Road, Alf. R. Martin. "I enclose a photo of a 12" reflector built by myself. It is mounted on Ford back axle housings. There are quite a number of amateur observers here. Recently, in this city, we have formed a club and meet once a month for discussion."

Home, James.

*ABOUT making camera lenses:* From time to time since this hobby of amateur optics was got going in 1926, requests for instructions for making camera lenses have been received. A number of years ago we addressed letters to some of the photographic journals, asking for light on this situation and parts of the replies, published below, still make interesting reading; they show that the job surely is not a beginner's

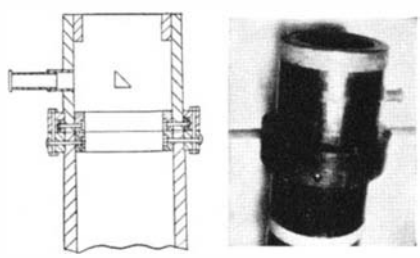


*Figure 2:* **DeMuth, Japan**

job, also perhaps that the ability of at least some amateurs may have been a bit underrated. It is true, however, that at that time there were few who could be called advanced amateurs, as there are today.

The first letter:

"I am afraid you are up against a tough proposition. The photographic lens is entirely different in conditions from the telescope lens in that it must cover a very wide field at a large opening, say 80 degrees at F/4.5, with minimum errors.

"Photographic lens computation is not easy. Lens designers are only able to compute about one lens per year. Even Dr. Rudolph, one of the most famous, calculates only one in about two years."

The second letter:

"We have not published material of this kind for three reasons: first, the calculations involved are over the heads of the majority of our readers; second, even if the calculations were understood, few, if any, readers would have the necessary grades of optical glass or the mechanical equipment to produce the lenses; and, third, the manufacturers keep their lens calculations a trade secret."

The third letter:

"Personally I am averse to exploiting making things at home which can be bought better made and often at lower cost in the shops. This is not wholly a commercial expedient, either. It is based on two facts—the mass of readers cannot make complex things, and the price of such things is usually lower than the cost of material and waste through spoilage. The optical stores are so generally equipped for grinding lenses and the optometrist is usually a college man trained in computations that the layman could do no better than formulate his needs and have them filled by an expert.

"I gladly tell you that never more than in photographic objectives is the refractive element a factor. Even further, the refraction and diffraction enter into the computation of curvatures. Flare spots and lateral catch of light show on the sensitive emulsions where the eye, looking through a telescope, might not see them or mentally ignore them." [That one sounds snooty.—*Ed.*]

The fourth letter:

"The making of a simple camera lens, such as a meniscus or rapid rectilinear, is not beyond the capacity of an amateur worker. When it comes to the question of making an anastigmat, however, the problem is a difficult one and it would require an excellent machine shop equipment and the making of so many tools that the cost of a single lens would be far above the retail purchase price. The anastigmat consists as a minimum of three elements, but those which would be easiest to construct would have four or six and it would presumably require a grinding shell and a polishing and test block for each surface, and as the utmost accuracy is required in the polishing, even a skilled optician needs much experience to make anastigmats which will pass the necessary tests.

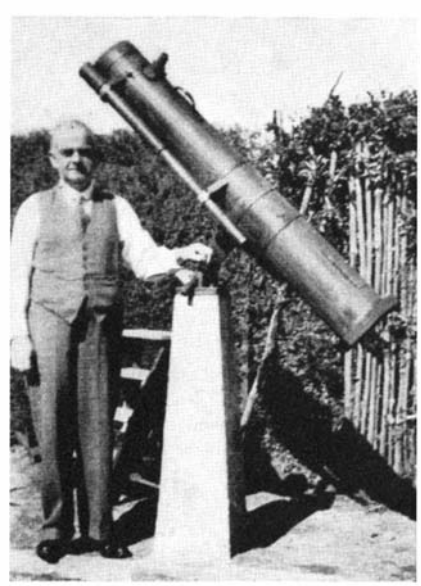


*Figure 3:* **Andrews, South Africa**

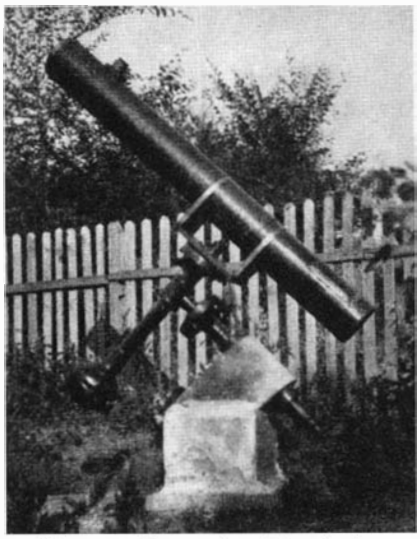


*Figure 4:* Ramensky, Manchu-kuo

"The principal difficulty, however, lies in the fact that, even if the amateur can get optical glass of approximately the proper constants—which he might be able to through the courtesy of one of the few lens manufacturers—the manufacturing optician finds that every batch of glass varies, so that in practice every lens has to be recalculated every time it is made from a new lot of glass. Of course, the optical firms do this rather empirically, and have in their possession data arrived at from many years' experience, which enable them to make these changes without much difficulty.

"We have had under consideration the possibility of publishing a book on lens making and could command the services of one of the best lens makers in the country for the technical details, but we have hardly considered the publication feasible for the reasons set forth above. Telescope making is child's play compared with photographic lens making."

These letters were shown to an amateur telescope maker who both calculates and makes his own camera lenses and he commented: "The first one tells the true story, the attitude shown in the second is justified, the cackle in the third gives me a ——, and the fourth is about right." He added, "Do not trust examples given in patent specifications of lens designs. Impossible glass types are frequently specified and residual aberrations or flare spots are said

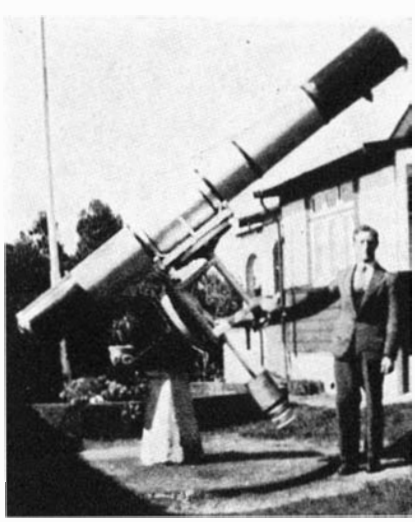


*Figure 5:* Martin, New Zealand

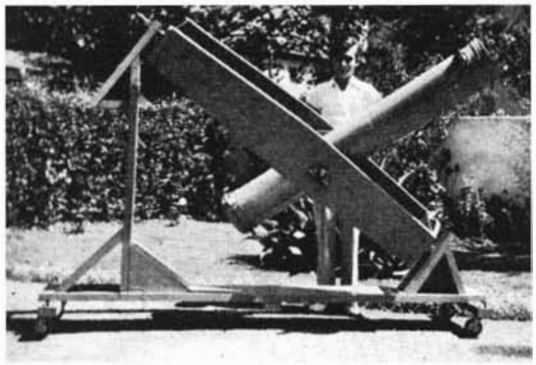


*Figure 6:* **Hole, Pasadena, Calif.**

to be deliberately introduced as jokers."

Some years later—that is, a year ago—we invited the writer of the above comments to prepare for Vol. II of "A.T.M." a detailed chapter on photographic lens making, for we were still hypnotized by the desirability of making such data available to the amateur and hoped there might be some possible way out. This is his reply:

"I believe it would be impossible to write a chapter on the general subject of photographic lens construction, because the mathematical treatment of comatic, astigmatic, sinical, chromatic, spherical, distortion and flatness errors would occupy an immense amount of space, even if the rudiments and one example only were taken. The absolutely necessary discussion of glass types and the graphic methods of 'bending' compromises would consume more space, as would the discussion of the relative merits of the various corrections for different purposes. And, even if you were to give me 500 pages, quarto, I should have neither the time nor the ability to write such a treatise. You know I'm neither a Frauenhofer, a Rudolph nor a Conrady.

"I can compute for you, however, some examples, giving glass types, radii, thicknesses, separations and iris positions for, say, an *f*/4.5 Tessar, an *f*/4.5 Cooke triplet, an *f*/6.8 Goerz Dagor, an *f*/6.3 Rudolph Protar, or some such popular combination. However, when the amateur had read the dope, he would find that the glasses he could obtain from B. & L., Chance, Schott or Gobain would not have the precise constants called for. Values would be sure to differ by several units in the fourth and possibly in the third place. He would then have to recompute his system for the new values, which would mean that he would need to be quite proficient in the art.

"In a doublet astronomical objective, it is *easy* to work to the 'V' figures of a pair of glasses in order to get fair chromatic correction, and then to figure one surface in order to approximate spherical correction for visual rays, since the axial image is all that matters. In a photographic lens, though, 20 or more compromises must be made, and few errors are completely eliminated, since, in order to cover a large field sharply at a large aperture, on panchromatic plates, relatively minor errors must remain in order that major faults may be eliminated. In order to cover 40° on 35 mm. film at *f*/2.0 apochromatically, within only 0.01 mm. of true sharpness, Lee had to use ten components, two of them unstable in air!"

Well, there we are—where? Nowhere, apparently. Incidentally, the man who wrote that letter is not a professional in any sense; he is a chemist who makes telescopes and so on as a hobby. But he dislikes answering letters and that is why we cannot give his name here—from past experience, he would probably shoot us. In fact, any mention here of any man's name always brings him a big batch of those six-page letters (without even return postage being included!), using up all his spare time and more, if he is kind to all.

We replied to the letter: "Your answer gives me a good laugh: you talk yourself into the proposed writing job and then right out again. But your logic is watertight: to give the background stuff would require a book; some examples might be given; but then, the exact glass not being obtainable in each instance, the amateur would be just where he started. I shall publish this sometime and if the readers who have asked for full instructions for making an anastigmatic lens don't still think I am in the Ananias Club they will stop teasing for them and materially lengthen my life." He replied: "Too bad about the wet blanket I pulled over the photo lens flame, but facts are facts. My own computations have been performed solely to fill some

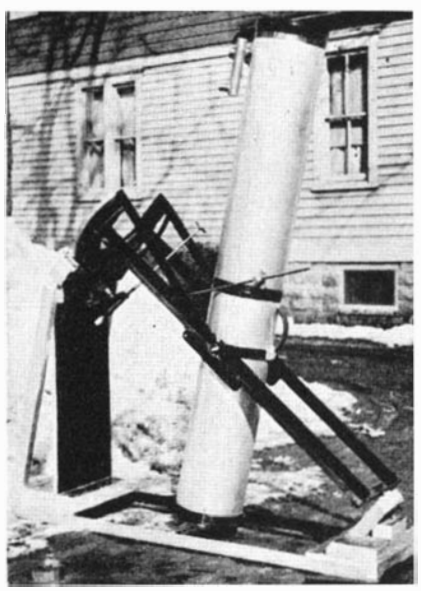


*Figure 7:* **Shafto, Neptune, N. J.**

personal need. I don't do outside jobs."

