WHAT IS DEATH?

By Barclay Moon Newman

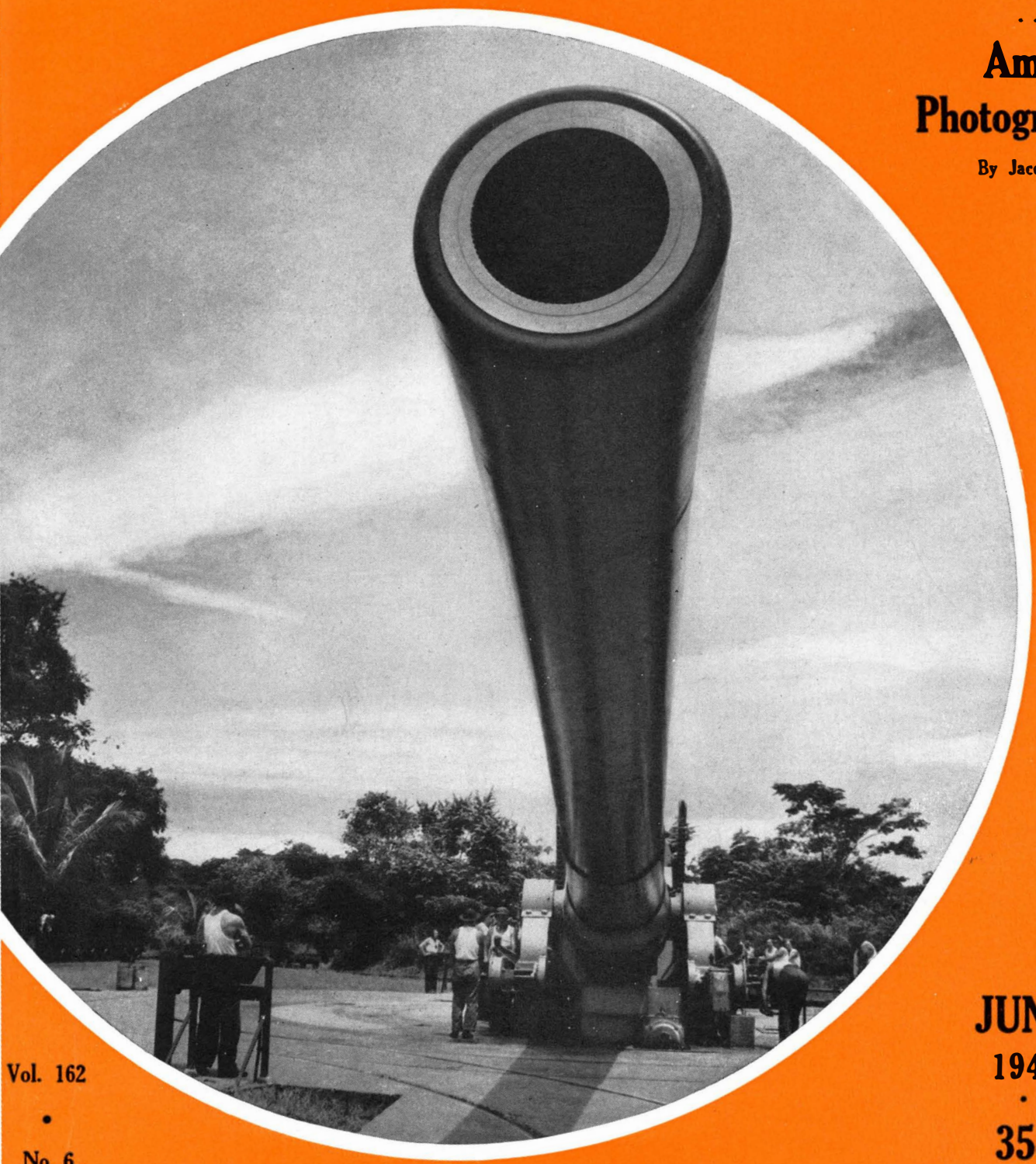
SCIENTIFIC AMERICAN

Including:
A DIGEST OF
SCIENCE & INDUSTRY

. . also . .

Amateur Photography

By Jacob Deschin



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Photograph by
ROBERT YARNALL RICHIE

JUNE
1940

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The SCIENTIFIC AMERICAN DIGEST

SCIENTIFIC AMERICAN

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NINETY-SIXTH YEAR • ORSON D. MUNN, Editor

CONTENTS • JUNE • 1940

LOOKING like a giant blunderbus and clumsy (because of the peculiarities of perspective) this 16-inch gun is nevertheless an efficient and deadly weapon at long range. It is part of the permanent defenses of the Panama Canal. Because of its emplacement on land, it is more accurate than would be a similar gun on an attacking battleship. See also page 324.

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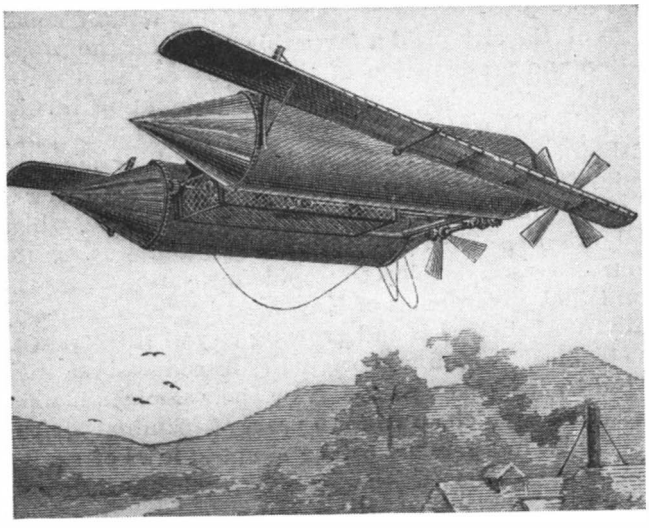
50 Years Ago in . . .

Scientific American

(Condensed From Issues of June, 1890)

CENSUS—"Americans who are loudest in their groanings about several census questions should look at the inquisition to which the Germans are subjected. . . The German year book gives the figures of even the income tax . . . The exact rental of each dwelling is obtained, and the average rentals for different conditions are published."

AIRSHIP—"The aerial catamaran herewith represented . . . has two cylinders adapted to hold a buoyant material, and connected by a light frame beneath which is stretched a platform of woven steel wire supporting an electric or other motor designed to drive a rearwardly extending shaft which operates two propeller blades. To the outer sides of the cylinders are connected wings, pivotally



mounted on horizontal shafts, the wings carrying racks engaged by annular gears in guideways carried by the cylinders, whereby the wings may be inclined at such angle to the horizontal line as may be desired. In operation it is designed that the cylinders shall be just sufficiently buoyant to not quite overcome the attraction of gravity, when, the wings being set at the desired angle, the motor is started to drive the ship by the action of the propeller blades, the upward and downward motion being regulated by the inclination of the wings."