The same man also wrote this: "I can't sit down with a couple of reciprocal and log. tables and a glass list and design, say, an anastigmatic magnifier. Each job has meant looking up forgotten equations and eikonels, brushing up on a differential or two, making a dozen graphs to assist in balancing compromises and then beginning algebraic third order work, which must be followed by trig. ray tracing. The tracing takes five to 100 hours and may show higher order faults which make it necessary to recompute some of the system. In other words, I stumble along, consulting Steinheil, Hastings, Gardiner, Conrady and Taylor from time to time. A good computer would be finished when I was half through."

Another amateur who has done much lens designing writes in the same vein: "The stuff you send me [just quoted.—*Ed.*] clicks with what I've always said—that you

can't give 'simple rules for calculation of optical instruments.' They are *invented*, not calculated. Every new item is a new problem. After you've traced rays through 100 or more sets of lenses you learn about what to expect, but you couldn't tell anybody how, any more than you can tell why you like the little red-head on the end better than the blonde in the middle."

Not, however, that all this will stop the requests for "detailed instructions for photographic lens making," since they come mainly not from amateur telescope makers but from outside. But with these various comments now in print, all we shall have to do in future is to tell them which back number to buy. We inserted them here merely to save ourselves future hard work! But even yet we harbor a bull-headed hope that, someday, somehow, someone will find a way to impart the "dope."

WHILE telescope making is not generally a juvenile hobby, a few keen lads have made good telescopes. Wilson Hole, 540 South Greenwood Avenue, Pasadena, California, has arranged a double yoke in "wheelemout" fashion (Figure 6). His use of a deep section for the yoke sides is pleasing to look at and lends steadiness. His carriage has four corner screws—½" bolts—which screw down to give a solid stance, much as a wrecking crane lets down corner screws or a dredge pokes down spuds and ceases merely to float. Hole, a young friend of R. W. Porter's, writes that he has made about five mirrors and completed three telescopes in the past two years. He hopes to join the A.A.V.S.O. His age is 14.

Figure 7 shows a mounting of angle iron, made by Eugene Shafto, 1114 Corlies Ave., Neptune, N. J. The yoke, with split ring, is arranged the same as the one on the 200" telescope at Mt. Palomar. The ring is of hard wood, backed with iron. The maker submits a list of expenditures, which totals $16.75 for the 8" telescope.

A second keen lad who has made good as a telescope builder is George Economy, 108 Auburn St., Manchester, N. H.—see Figure 8. He is 13 and did the job in three weeks, making a model described in earlier editions of "A.T.M." by John M. Pierce. The entire cost, he writes, was $15.

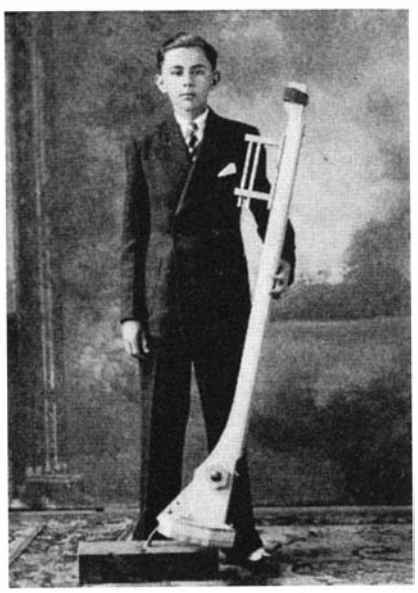
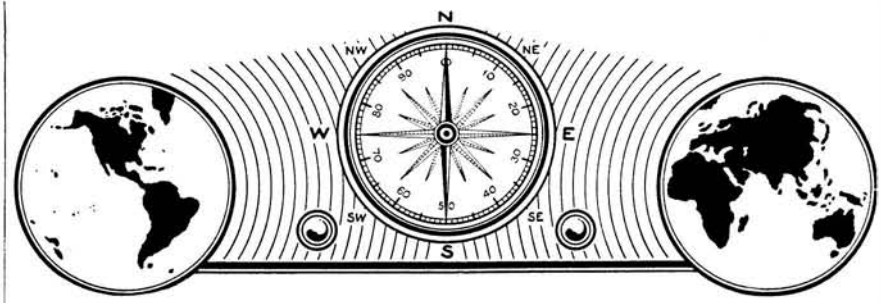


*Figure 8:* Economy, Manchester




# WORLD-WIDE RADIO

**Conducted by M. L. MUHLEMAN**
Editor, *All-Wave Radio*

## Marine Radiophone Service

A NEW two-way marine radiophone service for commercial craft in New York Harbor and nearby waters has been inaugurated by the New York Telephone Company. Equipment has so far been installed on five Pennsylvania Railroad tugs,

**Control equipment for the marine radio telephone service is within easy reach of the pilot of the tug**

and two tugs operated by the Oil Transfer Corporation and the Socony Vacuum Company.

It is expected that the service will be widely used by various classes of harbor vessels, and possibly by certain vessels operating in Long Island Sound and on the Hudson River.

The Western Electric shore radio equipment installed by the telephone company includes a 400-watt short-wave transmitting station atop the building at 25 Hyatt Street, St. George, Staten Island. This station transmits on a frequency of 2590 kilocycles under the call WOX. Three receiving stations are maintained nearby on the island to insure consistent service. Facilities are provided at the central station for interconnecting the radio voice-ways with the telephone company's regular land wires. The seven boats so far equipped have 5-watt transmitters which operate on a frequency of 2198 kilocycles.

An improved method of calling the boats by means of selective signaling apparatus has been put into use. Under the old system of loudspeaker monitoring, the ship crew had to listen constantly for the ship's particular call. With selective signaling, a regular telephone bell rings on the ship being called, obviating any confusion. The manipulation of the ship telephone is nearly the same as that of an ordinary telephone, thereby making unnecessary the employment of skilled operators on the boats.

These stations can be picked up on any all-wave receiver covering the frequencies of 2198 and 2590 kilocycles. If two receivers are used, one tuned to each frequency, both sides of the conversations can be picked up. No definite operating schedules are maintained; the system is used only when there is traffic to be handled.

## Noise Interference Data

SOME interesting figures dealing with the analysis of radio noise complaints received by three large power companies during the past year have been released by Philco. The percentages are of particular interest, as they indicate the degree of probability of the source of noise interference you may be experiencing.

The total number of complaints received was 9334. In 2735 cases noise originated in consumers' electrical equipment, and in 984 such instances the equipment was motor operated. In 563 instances, noise was due to building wiring defects, and in 532 instances due to interrupter devices.

The following percentages indicate the responsibility for the most prevalent forms of noise interference:

| *Responsibility* | *Percentage* |
|---|---|
| Power Company | 23.6 |
| Other Utilities | 6.4 |
| Consumers' Equipment | 29.3 |
| Radio Sets | 13.0 |
| Transient and Not Found | 27.7 |

If you're troubled with noise interference, scout around for defective electric light bulbs, washing and sewing machines, neon signs, oil burners, electric sign flashers, and so on, as the most likely sources. You may find the trouble in your own home.

## "Magic Voice" Tone Tubes

A NEW approach to the attainment of naturalness in electrical sound reproduction has been made in the 1937 RCA-Victor "Magic Voice" series of radio receivers. Normal low-frequency response has been gained in these sets without resorting to artificial means of build-up.

The accentuation of bass response, particularly from 100 cycles down, is brought about through the use of built-in phase-reversing resonator tubes. These tubes are

nothing more than a series of cylinders, open at both ends, which project through the bottom of the receiver cabinet. The rear of the cabinet itself is closed in, so that sound waves radiating from the rear of the loudspeaker must seek outlet through the resonator or tone tubes.

Under ordinary circumstances, the sound waves radiated from the rear of a loudspeaker extend into free air and, by means of reflection from the wall of a room, or by direct transmission through the air surrounding the receiver cabinet, reach the front of the loudspeaker. Due to the difference in phase between the front and rear sound radiations from the loudspeaker an interference is set up and certain frequencies are attenuated. The maximum amount of attenuation takes place at the low frequencies with the result that bass response from the loudspeaker is often deficient.

By means of tone tubes or acoustic neutralizers, the air set in motion by the back waves from the loudspeaker is caused to flow from the ends of the tubes in phase with the front waves, so that cancellation no longer occurs. Instead, the back waves reenforce the front waves, with a consequent increase in the efficiency of sound projection. Thus, by providing this simple means of making the back and front sound waves from the loudspeaker additive, the bass response is increased above the normal limits of the loudspeaker.

## Netherlands Broadcasts

BECAUSE of its extensive colonial possessions the Netherlands is interested in developing short-wave broadcasting along the lines of imperial broadcasting in Great Britain. The Phohi (Philips Broadcasting Holland-East India) has taken the initiative in this matter and now has four distinct short wavelengths at its disposal. It is proposed to increase the power of one of the transmitters to 60 kilowatts to insure its being heard as well as the stations of other colonial powers.

The transmission of propaganda broadcasts to the United States by these stations to stimulate travel in the Netherlands is now under consideration, the plan being to broadcast three hours a week.

## Noise Filters

A NOISE filter is a practical, inexpensive device designed for the purpose of reducing or eliminating certain forms of noise in radio receivers, but a noise filter is no cure-all.

A noise filter will not reduce or eliminate noise which reaches the radio receiver via the antenna. It is not designed to do so. It is of value only in such cases where the noise interference reaches the receiver via the power source—A.C. outlet, D.C. outlet, 32-volt lighting plant, or storage battery operated vibrator power supply.

It is an easy matter to determine if noise enters the receiver through the power line or by way of the antenna. Turn on the receiver and tune to a point between stations. Then disconnect the aerial and ground (or the two leads of the antenna if a doublet is used). If the noise disappears or is greatly reduced, the chances are that the noise is being picked up by the antenna system. On the other hand, if the noise persists, and is not reduced appreciably when the antenna system is disconnected, then it is safe to assume that the noise is being fed to the receiver through the power line. In such an instance, a good noise filter (not the type you can buy from peddlers on street corners) connected between the electric outlet and the receiver power plug will reduce or completely eliminate the disturbance.

If the noise is fed to the receiver via the antenna, a noise-reducing antenna system should be employed. If one is used and the noise still persists, then the horizontal doublet wires should be raised to a higher level, or suspended in a different direction.

Neither the noise-reducing antenna nor the noise filter will reduce interference from natural static.

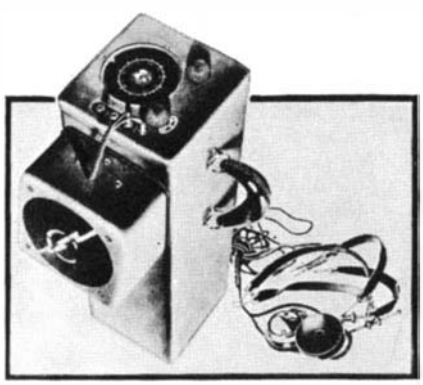
## Self-Powered Portable Radio

A SENSITIVE receiver about half the size of a golf bag, weighing only 18 pounds, and operated entirely from dry-cell batteries, is the latest development of the Crosley Radio Corporation.

This new receiver, shown in the accompanying illustration, is truly portable in every respect. The carrying case houses the receiver chassis and the battery compartment. The loudspeaker is attached to the side of the case and is connected to the receiver by means of plugs which may be removed from the jacks on top of the carrying case when it is desired to use headphones.

Because of the high sensitivity of the receiver only one foot of antenna wire is necessary and a ground connection need not be used at all. There are no attachments to be made to exterior points, and if one wishes, the set can be placed into operation and used while walking, or on bus, automobile or train rides. The fact that it is portable and ready for instant use, gives the set a much wider scope of usefulness than the ordinary type of receiver.

By means of the headphones the receiver can be used at, say, a football game without



**The new self-powered portable receiver described in these columns**

disturbing those sitting nearby. It would be possible, then, to watch the game and simultaneously follow the play-by-play broadcast from a local radio station.

The receiver employs six dry-cell type tubes and has a standard airplane-type tuning dial. Since a ballast tube is used to control filament voltage to the receiving tubes, no auxiliary control other than the "on-off" switch is required.

# CAMERA ANGLES

**Conducted by JACOB DESCHIN**

## Photographing Domesticity

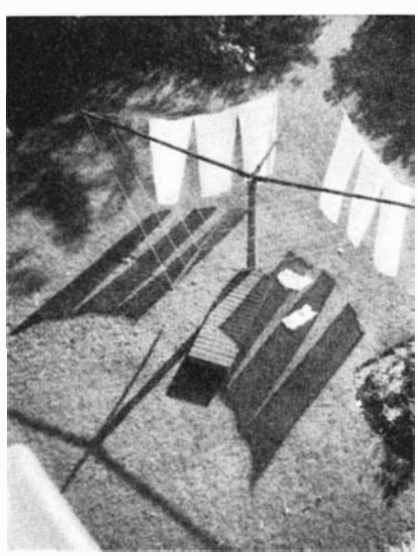
THE life domestic as a photographic possibility is a veritable gold mine if we will take the trouble to look around. The next time you are obliged to stay indoors for one reason or another, such as bad weather or pure inclination, let your gaze roam leisurely about the little world that you call home. You will be surprised how many camera subjects will take shape before you that you had never suspected; how nooks and corners, made humdrum through long familiarity, how the daily routine, apparently uneventful because of close association and repetition from day to day, suddenly appear new and attractive when observed from the point of view of the camera.

"A Sunny Corner"

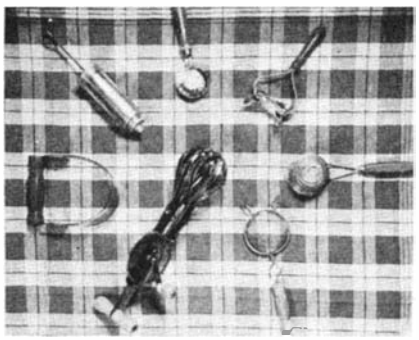
You will do best to set your camera on a tripod or other firm support and study your subject carefully. Sometimes you may wish to include a human subject, in which case the latter will be merely a part in the general composition and not the main feature. In most instances, however, you will find the inclusion of human subjects unnecessary—sometimes detrimental, in fact. A view camera will be best, though any camera will do which has a ground glass on which to compose the subject. A camera of the simple bellows type having a direct view finder need not be a handicap if you measure the distance carefully, stop the diaphragm of the lens down sufficiently to get over-all sharpness (where this is desired, as it probably will be in most instances) and, because it will often happen that you are obliged to include more in the picture than you wish, use the enlarging method of printing in order to cut out the extraneous matter and yet get a good sized print.

The most appropriate lighting for this type of camera work is that which you find illuminating the subject when you spot it. Since lighting makes the picture, it is lighting that will reveal the picture possibility to you when you first view it. The light may come from a table or floor lamp or it may be some arresting effect caused by daylight coming directly through a window or reflected from a light-toned wall. Sometimes, as in the case of "Kitchen Curves," you will find it necessary to use strong artificial light carefully directed to obtain a desired result. In this case, the subject called for an even light over the entire area. Two reflectors were therefore used, each containing a single Photoflood bulb, and their position so disposed that the entire area was evenly, or, to use the more technical term, flatly, lighted.

The majority of subjects will be found to be worth while because of the peculiar way in which daylight falls upon them, as in "A Sunny Corner" and "Wash Day." The latter was photographed from the rooftop of an adjoining building, the subject having been found appealing because of the long shadows caused by a late afternoon sun. "A Sunny Corner" seemed to justify an exposure by its simplicity, sense of peace, its coziness and warmth and gener-



"Wash Day"



"Kitchen Curves"

ally by its genuineness. The atmosphere of the corner was found to be aided by the almost total lack of detail in the black part of the picture.

Simplicity is the keynote of the domestic life. The worker who attempts to photograph it sympathetically will soon sense this; he cannot succeed in this work until he does. After he begins to appreciate the pictorial value of familiar things he will find subjects by the dozen where formerly he saw very little.

## A Horrible Example

FOR the edification and moral instruction of our readers, we offer this month the example of a photographic novice who made the fatal error of believing that the purchase of an expensive camera immediately makes the owner a good cameraman. Of course, we know this is not so, and it may be that if we asked the Horrible Example if he thought this were so, he would deny it also. But the fact remains that his actions certainly would contradict him severely.

The sad story follows: Induced, as who is not these days, to join the camera clan, the Horrible Example purchased a 15-dollar outfit that seemed for a beginner a fairly good piece of equipment for the ordinary purposes he originally had in mind; namely, pictures of the family, friends, and other run-of-the-mill subjects. His first results showed under-exposed or abnormally over-exposed negatives with the consequence of poor prints and, in some cases, no prints at all. He blamed the camera, of course, instead of himself. On questioning him this department found that he had taken so little trouble to acquaint himself with the fundamentals of photography before attempting to use the camera that he did not even know the difference between an under- and an over-exposed negative, invariably closed his diaphragm down to F:22 because, he said, he wanted to get everything sharp (ignoring, of course, the fact that there had to be enough light available to permit him to do this), and so far misunderstood the meaning of lens speed and shutter speed that, being told that his lens was "speedy" he made an indoor shot under poor lighting conditions at the fastest speed his shutter would permit!

Believing, as we must assume he did, considering his subsequent actions, that the fault was not his but the camera's, he bought another—F:3.5 lens, reflex mirror, and all, for about 40 dollars. Strange as it appeared to him, the pictures still would not "come out" properly. He now turned, a novice of three weeks' standing, to amateur movies, paying about 200 dollars for a 16-mm motion picture camera, a projector, splicer, screen, and so on. He seemed to have a little better luck with this, possibly because of the F:1.9 lens and the advantages of the short-focus lens. Still hankering for a still camera as an adjunct to his movie activities, he purchased an 80-dollar twin-lens reflex camera and the last this department heard of this bewildered young man's camera experiences was that he accidentally dropped it into a fish bowl while trying to take his first picture with it!

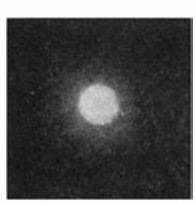
The Horrible Example who has been the subject of this discourse is a family man fully in possession of his faculties, he has money in the bank, and is a respected member of his profession. His case is typical; the reason some do not go the lengths he did is because they do not have the money to do it with. Persons like these should not be discouraged but, when they will listen, given suitable advice so that photography, either as hobby or profession, may maintain the high standards to which it is entitled.

## Twin-Lens Reflex

RECENTLY imported, the new Fothflex twin-lens reflex offers camera hobbyists a choice of F:2.5 or F:3.5 lenses, direct focusing on a viewed-from-above ground glass, focal-plane shutter speeds from 2 seconds to 1/500th, built-in delayed action shutter device, automatic exposure counting, and other features in a metal body camera without a bellows. Matched lenses for viewing and photographing permit the user to see the subject up to and during exposure. The camera makes 2¼ by 2¼ inch negatives, 6, 9, or 12 to the roll depending on the type used.

## "Stopping" the Moon

WHAT is the longest exposure the moon will stand without showing movement on the negative? This department set out one night at 10 P.M. to find out and here is what it learned: Exposures varied from one second to several minutes. The diaphragm opening was F:4.5 and 35-mm. film was used. Enlargement of the results to about a dozen diameters indicated that an exposure of 30 to 45 seconds could safely be made without showing noticeable movement, though a full minute's exposure did show a definite sign of "doubling" up. The accompanying illustrations show the results of exposures made at 10, 20, and 30 seconds, and one minute. Since many night pictures can be made within less than one minute provided a fast enough lens and



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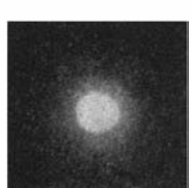
20 sec.



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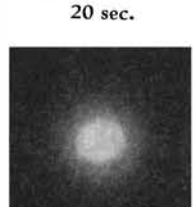


1 min.

superpan film is used, it is apparent that the inclusion of the moon when desired is quite within the realm of possibility. Try it sometime.

## Loading Bulk Film

A NOTE of caution to buyers of 35-mm film in bulk: This department has discovered on two occasions that after exposing a roll of film cut from a 25-foot roll, the last two or three negatives were found to have large numbers punched through them. Handling the film by the edges in absolute darkness, as one is obliged to do when loading film on a spool, it is impossible to detect these perforations, and as a result two or three exposures are spoiled. The way to avoid this is to feel along the end of a new bulk roll and cut away a strip the length of the perforated part.

## Let the Highlights Fall—

THE old-time photographer's rule to "expose for the shadows and let the highlights fall where they may" was recently observed by a modern photographer in a manner that must have come as a distinct shock to camera-hobbyists. Mr. Steichen was the photographer and his photograph, used in an advertisement, showed a sunbathing female nude reclining on a white stone staircase. The figure was in good tone throughout but the staircase was so flooded with sunlight that hardly more than a suggestion of the stairs was visible, the rest being "blank paper." Mr. Steichen evidently permitted the "highlights to fall where they may" deliberately in order to bring about the impression of strong sunlight. Mr. Steichen is a photographic genius and whatever he does in his line is worth anybody's attention. His implied lesson here seems to be that when a certain effect is desired "anything goes."

## The Child at the Zoo

WHAT would happen to the zoo if there were no children to visit its inhabitants? Certainly it would lose much of its interest, for half the pleasure derived from the zoo by adults is in watching the pleasure it gives the youngsters. The next time you take a child to the zoo don't forget to bring your camera. You may find you have more fun photographing the child enjoying himself, particularly in feeding the exhibits, than in seeing the animals. In

"Feeding Time at the Zoo"

"Feeding Time at the Zoo" the child offering a peanut to the camel has attracted a crowd of both youngsters and adults; the photographer leans well over the railing and takes a shot that proves to be both a good study in concentration and a fine example of human interest photography.

## Lunchtime Photography

TOTE your camera with you when next you go out for lunch and avoid regrets over the chance shot you wish you hadn't missed. If you have a camera of the "candid"

"Lunchtime"

type you will probably find it the most useful. The two messengers conversing over their sandwiches while seated at the edge of the fountain is one possibility.