HOW TIMES CHANGE!—"In a recent speech Congressman Atkinson, of West Virginia, said: 'If all the ports of entry on both oceans were to-day blockaded so that no vessel could enter them bearing the products of other countries, and war should be declared against us, we could, with our present facilities, produce every munition of war, and every article that we might need for our sustenance for a thousand years.' "

SAFETY—"The recent experiences of several steamers plying between New York and Liverpool give renewed emphasis to the call for the invention of new and improved constructions and appliances for saving life and preventing accidents at sea . . . In the construction of the hulls; in means to ascertain the vicinity of ice in fog; in automatic devices for quickly turning and stopping the vessel; in boats, rafts, life preservers; in means for preventing the sinking of ships; there is abundant room for invention and improvement. Perhaps the greatest want of all is a ship that cannot sink, no matter where or how badly wounded."

WRITING AT A DISTANCE—"One of the marvels of electricity, and one of the most striking of the Edison exhibits at the Paris exposition, was the little instrument which enables the operator to sign a check 100 miles distant. The writing to be transmitted is impressed on soft paper with an ordinary stylus. This is mounted on a cylinder, which, as it revolves, 'makes and breaks' the electric current by means of the varying indentations on the paper. At the receiving end of the wire a similar cylinder, moving in accurate synchronism with the other, receives the current on a chemically prepared paper, on which it transcribes the signatures in black letters on a white ground."

SMELLS—"By the reaction of sulphureted hydrogen on acetone in the presence of condensation agents is obtained principally trithio-aceton $C_9H_{18}S_3$, and small quantities of a non-volatile, definitely crystalline compound $C_{15}H_{28}S_4$, tetrathiopeuton. At the same time, however, an exceedingly volatile body is formed which possesses a smell so horrible that, in comparison therewith, ethylmercaptan, ethylenmercaptan, and other volatile sulphides must be considered as faint-smelling substances!"

POWER—"The utility of wire rope transmission of power has become widely recognized. Not only among the rugged hills and mountains of the East and far West where streams go rushing down through caverns and rocky steeps, where no locations for mills or factories are afforded, is this means of transmission of precious power appreciated, but it is so convenient to use it that we find on the prairies of the West mills being operated at a long distance from water powers by the wire rope. A few days ago, on a trip through Nebraska, we noticed a rope stretching for nearly a mile from a water power to a mill that had recently been built adjoining a railroad, the owners finding it much more to their advantage to have it there, with the switching privileges afforded, than at the dam. The expense of hauling the flour which is thus saved to them will very soon pay for the system of power transmission."

MENTAL CRIPPLES—"The hardest thing to get on with in this life is a man's own self. A cross, selfish fellow, a desponding and complaining fellow, a timid and care-burdened man—these are all born deformed on the inside. They do not limp, but their thoughts sometimes do."

AND NOW FOR THE FUTURE

¶ "America's Winged Weapons," a succinct survey of the planes of our national defense forces. By James L. H. Peck.

¶ Seeing with electricity: How the electron microscope works. By Jean Harrington.

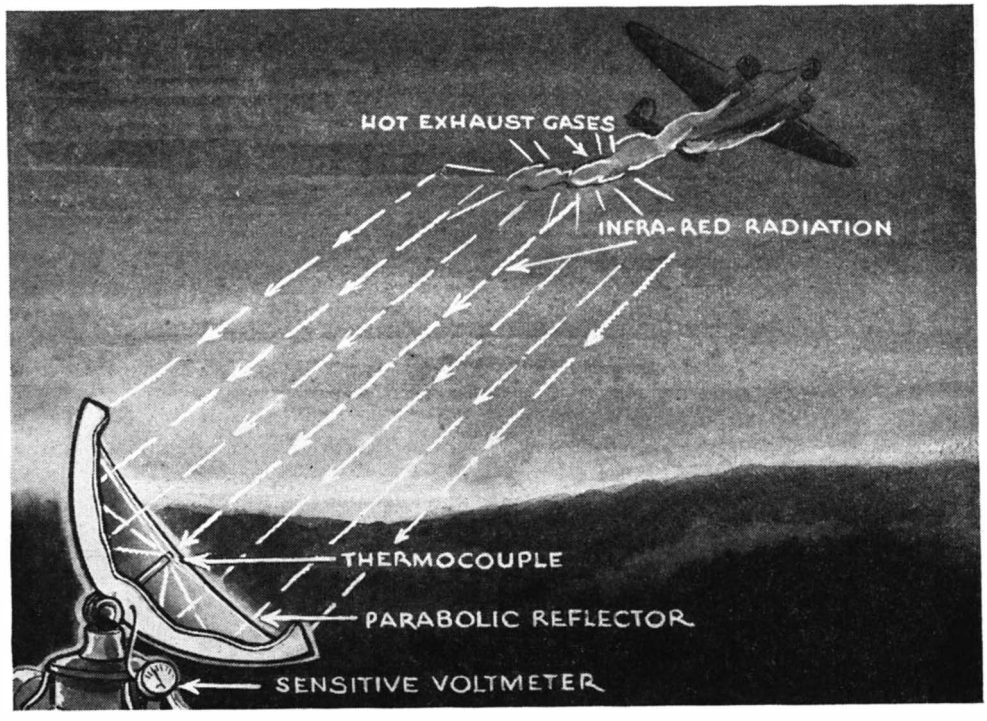
¶ Fighting a war of grinding attrition against friction, man's friendly enemy. By Walter L. Finlay.

¶ Sulfuric acid: Its expanding uses measure the progress of nations. By William H. Waggaman.

Watch for our new editorial feature: Browsing With the Editor. Significant facts from the broad field of science and industry.

LONG RANGE DEFENSE

PROVIDED we have enough of them, the Army's 16-inch guns could stand off any enemy, for they out-range and out-shoot similar guns on battleships. High elevation gives greater range, while steady, land mounting gives greater accuracy. They hurl shells weighing over a ton more than 30,000 yards.



To detect approach of a plane whose engines are cut off as it glides silently toward its objective, the tool which astronomers use to measure heat of distant stars might be adapted to military use. The thermocouple at the focus of the reflector would be affected by heat thrown off from the distant plane and the resulting current noted on a sensitive voltmeter. Even the warm air from a gliding airplane might be detected with this

INVENTIONS WIN WARS

Suggested Developments . . . To Detect, Defeat Warplanes, Submarines . . . Humanitarian Aspects . . . Physical Principles Which Inventors Must Follow

By MAJOR WILLIAM H. WENSTROM

WE live today in the midst of a world-wide struggle, declared and undeclared, between peace-loving democracies and aggressive totalitarians. The sympathies of most Americans, needless to say, are with those nations which are struggling for "life, liberty, and the pursuit of happiness."