## Speedgun Photography

THE varied uses of the Photoflash gun are described in a pamphlet being sent free for the asking by S. Mendelsohn, of New York City. The pamphlet covers the making of portraits, both human and canine, by means of the Photoflash bulb and the speedgun and describes a simple way of making photomontages with the speedgun. The gun may be attached to any camera using a between-the-lens shutter and the accessories available include a remote control device which makes it possible for the "gunner" to shoot his own picture. The Mendelsohn speedgun is the one which has been in use among press cameramen for some years and which has now become available for amateur use as well.

## Slow Development

A TIP from an old-timer recently received by this department: In order to get a good scale of tones in the portrait negatives he develops he uses a pyro-metol formula but starts development with but a third of the carbonate called for. After development has proceeded for a while he observes progress by the light of a red lamp (he uses portrait film, orthochromatic) then switches off the light and continues, studying the negative every little while. When the image seems to be coming up, but slowly, he pours in another third of the carbonate, being careful to lift the batch of negatives by one end so that the carbonate is well mixed in the developer solution be-

fore affecting the negatives. Otherwise unequal development would result. Finally, he pours in the last third of the carbonate. The whole procedure takes about a half hour but the photographer says the method is ideal for the long-scaled negatives he wants.

"The Flower Seller"

## Chance Compositions

NOW and then we come across a subject accidentally well composed and ready for a snapshot. Such a one as "The Flower Seller" is a case in point. The figure is placed just right in relation to the shadow and the contrast of light and shade lends atmosphere to a subject which would have been worthless without it. The picture was made in late afternoon from an elevated railway platform.

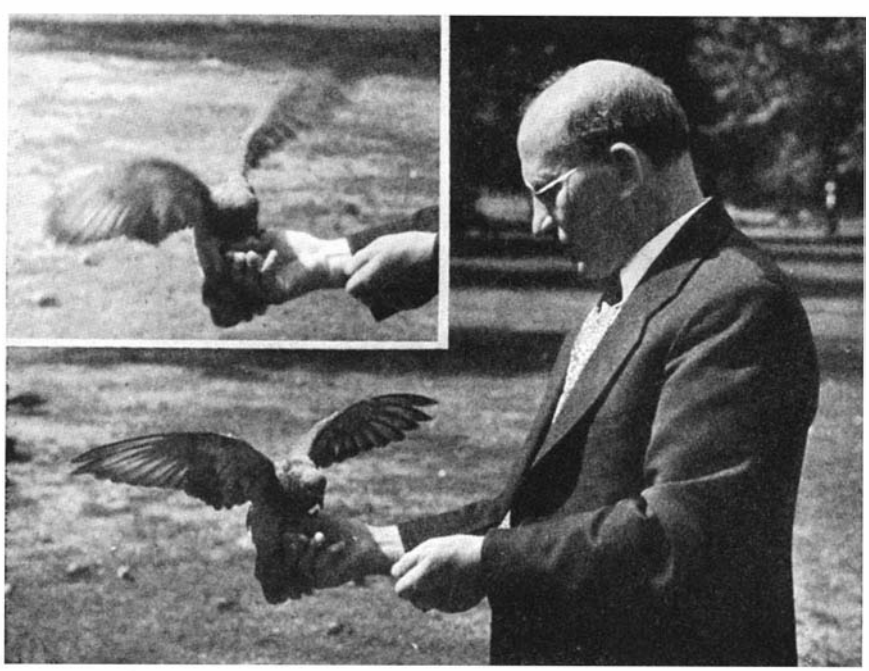
## Tree Reflections

IN "Reflections" this department offers a suggestion for the proper manner in which to photograph the reflection of trees in water. The reflection of the trees alone might prove a little puzzling, despite the strip of shoreline in the lower right-hand corner, the viewer being inclined to turn the picture upside down in an effort to determine whether the picture was that of the trees themselves or their reflection. As it is, the lily-pads on the water's surface not only make the scene clear but also add contrast and interest. A good portion of shoreline in the upper part of the picture or, better still, a human subject looking down into the water, would also be effective.

"Reflections"

## Flapping Wings

IT takes 1/500th of a second to stop the motion of a pigeon's wings, and here is the evidence. The use of peanuts as bait made the pigeon in the illustrations fly to the feeding hand three times in succession, making possible three exposures (only two are reproduced), the first at 1/100th, the second at 1/200th and the last at 1/500th of a second. The first is quite hopeless, of course, the second just fair, but no fault can be found with the third, for here the wings are as "frozen" as if purposely posed.



"Flapping Wings." "Stopped" at 1/500. Inset: At 1/100


## THE SCIENTIFIC AMERICAN DIGEST

(*Continued from page* 289)

solution attach themselves to the negatively charged surfaces of the metal in such a way as to reduce its effective contact with the liquid. They have further found that the amount of an amine needed to minimize corrosion is related to the cross-sectional area of its molecule. The area covered by each molecule is extremely minute, but it has been shown that if the ions can be made to assume a tilted instead of an erect position with respect to the metal surface, smaller amounts of amines are effective.—*D. H. K.*

### Road Taxes for the Flier

IN a recent article "Where Are the Private Fliers?" by Robert Crawford, published in *The Sportsman Pilot*, Mr. Crawford has the following pertinent remarks to make concerning gasoline taxes:

"Gasoline is too high. Why should the flier be heckled with road taxes? Most states realize that the average flier won't take the trouble to ask for his refund, or go through the various red-tape procedures to get it, and the various states pocket the money. Texas charges you one dollar each time for the privilege of filing a claim, so how many fliers do it? In the meantime, thousands of dollars roll up in the Texas treasury and they can smile. Is this a racket?

"Arkansas leads the way by doing away with the gasoline tax for airplanes entirely. So, fill up, gentlemen, in Arkansas. The Carolinas and Tennessee as well as Colorado, Wyoming, and Utah grab as many pennies as they can and tell you to whistle for your refund. Do these same states disrupt transportation by taxing each railroad ticket 5 cents every 15 miles of travel? What a holler would go up if they did! Are there five fliers in the United States who travel cross-country and take the trouble to demand their rightful refund? I doubt it. If a hundred of us would do as I do, make *every* demand for a refund and with each letter to a tax department write a PROTEST and demand sensible handling of the tax situation, there would be a change.

"Remedy: do away with all State taxes of gasoline for airplanes. Substitute a two-cent Federal tax to be used in building of new airports *only*."

### Preventing Collision in the Air

LONDON *Flight* carries an interesting account of an instrument entitled the Radiaura, designed to prevent collisions at sea and tested with satisfactory results by the British National Physical Laboratory.

As constructed at present, the Radiaura is too bulky for aircraft use and only works in two dimensions. But reduction in weight and modification for use in three dimensions should not be too difficult. We would then have an apparatus for preventing collisions in the air whose utility would be obvious.

The Radiaura makes use of the cathode-ray tube. For those readers who are not too deeply versed in radio, it may be stated that the cathode-ray tube consists of an electric filament placed at the narrow end of a conical glass tube, almost completely evacuated of air and containing a mere trace of helium. Near the filament, or cathode, is a circular plate, technically known as the anode, through the center of which is a hole. When the filament is heated by passing a current through it, and a suitable electric potential is applied to the circular plate, a stream of electrons is shot from the filament or cathode to the anode. Because there is a hole in the anode plate, the electrons pass on and hit the flattened base of the cone. If the base of the cone is coated with a fluorescent material the point of impact shows up as a spot of light.

The stream of electrons is of negligible weight, and can be instantly deflected by charging pairs of plates, disposed at right angles to one another, or by electro-magnetic coils. Because of the low weight of the electrons the jet can be deflected very rapidly. If the motions of the jet are fairly rapid, persistence of fluorescence makes the path traced out by the spot appear as a line of light on the screen.

The cathode-ray tube is, of course, only one element of the "collision preventer." In conjunction with the tube a pair of loop aerials are fixed in vertical planes at right angles to one another. These aerials, suitably tuned and adjusted, influence the line of light produced by the cathode-ray tube.

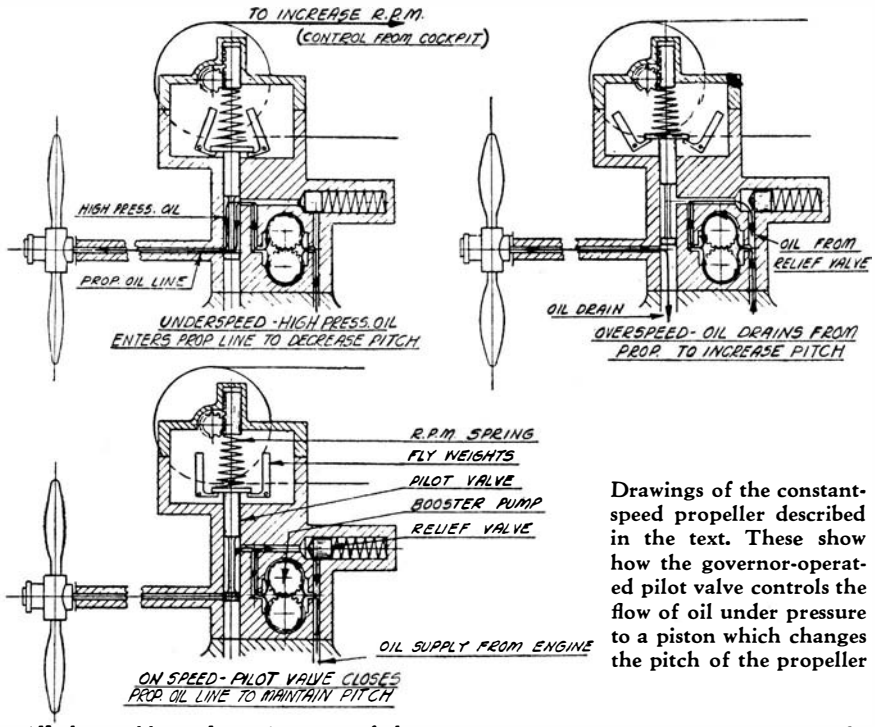
As soon as a transmitter carried by another vessel (sea or air) comes within range, its waves influence the two loop aerials, and the line of light appears in the tube. The line of light gives the bearing of the approaching ship, and the length of the line increases as the approaching vessel comes nearer.

Very simple in principle, the apparatus is quite complicated in actuality. For three-dimensional use, it may be conjectured that two cathode ray-tubes might be necessary and also a duplicate set of aerials. But once the electrical technologists really get busy, with their vast scientific resources, the practical difficulties should soon vanish.

With increasing air traffic, and increasing blind flying, an instrument such as the Radiaura would be highly welcome.—*A. K.*

### The Mystery of the Constant-Speed Propeller

THE original Hamilton Standard controllable-pitch propeller—which was awarded the Collier Trophy as the outstanding aeronautical development of the year 1933—was limited to two pitch positions: a low-pitch position for take-off and climb, and a high-pitch position for high speed. This was a great step forward and considerably improved the efficiency of operation. But a two-pitch manual setting is not entirely satisfactory, since the airplane needs a multiple variation in speed to suit all conditions of flight. Also, the pilot has already so much to think of that manual control is somewhat of a burden. Again there must be some kind of control of the engine—no over-speeding in a dive, no overloading at take-off or in a sharp climb.




**Drawings of the constant-speed propeller described in the text. These show how the governor-operated pilot valve controls the flow of oil under pressure to a piston which changes the pitch of the propeller**

All these additional requirements of the controllable-pitch propeller have been met by the constant-speed propeller, which is being adopted on many airlines and is giving splendid service.

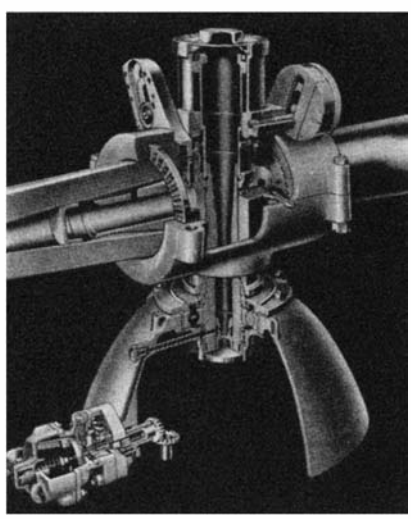
We have in these notes hinted at the underlying principles of the constant-speed propeller, but an authoritative description of the controlling mechanism has hitherto not been available. This mechanism is so ingenious and "satisfying," that a detailed description is fully justified.

The basic principle of the automatic change of pitch is very simple. Counterweights acted on by centrifugal force tend to increase the pitch as the engine speed and the speed of the plane in level flight go up; oil pressure supplied from the engine works in the opposite direction. The two conflicting forces so balance one another that the pitch is adjusted to keep the engine speed always the same, no matter what the throttle setting or the flight condition may be.

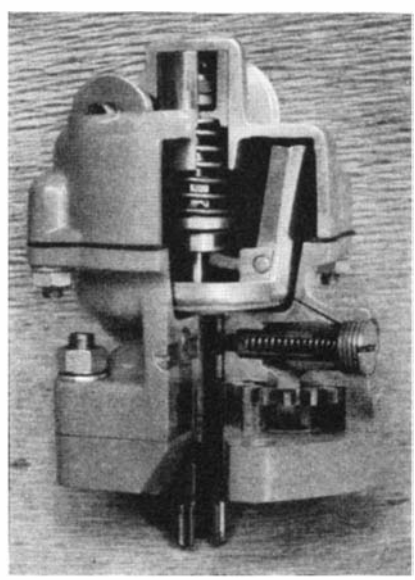
The sketches illustrate the automatic pitch selector. A simple gear pump, driven from the engine and called "booster pump" in the diagrams, boosts the engine oil pressure to 180 to 200 pounds per square inch, at which figure it is maintained by means of a simple relief valve.

The heart of the "selector" is the pilot valve. The governor, consisting of counterweights or "fly weights" tends to fly out and compress the spring while raising the pilot valve. On the other hand, when the engine is not rotating fast enough, the force of the governor becomes less than that of the spring, and the pilot valve goes down. It then uncovers the port leading to the propeller feed line as shown in the "Underspeed" sketch. This allows oil under pressure to flow from the booster pump to the propeller, where a piston working in a cylinder decreases the pitch of the propeller, allowing the engine to speed up accordingly. Everything is exactly the converse in the overspeed condition.

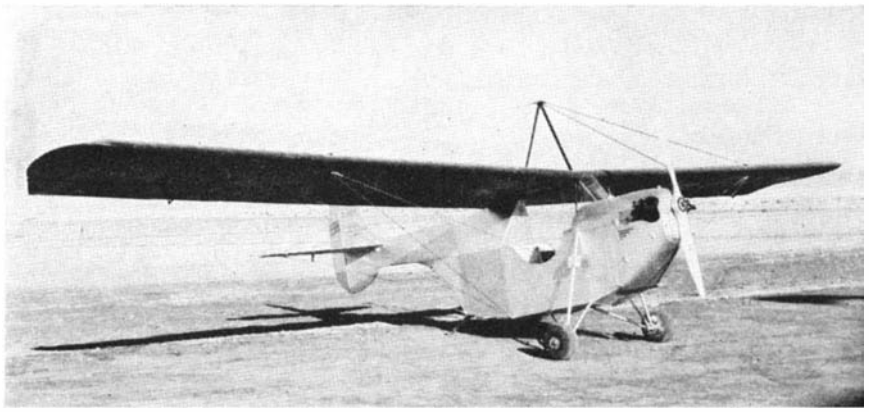
There is also a control from the cockpit which can be made to change the tension of the governor spring, thus changing the fixed revolutions per minute to some other



**The selector unit shown in its relation to the constant-speed propeller**



**Cut-away view of the selector unit. Compare it with the drawings above**



**The National Airplane, a low priced flivver plane**

desired figure. In the "On Speed" position, no oil flows to the propeller, and the relief valve opens so that the pressure-boosted oil just circulates 'round and 'round.

In one of the photographs the selector unit is shown in relation to the controllable-pitch propeller itself with the feed lines clearly indicated. With the actual mechanism of pitch variation, the reader is no doubt already familiar.

The constant-speed propeller has a number of advantages in addition to improving the performance in take-off and at high speed. With this device it is possible to go through various maneuvers in acrobatic flying without the necessity of readjusting the throttle to prevent the engine overspeeding. On multi-engine airplanes it is evidently important to keep the engines on either side of the fuselage always in synchronism. This is quite a difficult task for the pilot, which he is very happy to turn over to the selector. There are also other technical possibilities in the device which help to explain its popularity.—*A. K.*

## The Flivver Airplane

A RECENT newspaper story was entitled "Tests Reveal Air Flivver at Low Price Nearer. Six Types of Experimental Machines Used in Inquiry for Commerce Bureau."

There is not the slightest doubt that announcements of this character do a great deal of harm to private flying in the United States, although we do not know whether the Department of Commerce or the newspapers themselves are to blame.

The Department of Commerce announced a 700-dollar-airplane nearly three years ago, and nothing of the kind has appeared under its auspices. The experimental planes produced under its program cost at least 3000 dollars. The argument is that they are much safer than ordinary planes, but the ordinary planes are licensed by the Department itself, are faster than the new variety and are actually on the market, not in the experimental stage.

As a matter of fact the flivver airplane is right here with us now. We know definitely that one company in the middle-west, selling a two-seater under 1500 dollars, sold 280 airplanes in less than six months, and has recently placed an order for a million dollars' worth of engines. Other companies selling machines in the same price range are doing almost equally well.

Our recommendation is that both the Department of Commerce and the newspapers should cease announcing "flivver airplane near" or "coming" and give due credit to the successful efforts of today's manufacturers.

By a coincidence, and as if to underline the points of the above remarks, we have just received a description of the National Airplane, which is definitely in the low price range. The workmanlike small machine is shown herewith. It costs less than a thousand dollars, has a top speed of 85 miles per hour, and the gas consumption is given as 2½ gallons an hour. The engine develops 35 horsepower in its two opposed cylinders, the weight empty is 465 pounds, and the gross weight is 900 pounds. At least some one is actually building flivver airplanes in this country.—*A. K.*

## Will New York City Lose Again?

WHEN the first transatlantic airplane service is put in operation, it would seem logical that New York City should be the American terminal. But New York City lost the opportunity of being the domestic air terminal of the east when it allowed Newark to build an airport that was more desirable than Floyd Bennett Field. Now history is likely to repeat itself. Charleston, South Carolina, and Baltimore, Maryland, are both actively competing for the honor of building the transatlantic air terminal. Both cities have pledged 1,500,000 dollars to make the necessary improvements at their respective municipal airports, while officials of Pan American are actively negotiating with the mayors of these cities. This great operating company is apparently of the opinion that the more southerly cities would be more suitable for winter operation, and that there would be very little loss of time on the southerly route (Bermuda, Azores, Portugal) if passengers and mail had to be transferred to fast landplanes at either Baltimore or Charleston. Moreover, New York City apparently has considerably less local pride, and that is probably the main reason why it will lose out in the competition!—*A. K.*

## Carbureter De-Icing

WINGS, struts, tail surfaces, and the propeller of the modern plane are now effectively protected against ice formation. Ice in the carbureter is the next peril to conquer. The Air Commerce Bulletin describes a number of devices for eliminating or preventing this trouble. Ice in the carbureter checks the flow of the fuel mixture and the phenomenon may occur when the

outside temperature is as high as 50 degrees or 60 degrees, Fahrenheit, because the vaporizing fuel causes a temperature drop.

One type of carbureter which has been successful in tests is the Chandler-Groves. Much of the icing difficulty in the carbureter arises from contact of the fuel mixture with carbureter parts after vaporization has caused cooling. The Chandler-Groves carbureter is designed on unconventional lines in such a fashion that the mixture leaves the carbureter immediately after vaporization. No contact with parts; no icing.

In a conventional Stromberg carbureter the difficulty has been met in quite another fashion. The moment ice begins to form, it closes a small aperture in the barrel and a mechanism controlling an alcohol valve functions. The alcohol injected into the fuel mixture breaks up the ice. There is also a novel arrangement for preheating the air without raising it to such a temperature as to lower the efficiency of the engine.

Another line of attack is in a special mixture developed by Dr. C. C. Callis. A minute amount of the secret stabilizing fluid, added to the carbureter for not more than a minute, will dissipate the ice. Tests at the School of Aeronautics, New York University, and at the Bureau of Standards agree as to the splendid properties of the Callis stabilizing fluid.—*A. K.*

## Removing Fluorine from Drinking Water

IN many parts of the country injury to teeth has been traced to the presence, in minute amounts, of fluorine in drinking water. In some way the presence of compounds of fluorine in drinking water causes spotting and disintegration of the enamel of teeth, and hence it is extremely important in those localities where water supplies contain this element to remove it before drinking the water.

Many researches have been directed toward finding an efficient and economical method for doing this, and several methods, more or less successful, have been proposed. The latest and so far the most practical solution to this problem is to pass the water containing fluorine over a bed of activated alumina. Apparently the alumina absorbs the fluorine and makes the water safe.

To apply the method a small unit containing less than 10 pounds of alumina in a bed 6 inches deep and contained in an enameled vessel 12 inches deep and 8 inches in diameter has been built which will remove fluorine from 250 gallons of water before a renewal of the alumina is required. Such a unit can be used for treating water in a single household and the replacement of the spent alumina is easily accomplished. Larger units for treating municipal water supplies are yet to be developed. It seems probable that treatment of only that part of a water supply used for drinking will be preferred to treating the whole supply, because of cost.—*D. H. K.*

## Science in India

TO many in our western world India is or has been the home of mystic cults and occultisms, but western science has taken hold there and has come to fruition in several forms, one of which is the relatively recent foundation of sound scientific journals. Two of these, *Current Science* and *Science and Culture*, reach the editor's desk each month and are very similar to high-grade scientific journals elsewhere. The former is patterned largely after *Nature*, of London, is quite technical and is published at the Indian Institute of Science, Herbal Post Office, Bangalore, India, under the editorship of Prof. C. R. Narayan Rao. The latter journal is a little more popular and is edited by the well-known astronomer Prof. M. N. Saha, at 92 Upper Circular Road, Calcutta. Both are in English.