However they may lag behind in the matter of armament, regimentation, and general blood-thirstiness, democracies which encourage free and inquiring minds among their citizens should at least excel in the very important quality of ingenuity. American free-lance inventors, for example, are renowned the world over for their intelligence, persistence, unconventionality, and sheer weight of numbers. And however we Americans may hate the macabre business of war itself, there is plenty of sober reason, these days, for American inventors to give serious thought to military and naval inventions. Inventions that serve to check those premier weapons of sudden and secret attack—the warplane and the submarine—may even classify as works of true humanitarianism. Herein are a few suggestions. Though most of the basic ideas suggested to American military-minded free-lances in this article are essentially simple, their practical development would, needless to say, entail plenty of painstaking technical research.

As to possible war-winning inventions, the inventor can save himself no end of time and trouble at the start by writing off the slate as illusory the three weapons most dear to the hearts of feature writers and movie scenarists: (1) a super-lethal gas; (2) a super-powerful explosive; and (3) a "death ray" capable of killing men, or disabling tanks, airplanes, or ships at a distance.

DEVELOPING either a super-lethal gas or a super-powerful explosive is hazardous enough in a large plant equipped with adequate safeguards. For the average free-lance, such work would be prohibitively dangerous. Despite all the organized research lavished on these two projects, so far as I know, no new wartime gases have been developed since 1918, and "atomite" (the latest high explosive) is only a third more powerful than 1918 trinitrotoluol, or TNT.

In principle, the much publicized "death ray," perhaps first described by H. G. Wells in his fantastic story of invading Martians, is simply a closely compacted beam of electro-magnetic radiation, or radio waves. The wavelength depends on the target, which must "resonate" to it for maximum current and voltage effects within itself. For man-targets, a wavelength of 3 to 4 (or 1½ to 2) meters might be used. For average warplane-targets, a wavelength of about 40 (or 20) meters might be suitable (assuming 65 feet wing spread).

Very simple, so far. Bugs and mice, perhaps, actually have been killed with "death rays" of a sort. All you have to do, to bring down a German bomber flying over London, say, is to direct upon it a *sufficiently powerful* radio beam at perhaps 20 meters wavelength, or 15 megacycles per second frequency. But wait a minute. There is the slight consideration of electric power. To bring down that German bomber by this method may take about all the electric power in Great Britain, or possibly all the power in the British Empire, to say nothing of a lot of super-powerful vacuum tubes as yet undeveloped. Perhaps it would be simpler and cheaper, after all, to shoot that bomber down with a battery of very efficient British 3.7-inch anti-aircraft cannon.

The standard airplane locator, in wide use by the world's armies today, is a very simple device operating on the principle of audio frequencies or sound waves.

In the regular military instrument, a cluster of four large horns is mounted on a universal pivot, the mouths of the horns being pointed at the noise-producing airplane, and the small ends of the horns being led to earphones on two men, either with or without the aid of audio amplifiers. The horns are then, in effect, two pairs of magnifying ears, one pair giving the plane's azimuth angle, and the other pair its altitude angle. An airplane can be detected and located by this device at distances of 10 miles or more, *provided* that the airplane's propeller, as well as its motor, is turning over at somewhere near normal revolutions.

Silencing the airplane engine alone does not avoid detection, for at modern high speeds most airplane noise actually comes from the propeller. If the pilot throttles back his engines, however, and glides silently in towards his objective from high altitude, that is a horse of a different color which calls for a locator of radically different design. Even so, the standard audio locator still has a fleeting chance, because the pilot must occasionally "gun" his motors unless he wishes them to choke up.

Telescopes and binoculars are, of course, widely used, but there are definite and rather low limits to distant-seeing by this means. This limitation is largely due to the extreme shortness of light waves compared with the molecular structure of the atmosphere and of the particles suspended in it.

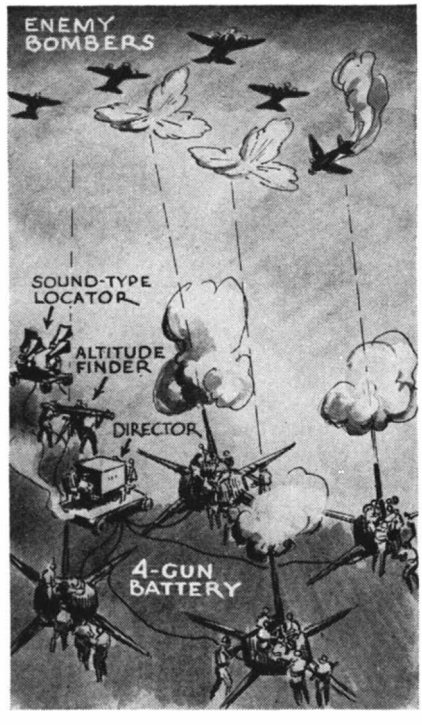
In ordinary diffused haze, yellow filters on binoculars help slightly. Red filters, passing only the longest visual wavelengths, help considerably; they are, in fact, standard practice for all long-range aerial photography. But through very dense haze, or fog, or clouds, involving larger particles of liquid or solid, no visual filter will enable us to see. Nor is near-infra-red photography much more effective.

Anyone who has ever ridden in a high-powered airplane at night has noticed large blue flames streaming backward out of the engine exhaust ports. These flames mean plenty of heat (or infra-red) radiation — on a wavelength somewhere around one thousandth of a centimeter. Hot, exposed cylinders or radiators also mean infra-red radiation, and so does even the warm air streaming backward from these parts.

The most sensitive known detector of heat waves is the thermocouple — an electrical junction between two wires of dissimilar metals. For maximum sensitivity and directional effect, the thermocouple itself is placed at the focus of a large parabolic reflector. Such an arrangement can be made so amazingly sensitive that it will indicate the heat radiated by a candle several miles away. For airplane-locating, two or three of these thermocouple units, each mounted on horizontal and vertical degree-scales similar to those on a theodolite, might be set up at known ground locations. The airplane's position in free space would then be found by triangulation.

As another possibility in airplane-detection-and-location, rather remote at the present time, how about using electro-magnetic waves still longer than infra-red — ultra-short radio waves of a wavelength, say, somewhere around half a meter, or 50 centimeters? Or possibly somewhat longer waves around 5 meters? On the 5-meter waves, the design of a transmitter and receiver circuits is easier and cheaper. But on the 50-centimeter waves, necessary parabolic reflectors, beam antennas, and other arrangements for three-dimensional direction-finding receivers are more compact, easier to handle, and less expensive. The general idea is somewhat similar to the new radio echo altimeter used on modern airliners, operated in reverse. Radio engineers and amateurs have already noticed occasional queer ultra-short-wave radio "reflections" that seemed to come from airplanes passing overhead.