It is good to see that India now contains enough persons of scientific background to support such excellent journals. For years we have received, unsolicited, from that collection of eastern nations various journals which contained a dismaying mixture of science and superstition oddly blended together in one organ. Here in the west the two are more likely to be separated, journals being either scientific or occult. But the fact that we have in this country so many journals devoted wholly to astrology and so on puts us in no position to patronize India.

## Fish Have Hard Life in Muddied Streams

THOUSANDS of fishing sites that once were the joy of fishermen will provide less sport and yield fewer fish than ever before as a result of soil erosion, says E. G. Holt, head of the wildlife section of the Soil Conservation Service.

"In all parts of the country, muddy waters and silt are diminishing the stock of fish," he said. "The reason is plain. Eggs laid by game fish cannot survive when streams are full of mud and erosion debris. Also, blanketing of the bottoms of streams with ooze and silt is destructive to food supplies, such as insect larvae, worms, and small plants."

The decreased supply of game fish in inland streams and their tributaries has not come about suddenly. Unwise use of the land over a period of years, resulting in an excessive run-off of rain-water which washed tons of soil into the streams, has been steadily cutting down the rate of propagation.

Mr. Holt pointed out another reason why soil erosion can be blamed for spoiling

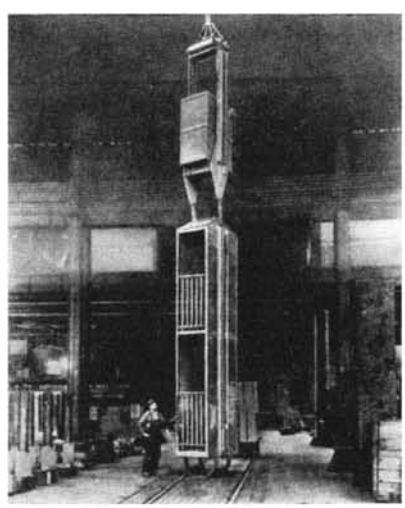
once-popular fishing locations. Many species of fish will thrive only in relatively deep, clear, running water, and when silt fills stream channels the fish leave, because they cannot live in the sluggish, muddy waters of shallow streams.

"Until there is more general control of soil erosion fishing conditions will not improve greatly," he said. "Unless silting of stream channels is stopped, there is no reason to expect that the fish can be brought back and the stock restored."

## Mine Cage

MINE shafts are not like elevators in business buildings; space is restricted and the traveling distance often runs to many hundreds of feet. Hoisting cages must, therefore, be designed to meet this problem.

The combination vertical ore skip and double deck hoisting cage shown in an accompanying illustration is one of several



Ore skip and mine hoisting cage

of identical size designed and fabricated by Allis-Chalmers Manufacturing Company. In this design, the weight was reduced by nearly one third of that of similar existing combined skips and cages by the use of a special high tensile strength alloy steel throughout. The reduced weight of this new equipment is sufficient to permit one mine to operate now to a depth of 800 feet greater than possible heretofore and all without increasing the rope pull on the existing hoisting equipment. These cages are to be used in a deep lead-silver mine in northern Mexico.

## Lightning and Atmospherics

IT is now generally agreed that the majority, if not all, the atmospherics encountered in radio communication originate in lightning flashes. When the storm is close to the receiver, it is possible to identify the stronger atmospherics with the neighboring flashes. In a recent communication, Mr. P. F. Fyson, Langherne House, Rushwick, Worcester, England, claims to have observed that the atmospheric crackle produced on a broadcasting receiver was heard before the lightning flash which caused it was perceived visually. If this difference in the perception of the two effects is real—it obviously needs verification by other observers—it would appear on first considera-

tion that the human eye is rather more sluggish in its operation than the ear; and Mr. Fyson suggests that this may be due to the time required for the chemical change in the retina to affect the optic nerve. An alternative explanation, however, may be found in the fact, which has arisen from recent research on lightning, that an intermittent electrical discharge appears to precede the actual main lightning flash. It is possible that this discharge may be invisible and yet may be capable of producing audible effects on a radio receiver. These sounds may thus be heard a very short time before the visible flash was observed.—*Nature* (London).

## New Facts Help Timber Growing in South

SEVERAL outstanding accomplishments, including the development of a method for procuring increased germination of black locust seed, improved methods of artificial reforestation in the South, as well as facts in regard to influence of severe fires on pine sapling stands and results of truck logging in second-growth shortleaf and loblolly pine, were developed last year by the Forest Service, U. S. Department of Agriculture.

The experiments were carried out by the Southern Forest Experiment Station at New Orleans, one of 12 regional forest experiment stations in the United States.

Development of the method for improving germination of seed from black locust trees was an important accomplishment, as the black locust is widely used in erosion control work and also is considered a valuable adjunct to the farm woodlot as it is an excellent source for fence posts. During 1935 more than four tons of the black locust seed were treated in Mississippi alone. The treatment involves soaking the black locust seed in concentrated sulfuric acid for a short time prior to planting in the nursery.

## Heat-Proof Windows

A NEW coating to be put on glass windows, which allows 90 percent of the light to pass but which filters out heat rays, is said to reduce the temperature inside a building by as much as 10 to 15 degrees and to minimize glare.—*D. H. K.*

## And the Botanist Missed His Reply!

ACCORDING to *Nature* (London), Sir William Fraser relates the following event in the scientific world:

"The Duke of Wellington . . . received a letter . . . from the eminent landscape designer and great authority on botanical matters, J. C. Loudon. It was . . . to this effect:

" 'My lord Duke: It would gratify me extremely if you would permit me to visit Strathfieldsaye, at any time convenient to your Grace, and to inspect the Waterloo beeches. Your Grace's faithful servant, J. C. Loudon.'

"The Waterloo beeches were trees that had been planted immediately after the battle of Waterloo, as a memorial of the great fight. The Duke read the letter twice, the writing of which was not very clear; and, with his usual promptness and politeness, replied as follows; having read the

signature as 'C. J. London' instead of 'J. C. Loudon':

"'My dear Bishop of London, It will always give me great pleasure to see you at Strathfieldsaye. Pray come there whenever it suits your convenience, whether I am at home or not. My servant will receive orders to show you so many pairs of breeches of mine as you wish; but why you should wish to inspect those that I wore at the battle of Waterloo is quite beyond the comprehension of Yours most truly, Wellington.'

"This letter was received, as may be supposed, with great surprise by the Bishop of London. He showed it to the Archbishop of Canterbury, and to other discreet persons: they came to the melancholy conclusion that the great Duke of Wellington had evidently lost his senses. The Bishop of London (Blomfield) declared that he had not written to the Duke for two years; and to receive this extraordinary information puzzled the whole Bench of Bishops."

## Scheming to Teach Make-up to Apples!

BECAUSE of the desirability of high color on apples in the markets and because of the importance of apple-growing in West Virginia, it was deemed advisable to undertake an investigation of the red pigment of the apple at the Agricultural Experiment Station at Morgantown.

Many of the earlier investigators of plant coloring matter thought that all red, violet, and blue flowers contained the same pigment, believing that its color was changed by conditions prevailing in the various cell saps. However, it is now known that there are a considerable number of naturally occurring substances which produce these varying shades of color.

The red coloring matter of the winesap apple has been shown to belong to a group of complex organic substances known as anthocyanins of which there are several fundamental types. Like other anthocyanins the pigment occurs in the apple skins in the form of a glucoside. It was identified as idaein chloride, a pigment which occurs also in the cranberry.

Now that the pigment of the apple has been isolated, its chemical structure established, and some of its properties determined, it is planned to carry the study into the field and investigate the various factors which influence the formation of the pigment by the tree during the growing season.

## Half Our Hawks Do More Good Than Harm

CONTRARY to common opinion, not all hawks are chicken thieves. Six of the 17 most common species are good friends of the farmer. At least half do more good than harm, says the Bureau of Biological Survey, United States Department of Agriculture, in a new circular, "Food Habits of Common Hawks."

Some hawks occasionally kill chickens or useful birds, but for each of these a hawk usually eats dozens of rodents and many insects. Sparrow hawks, for example, seldom prey upon other birds, yet they often are blamed for misdeeds of other hawks. They could more appropriately be called grasshopper hawks, says the circular, as the chief food found in 491 of 703 sparrow

hawk stomachs was grasshoppers. Studies of the Swainson's and American rough-legged hawks show they are almost entirely beneficial in feeding habits.

Red-shouldered, broad-winged, and ferruginous roughleg hawks are preponderantly beneficial, seldom in need of control. The red-tailed hawk and the golden eagle are more beneficial than injurious. The marsh hawk and prairie falcon each have about equal proportions of harmful and beneficial habits. Both the bald eagle and osprey are harmful and beneficial in about equal proportion. Pigeon hawks tend to be destructive but may be tolerated in small numbers. Goshawks, sharp-shinned, Cooper's, and duck hawks do more harm than good.

Remains of poultry were found in nearly half of the 243 goshawk stomachs examined, and in only two of the 944 sharp-shinned hawk stomachs. The sharp-shinned hawk, however, feeds largely upon useful birds.

One of every 12 meals eaten by the red-tailed hawk, or hen hawk, probably consists of chicken. Otherwise, it is a good "mouser" and does more good than harm. Where poultry is not protected by pens or runs, this hawk has to be controlled.

Control measures are advised against offending hawks only, and not against the entire race. Copies of the Circular, No. 370, may be obtained from the Superintendent of Documents, Washington, D. C., at 5 cents each.

## Chain Loop—Humane Animal Trap

TRAPPING animals for fur, or to remove them as nuisances, promises to become a much changed and far more humane business than it has been during the long reign of the steel trap, through the introduction of an entirely new type of trap, the invention of Vernon Bailey, veteran biologist of the United States Biological Survey. Mr. Bailey's trap substitutes for the old-time steel jaws a firm-holding but painless chain loop, somewhat reminiscent of the string snares we used as boys to catch ground-squirrels and gophers. Only it is much stronger, wholly automatic in action, and can be built large enough to capture a grizzly bear.

Mr. Bailey has spent a long lifetime among animals, as their student and their friend. He has hated to see them tortured by steel traps—and often escaping from

**Humane animal trap—set**

**Humane animal trap—sprung**

them, at the cost of being crippled for the rest of their lives. Yet he recognizes the legitimacy of the fur trapping industry, which has for a long time depended largely on steel traps. To produce a better trap, that would never lose its catch and yet never torture or maim the animal, has been his ambition for many years.

The "Verbail" trap—as his friends have named his invention—is built very much like a bow. There is a strong but flexible spring-wire arch, with a piece of light chain attached to each end. The free end of each chain terminates in a ring, which slides freely around the opposite chain, thus forming an easily closing loop.