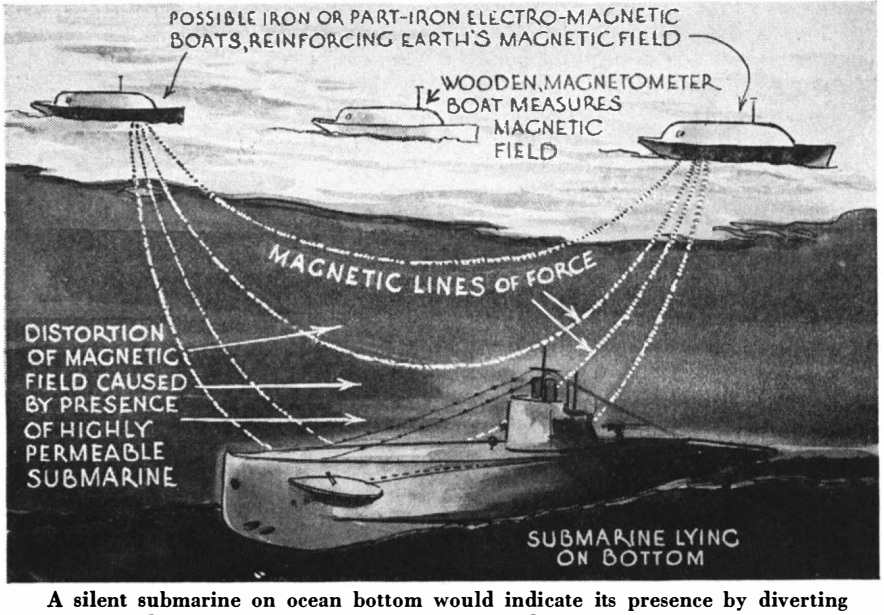
Suppose we have, in the center of London, say, a high-power, ultra-short-wave radio transmitter capable of sending out periodically repeated short tick signals of some characteristic form. Suppose we have, further, in the surrounding countryside, at distances of 20 or 50 miles outside the city, several suitable radio receivers, preferably of directional type. The receivers could be elevated to get both direct signals and those reflected from high-flying planes, or they could be placed beyond the bulge of the horizon where signals will be received only by reflection from airplanes. (The direct signals would be useful for timing, but might cause too much interference with the reflected signals.) In either case, two or three directional receivers might be able to locate the enemy airplanes



Anti-aircraft battery in action, with equipment to direct artillery fire

closely enough to hang up an effective H-E barrage. Or the triangulation might be made indirectly from time differences.

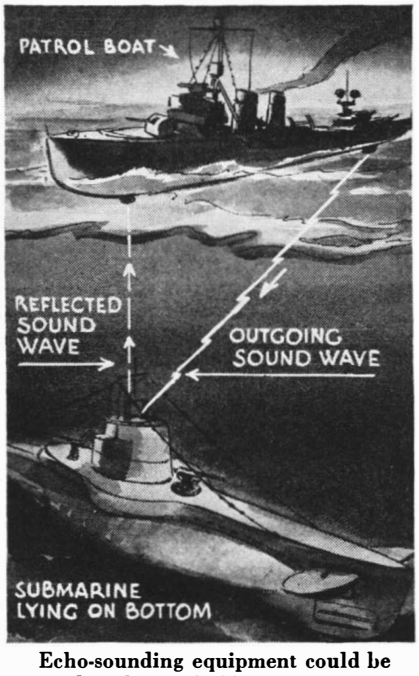
Submarines are particularly menacing to nations whose security depends on sea power — nations such as Great Britain and the United States. The standard method of locating submarines from surface patrol boats, derived from 1918 practice, depends on the underwater transmission of the noise from a submarine's propeller. The sound pick-up is a binaural pair of under-water microphones, preferably spaced several feet



A silent submarine on ocean bottom would indicate its presence by diverting magnetic lines between two specially equipped ships, as the author explains

apart, and similar in principle to a pair of under-water ears.

This method is wholly dependent upon the submarine's maintaining some engine revolutions, which it must do to maintain depth in deep waters such as most of the Caribbean Sea or the Pacific Ocean. But in shallow waters, such as the American or European coastal areas of the Atlantic, a sub can lie quietly on the bottom for hours at a time, undetected by ordinary hydrophone methods.

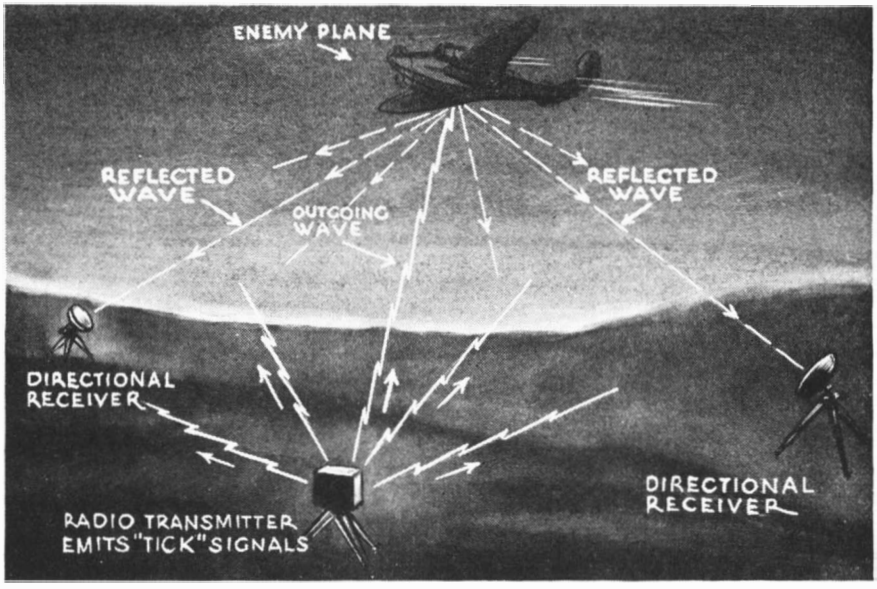


Echo-sounding equipment could be used to locate hidden enemy subs

But aside from these present methods, there are two physical principles by which we might make the submarine disclose its presence involuntarily even if it is not obliging enough to turn over its propeller. One is the principle of under-water sound reflection now in standard use as echo sounding gear on most warships and many larger merchantmen.

Standard echo-sounding apparatus records a continuous graphical trace of the bottom over which the ship is cruising — by sending out a sound tick from an underwater "loudspeaker" (repeated at intervals of about a second) and measuring the time it takes the tick to travel (at about 5000 feet per second) first down to the bottom, whence it is reflected, and then back upward to an under-water microphone on the ship. Set for 100-fathom maximum depth, the ordinary echo sounding gear traces a continuous profile of the bottom as the ship steams ahead at full speed, and clearly indicates a rock, a ledge, or other obstruction on a level bottom, provided the obstruction has a height of at least five fathoms (30 feet). This is somewhat more than the height of a submerged submarine lying on the bottom.

An ultra-sensitive echo-sounding set, with magnified depth change indication, could perhaps be installed as standard



"Tick" signals sent out regularly by short wave would be reflected by an unseen plane, picked up by several stations, and the plane then located by triangulation

equipment on submarine-chasing patrol boats. Where a submarine is suspected of lying quietly on the bottom, the patrol boat could cross and recross over the suspected area at high speed, meanwhile running the sounding set continuously. Whenever a small peak on the depth curve indicated a bottom-hugging U-boat, depth charges could be let go. Of course any submerged rocks, ledges, or wrecks should, if possible, be charted in advance, lest they give false alarms.

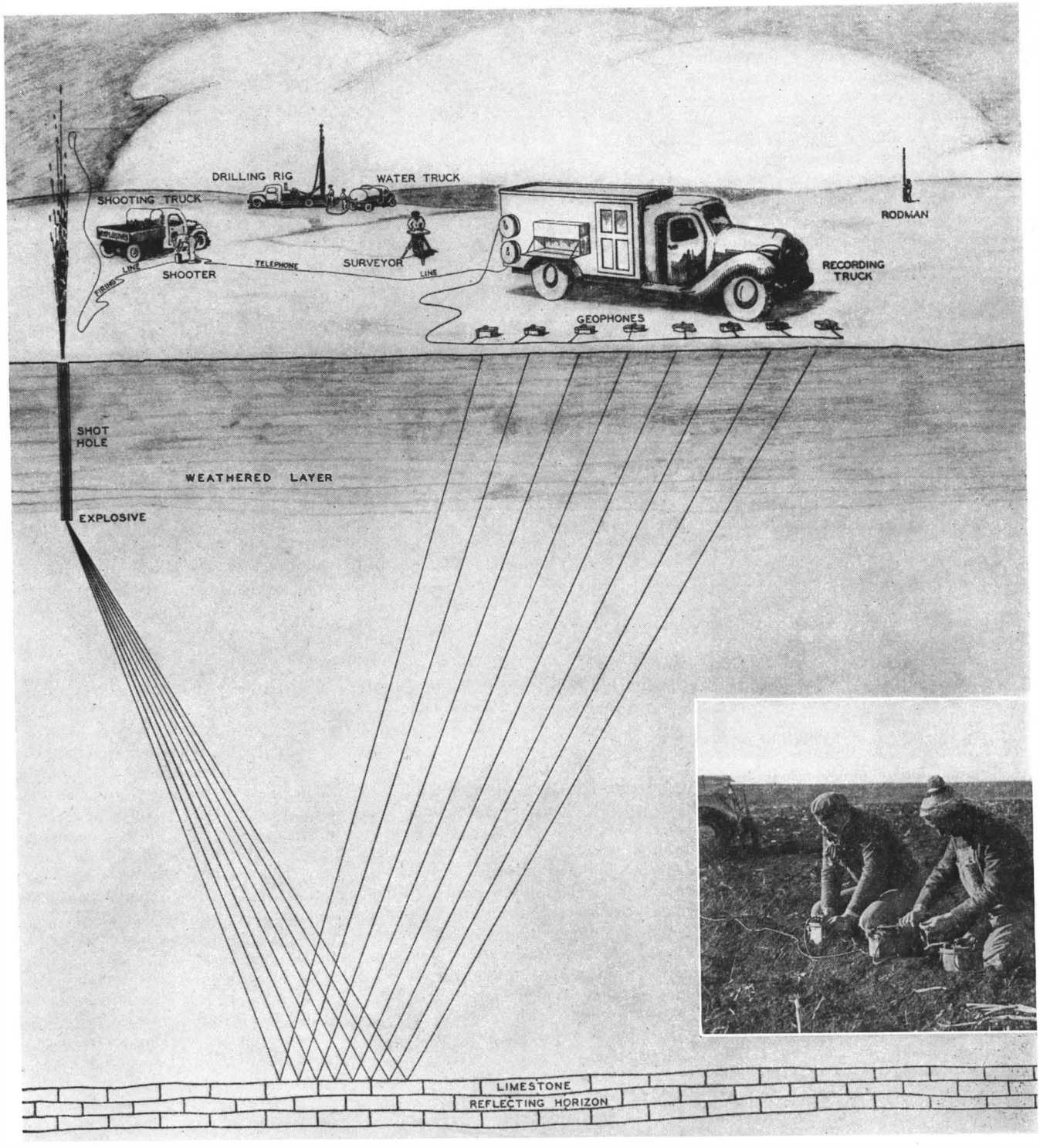
There is still another physical principle that might be used in locating submerged and silent U-boats — magnetism and permeability. The equipment required here would be considerable — in addition to the usual armed patrol boats, a small wooden ship, completely non-magnetic and equipped with ultra-sensitive recording or indicating magnetometers. And possibly two additional ships — part-iron craft equipped with powerful electric generators and wire-wound so that the whole boat is nothing more than a powerful electro-magnet of the bar type.

EVERY student in college physics has performed the experiment of drawing on paper, by means of iron filings or small compasses, the magnetic field between two bar magnets; and every student knows, too, that introducing a piece of highly permeable substance, such as iron or steel, into this magnetic field will tend to pull the lines of force into itself. thereby distorting the nearby lines of force. Very well, then — suppose a submarine is lying on the bottom at a depth less than 50 fathoms (300 feet). The wooden magnetometer ship cruises around the suspected area on the surface, making precise magnetic measurements of the earth's field with ultra-sensitive indicating or recording magnetometers. In the vicinity of the submarine (and most noticeably, directly above it) the magnetometers should show a sudden change in the direction or intensity of the earth's field, due to lines of force being distorted towards the submarine by its high magnetic permeability.

As an alternative method, considerably more complicated but possibly more effective, the two part-iron electro-magnet ships could be formed in column perhaps 500 yards or so apart, N (bow) pole of rear ship lined up with S (stern) pole of leading ship, the local magnetic field so created preferably reinforcing, so far as possible, the earth's magnetic field. The wooden magnetometer ship could then hold station midway between the two electro-magnet ships, making continuous magnetic measurements as described above.

The magnetic method would, of course, be slower and more complex than the echo-sounding method. But being immune from the blandishments of rocks and ledges, it would perhaps be more certain, except for faulty indications due to any submerged wrecks of iron and steel ships.

If you want to succeed as a free-lance inventor, in war or peace, don't follow the customary and well trodden paths — there the great laboratories and the formal organizations naturally have you licked from the start. But remember also that most of these organization scientists and team technicians have to keep their noses very deep in their own particular little ruts, so that often they have neither the time nor the energy to see the woods for the trees. So, Mr. Free-Lance, keep your eye on the woods as a whole, keep your viewpoint fresh and unjaded, and look for the new angles the at-first-sight-impossible angles, the angles that will drive quickly around those too-well-known stone walls into which big research teams are butting their collective heads.



Set-up of equipment for seismographing and, inset, placing the seismometers

Seismographing For Oil

THE seismograph used in the search for new petroleum deposits derives directly from the seismograph employed in earthquake seismology to record the location and intensity of earthquake shocks. Seismographs have been used by the oil industry for many years and have aided in the discovery of some of the world's greatest oil fields.