When the trap is set, a four-legged "spider" of light metal holds the loop open, wide enough to admit the foot of the animal to be caught. When the animal steps into the loop, the jointed legs of the "spider" let go and the spring flies apart, throwing the loop upward and at the same time pulling it shut—and the animal is caught.

The first reaction of a trapped animal always is to jump and pull. In an anchored steel trap, this always ends in a violent jerk, increasing the shock and pain of the jaws' first hard snap, and not unlikely breaking the animal's leg—if the steel trap has not already broken it.

In the "Verbail" trap, the effect is quite different. The chain cannot break the animal's leg, and its jump and tug are stopped by the "yielding resistance" of the spring that holds the chain. As a rule the animal, not being in any pain, soon accepts the situation philosophically and lies down to wait for what may happen next.—Copyright *Science Service.*

## Controlling Gas Explosions

RATE of rise of pressure during the explosion of a gas mixture is the most important characteristic of such explosions. This rate depends upon the temperature of the mixture when the explosion starts. For each mixture of flammable gas and air has been found a critical temperature which gives the fastest rise of pressure. The variation in performance of internal combustion engines between winter and summer can be traced to the differences of the initial temperature of the gas mixture in the cylinder. An improvement in operation should result from avoiding these critical temperatures by control of engine cooling.—*D. H. K.*

# CURRENT BULLETIN BRIEFS

*(Bulletins listed as being obtainable through Scientific American can be supplied only by mail)*

EVALUATION OF MINIATURE NEGATIVES, by J. W. Orelup, describes an instrument which, with a photo-electric exposure meter, automatically gives the following data for 35 mm. photographic negatives: printing time; grade of paper; fog due to light or chemicals; whether processing of the negatives has been correctly carried out. *Write for Bulletin 1136B, Scientific American, 24 West 40th Street, New York, N. Y.—3-cent stamp.*

THE TROYVILLE MOUNDS, CATAHOULA PARISH, LA., is an archeologist's account of the excavation of a large Indian mound at Jonesville, La. *Superintendent of Documents, Washington, D. C.—20 cents, cash.*

THE USE OF CELLULOSE, CASEIN, AND OTHER PRODUCTS IN SYNTHETIC PLASTICS AND RESINS, by Carpenter and Kucera. The main chemical reactions underlying the processes of increasing importance to the synthetic resin and plastics industry are given, insofar as they are known. The manufacture, various properties, and numerous applications of phenol aldehyde, cellulose, vinyl and styrene, glyptal, urea, and casein plastics are discussed. *New York State Agricultural Experiment Station, Geneva, N. Y.—Gratis.*

STATE AND COMMUNITY ORGANIZATION FOR SAFETY is a 24-page booklet which outlines specifically the formation of groups for the promotion of highway safety. *National Safety Council, 20 North Wacker Drive, Chicago, Illinois.—Gratis.*

HOW TO ABOLISH POVERTY. By George L. Record. Described as "a program of political action to end the present and prevent future depressions, provide permanent employment for all, and increase the production of wealth and secure its equitable distribution."—*George L. Record Memorial Association, 26 Journal Square, Jersey City, N. J.—$1.00.*

ILLUMINATION HANDBOOK serves as an authentic source of lighting facts of particular interest to electricians, lighting fixture dealers, and so on. It provides a mass of detailed information on specialized fields of illumination. Deals with interior lighting, display lighting, flood lighting, underwater lighting, and highway lighting. *Commercial Engineering Department, Westinghouse Lamp Company, Bloomfield, N. J.—10 cents.*

WHY WE SEE LIKE HUMAN BEINGS is a book published by the Better Vision Institute to protect and preserve eyesight. A great deal of information about eyes is compacted into a small space in this small book. *Better Vision Institute, 50 Rockefeller Plaza, New York, N. Y.—$1.25.*

FURTHER EVIDENCE ON THE DEPENDENCE OF TERRESTRIAL TEMPERATURES ON THE VARIATIONS OF SOLAR RADIATION, by C. G. Abbot, Secretary, Smithsonian Institution, is a follow-up of earlier papers on a hoped-for method of weather prediction, which has now received the backing of Professors Millikan, K. T. Compton, and Bowman, and Chief of the United States Weather Bureau but failed to receive requested financial backing from a Congress more interested in boondoggling. *The Smithsonian Institution, Washington, D. C.—5 cents.*

PROCEEDINGS OF THE SECOND DEARBORN CONFERENCE OF AGRICULTURE, INDUSTRY AND SCIENCE. A 400-page transcript of the papers on power alcohol, starch and sugars, plastics, cellulose, soy beans, insecticides and fertilizers, delivered at the recent conference held under the sponsorship of the Farm Chemurgic Council and the Chemical Foundation, Inc. *The Farm Chemurgic Council, Dearborn, Mich.—50 cents.*

R C A REVIEW is a new quarterly journal of radio progress of which the July 1936 issue is Volume 1, Number 1. It is dedicated to making a permanent record of new information on electronics which is constantly being acquired in research laboratories. The material is of particular interest to students and others inclined toward the technical side of radio. *RCA Institutes Technical Press, 75 Varick Street, New York, N. Y.—Single Copies 50 cents, Subscription $1.50 per year.*

CONSTELLATIONS, by James Stokley, Director of the Fels Planetarium, Philadelphia, is an attractive pamphlet with good, clear, neat monthly maps of the constellations, with appertaining text of a rather light nature. *The Franklin Institute, Philadelphia, Pa.—35 cents, stamps or money order.*

SOLAR CAPACITORS is a comprehensive booklet prepared for engineers and laboratory executives in radio and other electrical fields where condensers of various types and capacities are in constant or occasional demand. This is more than an ordinary catalogue; it is a directory of capacitors. *Write for Bulletin 1136A, Scientific American, 24 West 40th Street, New York, N. Y.—3-cent stamp.*

WORLD CHEMICAL DEVELOPMENTS IN 1935 is a paper bound book of 197 pages, giving a complete review of chemicals throughout the world for the year named. *Superintendent of Documents, Washington, D. C.—15 cents (coin).*

THE FORESTRY PRIMER, 60th Forestry Aniversary Edition, is dedicated to the memory of Franklin B. Hough, the first forest agent. By Charles Lathrop Pack, it tells the story of the forests of the United States, their uses and abuses, their status at the present time, and the outlook for the future. *American Tree Association, 1214 Sixteenth St., N. W., Washington, D. C.—Gratis.*

A GOOD PICTURE EVERY TIME, by Alex. Strasser, gives the ironclad rules of photography and then tells when to break them in order to achieve the finest possible results. Beautifully illustrated with photographs to supplement the text. 40 pages plus space for notes. *American Photographic Publishing Company, 428 Newbury Street, Boston, Mass.—40 cents.*

# Books SELECTED BY THE EDITORS

## WHY BE TIRED?

*By Daniel W. Josselyn*

MOST of us would answer the question in the title of this book very bluntly: "Because we have too blooming much work to do and have to get it done." There is, however, another answer, and that is that we do not make the most of our energy. Mr. Josselyn seems to have quite a reputation as a specialist in reviving fagged office athletes and in this volume gives valuable information to the sedentary worker that will enable him to do more work in a given time with less fatigue. In just over 100 pages he gives some very sane advice on diet, on exercise, and on sex in their relation to the restoration of energy for tired business men and business women.—$1.10 postpaid.—*F. D. M.*

## ELEMENTARY PHOTOGRAPHY

*By Neblette, Brehm, and Priest*

IF you have little or no knowledge of physics and chemistry, yet want to delve somewhat into the whys and wherefores of photography, this book will be of great assistance. Without getting beyond your depth, you will find here a thorough background of the elementary principles of producing negatives and prints. Such background, properly utilized, will enable you to do better photography. The book was written as an easy-going text for students, but its lucidity and logical arrangement adapt it to the needs of anyone who fits into the general classification mentioned in the first sentence above.—$1.15 postpaid.—*A. P. P.*

## EARTHQUAKES

*By Nicholas Hunter Heck, Chief, Div. of Terrest. Mag. and Seismology, U. S. Coast and Geodetic Survey*

AT last there is a general, elementary treatise on seismology to recommend to the many who, during the past years, have asked for one but had to be told that none existed. Captain Heck's new book covers earthquake science from all angles, as indicated by its chapter heads: Earth Vibrations; Effects of Earth Tremors; Cause of Earthquakes; Release of Forces; Earthquake Study Without Instruments; Earthquake Study with Instruments; Present Seismographic Sections of the United States; Earthquake Records and Their Interpretation; Location of Earthquake Epicenters and Foci; Seismic Belts of the Earth; Description of Great Earthquakes; Earthquakes of the United States; Regional Investigations; Safe Construction in Earthquake Regions; Summary of Earthquake Information; History of Seismology. In all, 218 text pages of solid, compact matter. The chapter on instruments describes the various types. This is not, however, a book on how to make seismographs, for none exists, but it gives more insight into the instruments than the baffled beginner has yet found available. There have been only eight notable books on seismology in 30 years and most of these are either out of date, in a foreign language, or very abstruse. Commander Heck's book is a landmark.—$3.65 postpaid.—*A. G. I.*

## AUDUBON

*By Constance Rourke*

BIRDS come to mind almost as a synonym for the name of the great naturalist whose name this book bears. This is the story of his life, his work, his personality, his unflagging energy which drove him from Pennsylvania to Texas, from Florida to Labrador in his unending search for birds. Miss Rourke has made a life study of birds and of bird pictures and prints and, in addition, has traveled over much of the route followed years ago by Audubon. She is, therefore, eminently fitted for the job of portraying sympathetically the life of this great naturalist. The present volume, of over 300 pages, is profusely illustrated with black-line drawings in woodcut style and has, in addition, reproductions of 12 Audubon prints, beautifully done in his original colors.—$3.15 postpaid.—*F. D. M.*

## SKYWAY TO ASIA

*By William Stephen Grooch*

ADVENTURE is still to be found on the face of this old world of ours—adventure as thrilling and exciting as any encountered when knights were bold or privateers sailed the seas. Here is a taste of it, from the pen of a man who participated largely in the pioneering air-transport service across the Pacific. With but little background to guide them, other than that secured in the South American service, a group of American adventurers have conquered desolate islands in the Pacific, established air bases complete with radio stations and other necessities of modern avigation, and have laid the foundation for what will undoubtedly be an important link in world commerce. The author of the present book took an active part in this work. He tells his story of it as he saw it, recording also those little human phases that lend flavor to a narrative. No fiction could be more gripping than this simple tale of modern achievement, told without pretense of "highbrow" writing. As you read, you lose sight of the fact that the printed page is before you; the author might almost be telling his story across a couple of tall, cool glasses. Well illustrated; 205 pages.—$2.65 postpaid.—*A. P. P.*

## CREATE THE WEALTH

*By William Beard*

"THE author traces the rise of the idea of efficiency in engineering circles to the point at which comprehensive studies were made of the nation's productivity. Once actual and potential production has been surveyed, it is possible to attack the problem of raising standards of living in a sensible manner. Hence the author, applying the experimental method to current solutions, evolves a tested working plan which unites powerful forces, and indicates that the trend of the times may . . . result in its adoption."—$3.20 postpaid.