At the present time exploratory crews sent out by The Atlantic Refining Company are employing seismographs in an area in northeast Texas to determine the location of underground formations of the type in which oil is usually found.

In modern seismographic reflection shooting a charge of dynamite is placed in a hole drilled to a depth of from 40 to 100 feet. The firing of the charge creates a sound wave which spreads out in all directions. Each time the wave encounters a different reflecting stratum a small amount of energy is reflected back toward the surface.

The reflected vibrations are picked up by seismometers or geophones, amplified by vacuum tubes, and photographed on a strip of paper. Study of the photographic record, including the time it takes for the sound wave to reach the various strata and be reflected back again, makes it possible to chart the geologic characteristics of the subsurface. The charts, in turn, lend themselves to the selection of drilling sites over formations of a type favorable to oil deposits.

OUR POINT OF VIEW

Patent Sesqui-Centennial

SAMUEL HOPKINS, of Vermont, was granted the first United States patent in 1790. That was just 150 years ago this year. In the years since then there have been a total of more than 2,200,000 patents. Only 9957 of these were granted before the patent system was revised and refined in 1836, but in the last 50 years alone, 1,799,000 were granted, or more than four times as many as in the first hundred years.

This evidence of the importance and "workability" of our patent system makes difficult of understanding the many attacks levelled at it in recent years. That the protection it affords the inventor has spurred the enterprise of the nation seems conclusively proved. And why not? It was set up "To promote the progress of science and useful arts by securing . . . to inventors the exclusive rights to . . . their discoveries." Those exclusive rights have provided the incentive for vast developments in many fields, has given us numerous new industries, and promises to give us many more. The example of one automobile manufacturer, The Ford Motor Company, is illuminating. Commenting on the 28,000,000th Ford, the *New York Times* said that, since 1903, the Ford Motor Company has paid out in wages $4,230,000,000, purchased materials costing $10,000,000,000, while the government has received taxes of $700,000,000.

Multiply these figures by the number of cars of all makes produced, and by all the other new industries made by inventions of new things or of improvements on old ones, and the picture is extraordinarily impressive. Invention and the safeguards of the Patent System are the basis for this vast success.

Perhaps changes in the Patent System may be necessary. They should not, however, be made willy-nilly by politicians. They should be made only after thorough and judicious study of the facts by experts, not as a result of prejudice by dilettantes and social reformers. It has been a good system that has poured untold billions of dollars into the pockets of farmers and miners, investors and wage-earners, all those who have been and are touched by the fingers of our enormous industrial system. It should not be cast aside lightly, nor ripped apart by unwise hands.—*F. D. M.*

Opportunity

PART of this month's piece on the current and important question of television, supplementing that on page 265 of last month's issue, takes the form of a one-act playlet of comedy and pathos. (All dialog is fictitious, based on fact.)

Federal Communications Commission: "You television experimenters have shown some progress, so we are going to let you put on semi-commercial programs, starting next fall."

Radio Corporation of America: "Whee! Let's go, boys."

Business of preparing and publishing advertisements of television receivers, telling what has been accomplished and what is in store for lookers-in. Also of reducing prices so that John Public will be better able to purchase receivers.

FCC: "Stop! You have been bad boys. We don't like your advertising. You are actually trying to get the public to buy your equipment. You have taken advantage of our ruling. We take it all back. You can't go on commercial schedule until we investigate you and find out why you actually want to sell receivers."

Curtain.

In the figurative lobby after the show, a member of the commission made the following statement, as reported by the daily press: "Should the market be saturated with 30,000 receivers of one manufacturer, sold on the installment plan and promoted by a sales campaign and pep talks, any other set maker entering the market at a later date would be handicapped and retarded, wouldn't he?"

Wouldn't he? You're darn' tooting he would! And why shouldn't he be "handicapped and retarded." Since when has the American business method been to wait until all late comers have had an opportunity to take every advantage of the pioneering work done by others? Since when has it been the practice to penalize initiative and gumption, to crack down on those who have blazed the trail, and to hand ready-made success to Johnnies-come-lately?

Television has always had a warm spot in our heart. We have watched it from the time when it was a pup, its eyes literally unopened. We have seen it take its first staggering steps, its eyes still far from perfection. We have rejoiced at its first blurry successes, its first crude and flickering pictures. We have drunk a toast to its 441-line pictures that were good. We uttered a cheer when the FCC said go ahead. And now comes the ultimatum that the pioneers in the art cannot reap where they have sown, for fear that someone else in the industry may be "handicapped and retarded."

Words fail us; our typewriter stutters in protest at the words we would put on paper. "Handicapped and retarded," indeed! It is high time that citizens of this country, official and private, awakened to the fact that business and industrial progress must not be penalized by bureaucratic methods which prefer pseudo-solicitude for the public to the application of those doctrines that, in the past, have brought to us the end-products of scientific research and development.—*A. P. P.*

Let's Look At It Selfishly

WHEN an argument arises as to whether or not it is right and proper that American aircraft factories should supply planes to foreign nations, there is one phase of the situation that should not be forgotten.

Whether in peace or war, it is highly desirable that this nation should have available the best possible aircraft. In peace, we need reliable air transportation; in war, we need the finest available air defense. The only way in which these ends can be achieved is through experience—experience in design, in construction, in flying. It should be obvious that neither the transportation industry of this country, nor its military forces, can afford to spend more than a certain maximum in acquiring this experience. If, however, foreign nations purchase our airplanes in large numbers, we become the gainers in more ways than one.

First: A profit is realized on each sale, part of which may be turned back into the industry for research in improved designs. Second: This constant improvement in design will keep us one step or more ahead of possible enemies. Third: More orders mean greater production facilities which, in turn, place us in a highly advantageous position in case of trouble. Fourth, and most important of all: Operation of aircraft under wartime conditions reveals needed improvements that might never be found under routine testing.

Every thinking American sincerely hopes that the United States will be able to keep out of foreign entanglements; at the same time, he realizes that we must be prepared at all times to defend our own country when and if the pressure becomes too great. With aerial warfare daily becoming a more important part of the military scheme of things, it behooves us to keep our powder dry. We can best do this, as far as air power is concerned, by taking our profit in the foreign market and applying it to the upbuilding of our own air equipment.—*O. D. M.*

History In a Bog

Forest Managers Beginning to Use a Method of Long-range Climatic Prediction . . . Based on the Study of Fossil Pollen Grains with Microscopes

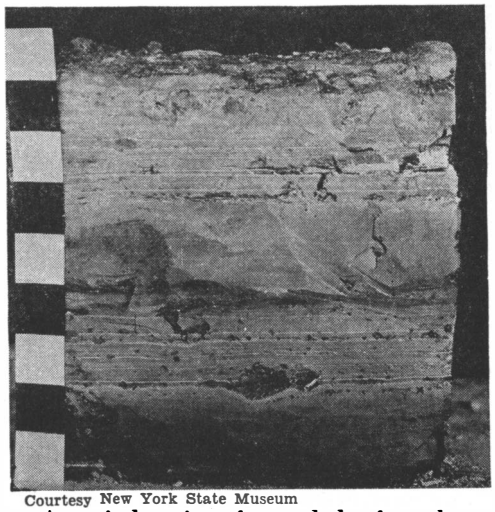
By W. F. McCULLOCH
School of Forestry, Oregon State College

FORESTRY is a long-time proposition. The lumbering industry a hundred years hence will depend upon forests which are started this year. When agricultural crops prove unsuited to a region they can be changed the next year, but by the time forest crops are found to be unsuited to a region many, perhaps costly, years have elapsed. Therefore, the forester must exert every effort to determine that his forests will, as nearly as can be foretold, successfully come to maturity. Careful calculations may be upset by accidents such as fires and insect epidemics, but climate is the chief controlling factor in the establishment and survival of forests. To assure some certainty of success in forest management it is therefore necessary to have some certainty of the kind of climate the forest must endure in the next hundred years. This may seem impossible, but weather is known to run in cycles, and if you know the weather of the past you can calculate that of the future with fair accuracy.

There are two methods of determining general weather conditions over periods of hundreds or even thousands of years. First, analysis of tree rings, a process which can predict weather cycles down to intervals of even a few years; second, pollen analysis, which deals with weather in cycles of centuries.

The first method is relatively well-known, and much information has been accumulated through correlating climatic variations with width of annual growth rings in trees. Periodicity of wet and dry weather has been established and, in conjunction with local weather bureau records, it can be discovered that either a wet or dry cycle is commencing. The first few years are critical in the life of forest plantations, and absence of moisture is most often the fatal factor. In forest planting, especially, short-range determination of the weather cycle is an invaluable aid because it is possible to choose years at the beginning of a wet cycle and plant accordingly.

The second method of long range forecasting, pollen analysis, is still new, relatively unknown, and not as well substantiated as tree-ring analysis. However, it does hold promise of adding to our knowledge of changing climatic conditions and it does have significance in forestry. It is obviously more intelligent to handle existing forests so that they will perpetuate themselves than it is to clear off forests in the lumbering process and then start from scratch with seedlings. From the long-range standpoint foresters wish to know whether or not forest species will maintain themselves naturally or whether they will die out under natural conditions, necessitating replacement with different species. Information on the possibilities of continued growth of a species in a given region may be calculated by determining whether its pollen is increasing or decreasing in peat bogs. This process of examining peat profiles in bogs to determine their pollen content is now known as pollen analysis. Because of the potential value of this kind of investigation it is described here in some detail.



Courtesy New York State Museum

A vertical section of varved clay from the bed of a former glacial lake in New York State. One-inch squares at left give scale. These thin, annual, horizontal bands of varying sediment enable the geologist to work out definite dates which, in some cases, can be correlated with bog pollen dating

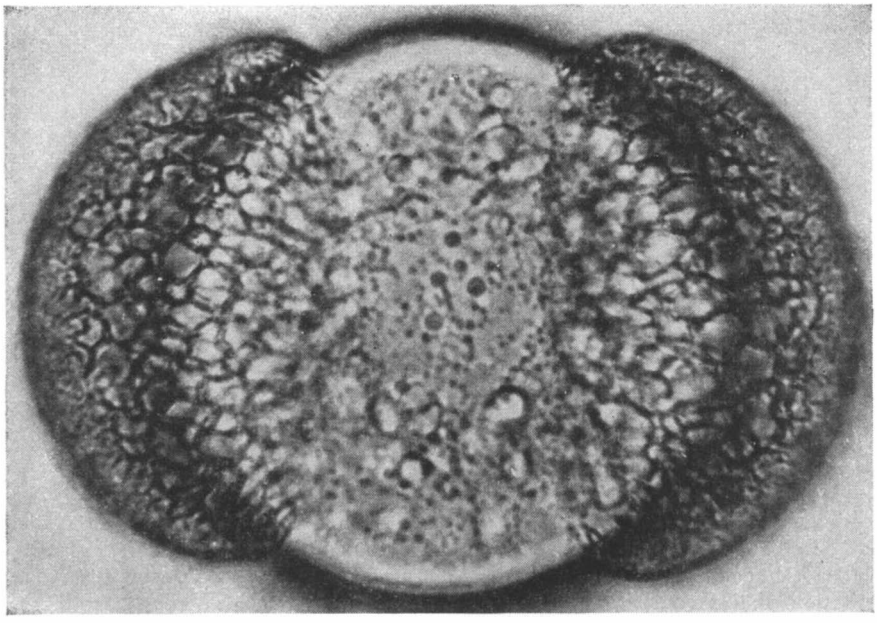
Until lately it was thought that fossils in rock and coal seams were our only record of forests of the past, but recent studies in Europe and in North America have disclosed a fascinating source of material which enables the reconstruction of forest history since the retreat of the glaciers. Different plant groups may be identified by their pollen; and the dominance of different types of plants, as shown by the excess of their fossil pollen in peat bogs, indicates a type of climate known to be hospitable to those plant groups. For example, gradual replacement of fir and spruce pollen by hardwood pollen indicates a period of increasing warmth in the long-time weather cycle; indicates also that southern trees may safely be introduced farther north. For those who are able to read them, such peat bog records of our forests are scattered all over the northern part of the continent.

THESE records are intimately tied up with the glaciers. As the ice melted and glaciers retreated, forests moved up from the south to take over the newly uncovered lands. The ice pack was by no means uniform, and many small depressions were left on the uncovered terrain. These low spots filled with water from the melting glacial front, and, with the advance of plant growth, bog formation began.

The principal plant in a bog is sphagnum moss. As it decays, plant fragments sink to the bottom of the pond, gradually filling it. As more and more plant remains sink down, the moss becomes a more or less homogeneous layer of organic material — peat.

With no drainage from the bog, the standing water over the peat becomes acidic. The constant addition of decaying organic substance soon raises the acidity to a point where decay organisms are either greatly hampered or cannot function at all. Materials falling into the bog are therefore preserved practically unchanged in the peat. Pollen is one of these materials.

It is not uncommon to find lakes covered with a yellow dust in the spring or, at the same time, to find a yellow ring around mud puddles. Upon examination this will prove to be pollen — tree



A winged pollen grain of Austrian pine, magnified approximately 1450 diameters, a probably unexcelled photomicrograph by Dr. F. P. McWhorter, of Oregon State College. The reticulations on the surface of the wings afforded identification

pollen, most of it. Almost all trees are wind pollinated; they do not have showy flowers to attract bees and hence they depend upon the wind to distribute their pollen. This is a somewhat haphazard method. Therefore, in order to assure fertilization of the female flowers, immense quantities of pollen are produced. Some of this falls into bogs and, as bog formation continues, succeeding layers of pollen are incorporated into successive layers of peat.