## MORE SIMPLE SCIENCE

*By Julian Huxley and E. N. da C. Andrade*

THE sequel to a recent book, "Simple Science" by the same authors, which dealt with mechanics, physics, chemistry, and biology, this book covers the earth's climates, earth history, the chemistry of life, soil, agriculture, artificial selection, and a short history of science. Most mature lay readers would find it very elementary—suitable for a lad of 12 to 14 or a reader whose knowledge of science is slight.—$2.65 postpaid.—*A. G. I.*

## ELECTRON DIFFRACTION

*By R. Beeching, A. R. C. S., B.Sc.*

PURE science research has opened many avenues for the study of matter. One of these avenues is supplied by the electron and its atoms. Through electron diffraction it becomes possible to study the arrangement of atoms in a

surface; solution of the problems of molecular structure will, without doubt, be of great importance to science and industry in the near future. The present book sets forth the technique of electron diffraction and will be of particular interest not only to physicists who are actually working in the field, but also to those who are interested in the latest developments in this particular branch of pure science research. The reader must have an understanding of the calculus. Pocket size, 108 pages with drawings, and a comprehensive index.—$1.35 postpaid.—*A. P. P.*

### YEARBOOK OF AGRICULTURE, 1936

*By the United States Department of Agriculture*

HERE is something commendable; the dull, statistical, annual reports of the Secretary of Agriculture have now been reformed, the statistics relegated to a separate book for statistics fiends, and the same space filled with material which should be of immense value to the practical farmer and breeder of plants and livestock, instead of following in the route of old mail order catalogs. It contains a treatise on the science of genetics and its immediate practical offspring, the breeding of better, more valuable plants and animals. Various breeding specialists in the Department of Agriculture contribute chapters on such things as improvement in wheat, corn, flax, tobacco, swine, mules, poultry, and so on. The treatise is explained in terms which the average practical man can understand and apply to his own practical problems.

The same fat volume includes the annual report of the Secretary of Agriculture, segregated from the scientific matter in the larger portion of the book, where the reader may either take its doctrines or leave them.—$1.25. Purchase direct from the Government Printing Office, Washington, D. C.—*A. G. I.*

### THERMIONIC EMISSION

*By T. J. Jones, M.Sc.*

COMPLETE understanding of the operation of vacuum tubes, either by the engineer concerned with their development or by the layman who likes to dig into a subject and find the real meat of it, depends largely upon an appreciation of the part played by the emission of electrons under varying conditions. The present book, pocket size, gives in compact form comprehensive data covering the subject. An excellent bibliography is included. An understanding of advanced mathematics is desirable.—$1.35 postpaid.—*A. P. P.*

### OLD WIRES AND NEW WAVES

*By Alvin F. Harlow*

HISTORIES are seldom interesting, but here is one on communication in all its branches that holds the reader's interest from start to finish. Beginning with the signal fires and other crude devices of the ancients, it carries the theme of rapid communication up to the present moment, including facsimile and television. No mere recording of events as they happen, the book is made doubly interesting by the style in which it is written. The author has, without marring in the least the authenticity of his work, managed to inject a degree of humor and reader appeal that is unusual in a book of this kind. Fathers (and mothers) will enjoy this running story; high-school youngsters will then get a chance at it and will absorb knowledge painlessly while being entertained. All the facts are backed by sound authority. Well illustrated; 548 pages.—$5.20 postpaid. —*A. P. P.*

### ELEMENTS OF OPTICS

*By Joseph Valasek, Ph.D., Assoc. Prof. Physics, University of Minnesota*

NOT a new book, but the second edition of an older one which was revised in 1932. Because there has been some call for a short textbook on optics it is reviewed here now. In 230 pages the author succinctly covers light and its propagation, photometry, velocity of light, wave theory, reflection, refraction, lenses (aberrations), optical instruments, color, interference, diffraction, double refraction and polarization, radiation, relativity, the nature of light. This is a beginning textbook for a three-month college course, and is for those who have had some physics, also geometry, algebra, and trigonometry. Being short and compact it will require close study.—$2.40 postpaid.—*A. G. I.*

### ROMEO AND JULIET

*The Play and the Complete Screen Script*

IF you have seen, or expect to see, the motion picture "Romeo and Juliet," you will want to read this book. It gives the original Shakespearean text of the play, the actual shooting script of the screen version, and articles and notes on the technical problems involved in putting this ever-popular play on the screen. The side-by-side placement of the text and the script shows how faithfully, in this one instance, the producers have followed the original, leaving out much of the "hokum" that too often characterizes Hollywood's attempts to put classics on film. Illustrated.—$2.20 postpaid.—*A. P. P.*

## Junior Scientists' Selection

AMONG the welter of new books for children this year, there are a number of excellent ones for the Junior Scientists. Most of those mentioned briefly below are for the ages of six or eight to fourteen; contain interesting facts presented in easily readable fashion; are well illustrated; and will make splendid Christmas gifts from the elders who read this page.

HOME CARPENTRY, *by Edwin T. Hamilton*, contains over 100 different articles, ranging from book cases to bed-tables for the amateur craftsman, and includes 200 illustrations and plans.—$3.20 postpaid. . . . OUR NAVY, *by Charles J. Finger*, gives an outline history of this important branch of our national defense (ages 10 to 14).—$2.15 postpaid. . . . THE BOOK OF LIVING REPTILES, *by Raymond L. Ditmars*, famous curator of the New York Zoo, *and Helene Carter;* all about crocodiles, alligators, snakes, turtles, and lizards—where and how these strange creatures live.—$2.15 postpaid. . . . THE DIRIGIBLE BOOK, *by William Clayton Pryor and Helen Sloman Pryor.* A splendid book of photographs of large and small airships, inside and out, with a story about Bill and Ann. Includes pictures of the new German *Hindenburg*, taken on her maiden voyage.—$1.15 postpaid. . . . DO YOU KNOW ABOUT FISHES?, *by Janet Smalley*, a new picture book in four colors and black-and-white, by the Philadelphia artist-author who has been so successful in making facts exciting for little children.—$1.40 postpaid. . . . WIGWAM AND WARPATH, *by Juergens-Lichtie.* By means of text and 100 illustrations, the youthful reader learns how the Indians lived.—$1.15 postpaid. . . . FAMOUS AMERICAN TRAINS AND THEIR STORIES, *by Roger Reynolds.* Dramatic stories of the best-known American trains —how they got their names, what rivers, mountains, deserts they cross.—$1.15 postpaid. . . . LET'S GO 'ROUND THE WORLD WITH BOB AND BETTY, *by Phyllis Ayer Sower.* Through the Panama Canal, across the Pacific and around the world! Many new things to see at all the fascinating ports. —$1.15 postpaid. . . . MIGHTY ENGINEERING FEATS, *by Harriet Salt.* An authentic book for young people 14 and over. Vividly and authoritatively discusses 10 of the mightiest engineering feats which have gone into the making of our country. Photographs and line drawings.—$2.70 postpaid. . . . MORE SONGS OF WILD BIRDS, *by Albert R. Brand.* Three double phonograph records made direct from nature are included with this volume, which is a guide to bird song for boys and girls of all ages.—$2.65 postpaid. . . . THE BOYS' BOOK OF MODEL AEROPLANES, *by Francis A. Collins.* This is the Third Revised Edition of a book which will interest the future airplane pilot who likes to make things.—$2.15 postpaid.

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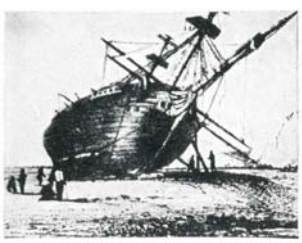
# Green Laurels

By the Famous Naturalist-Writer, Donald Culross Peattie



H. M. S. "Beagle" in which Darwin voyaged around the world. Illustration (reduced) from GREEN LAURELS

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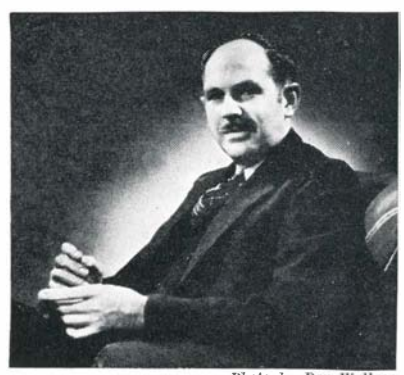

*Photo by Don Wallace*
The Author—DONALD CULROSS PEATTIE—Winner, First Annual Gold Medal, Limited Editions Club

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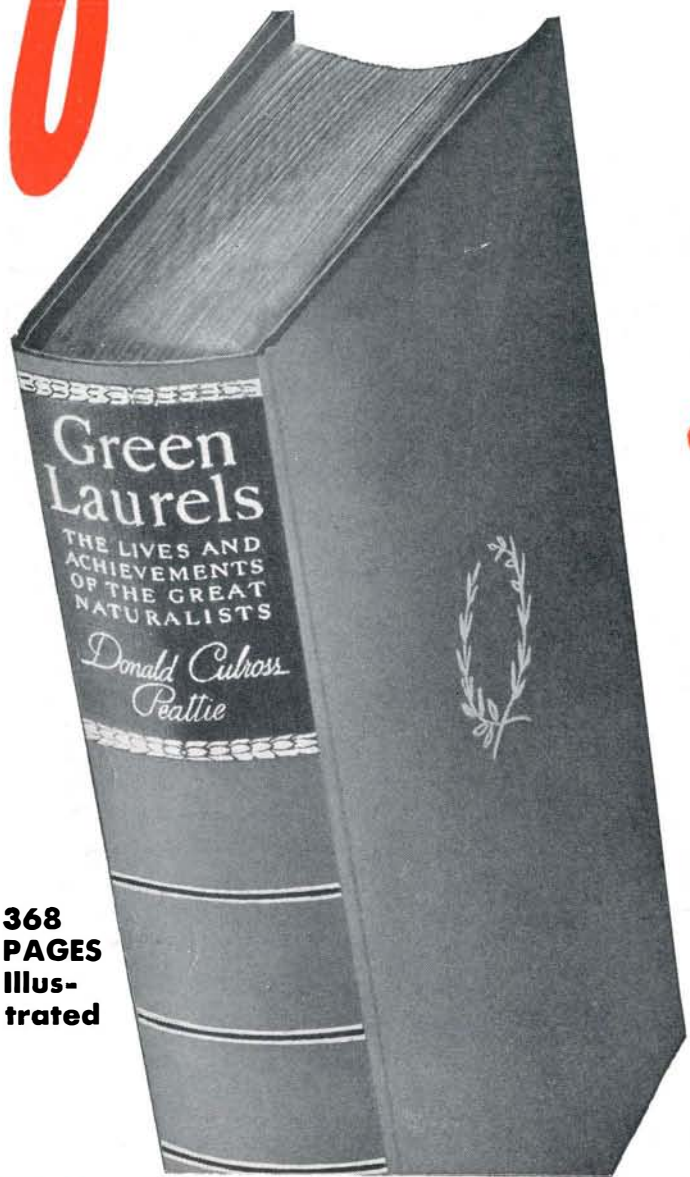


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