Peculiarly enough, pollen, though seemingly a fragile substance, possesses an exceptionally durable outer coat. This outer coat, or wall, is characteristically marked; sculptured, punctured, crossed with bands or spined like a sea urchin, but in all cases is marked, so that the pollen of grasses are distinguishable from that of flowers, shrubs from trees. For this reason it is possible to follow forest history very readily. The pollen of forest trees is readily separable down to genera, and occasionally even to species.

ANALYSIS of a vertical series of samples from pollen-containing peat makes it possible to trace the history of the succession of different kinds of trees composing the neighboring forests from the time when the bog was established. Coniferous pollen is mostly equipped with wings, as shown in the illustration; and some investigators have assumed that it will travel farther than the non-winged pollen of non-coniferous species. However, the very fact that forest pollen is so widely transported by wind is adequate assurance that the record will be representative of trees over a wide area, not merely of those adjacent to any given bog. The author has found pollen floating in sea water 75 miles offshore from a forest of Sitka spruce and hemlock; and pollen has been trapped on glass slides exposed on airplane wings at an altitude of 10,000 feet.

A very fine correlation has been worked out in Europe between peat bog histories and clay varves, another form of geologic record. Clay varves, shown in the other illustration, are the sedimental bands of water-borne silt laid down year after year. The coarser material brought down by the spring flood water alternates with bands of finer silt laid down by the quieter water of midsummer, and thus provides an annual record. Varves may be counted back about 25,000 years, which is roughly the length of our pollen deposit history. Investigators in Europe have discovered, for example, that at the geologic period when birch remnants were common in the varves there was an abundance of birch pollen in the peat deposits of the same period. Similarly, finding spruce or other conifer twigs and leaves in the varves would be correlated with finding pollen of that species in peat layers of the same age. This is the strongest evidence of the authenticity of peat bog history.

The mechanics of pollen analysis are simple. Samples of peat from successive layers are obtained by means of a peat sampler. This is a short section of pipe equipped with a cap at one end. The cap is attached to a steel rod running through the pipe, and threaded so that any number of rods may be coupled on. The sampler is pushed down into the peat to the desired depth, then the rod is pulled up gently, drawing the cap back into the pipe where a spring engages it. The sharpened lower edge of the pipe is thus exposed and, as it is once more pushed down, a core of peat is cut off and retained in the pipe.

Separation of pollen grains from the peat may be accomplished by adding chemicals which destroy the peat and leave the pollen grains fairly well intact. Another method, used by the author, is to separate the materials with an ordinary milk-shake mixer. After thorough agitation the various particles may be separated by adding a water-soluble dye such as safranin. This colors the peat pink, and leaves the pollen grains their natural brownish or yellow color, greatly facilitating identification.

A drop of peat material is placed on a microscope slide and the grains are tallied in order of occurrence. Only a few different kinds appear in the record at one time, and it is not necessary to count a great many at each level in the bog in order to establish a truly representative sample of the pollen present.

When samples have been obtained at one-foot intervals down to the bottom of the bog it is fairly easy to reconstruct the history of plant succession in that region. The replacement of tree pollen by grass pollen in some bogs, followed again by an abundance of tree pollen, indicates that over a long period there was sufficient change in climate to eliminate trees and replace them with vegetation of prairie-like character. Return of the trees may be interpreted to mean return of moister weather cycles. This is the important phase of pollen analysis to foresters. It gives at least an indication of the kind of weather to be expected for the next few hundred years; and therefore an indication of the kinds of forests which may be expected to maintain themselves in the region during that period.

EXAMINATION of a bog north of Syracuse, New York, showed balsam fir and spruce to be the most numerous pollen at the bottom of the bog. These two species gradually gave way to beech, oak, and white pine. Similar conditions have been found by other investigators working in Ohio and the southern Lake States; in all cases a solidly coniferous forest followed the retreat of the glaciers. Hardwoods came in from the south, at first slowly, then in increasing numbers, until they dominated the forest. This is the condition existing today. Hardwoods grow more rapidly as young trees and, starting from seed, will generally grow fast enough to shade out associated conifers. From the evidence of pollen analysis, hardwoods may be expected to be a safe bet for forest production in the northern United States for several hundred years. After that time it may be necessary to anticipate return of the conifers. Analysis of the pollen profiles that are being laid down in peat bogs today will tell the tale.

What Causes Magnetic Storms?

Not Sun-Spots but Gases Erupted from the Sun and Traveling to Earth at Times of Solar Turmoil . . . Sun-Spots May but Need Not Accompany This

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

MUCH public interest has lately been aroused by the occurrence of "magnetic storms." Along with variations in the Earth's magnetic field (which, by themselves, would have been noticed only by the possessors of delicate recording apparatus), great electric currents flowed through the solid crust of our planet. Points a few hundred miles apart were at electric potentials differing by hundreds of volts — which became almost dangerously evident when a continuous telegraph wire joined them. The "earth currents" spilled over into telegraph lines and completely disorganized the operation of the intricate — and usually perfectly functioning — automatic recording instruments used in modern telegraph practice. Radio reception was badly disturbed, too, showing that the trouble extended far up into the upper reaches of the air, to the ionized and electrically conducting layers which normally act like a smooth concave reflector, and divert radio waves around the Earth. All North America, and communications with Europe, were affected, and, judging by previous experience, the effects were world-wide.

The first thing that those who knew anything about the subject asked astronomers was: "Where are the sun-spots which are responsible?"

This was no idle question. For half a century and more, the Earth's magnetic field has been carefully recorded by automatic apparatus at many stations. Great numbers of magnetic storms have been observed — only occasionally as large as those which recently happened — and it has been found, year by year and decade by decade, that their numbers rise and fall in striking parallelism with those of the spots upon the Sun, in a manner which leaves no possible doubt that the two are in some way closely connected. What is more, it is usual, at the time of a great magnetic storm, to find a group of sun-spots near the center of the Sun's disk — though this is not a rule without exceptions.

In the same system of related phenomena belong the great displays of the aurora — the Northern Lights — which extend south from the Arctic regions to the middle latitudes, and, rarely, even into the tropics. These are practically always accompanied by pronounced magnetic disturbances, and are related in the same way to sun-spots.

The evidence was convincing, even 40 years ago, that these were all intimately related — not by accident, but by some real causal connection. But the interpretation of this connection still leads to some of the most puzzling problems of cosmical physics.

In the first place — which is cause and which is effect? The luminosity of the aurora and the disturbances of radio transmission occur simultaneously in the same part of the upper atmosphere, and evidently are two sides of the same event. But do the currents inside the Earth cause those in the atmosphere, or vice versa? This question can be handled mathematically. If the disturbing magnetic forces which are superposed on the ordinary steady magnetic field, and their changes with time, have been so well observed that we can get a good idea how they changed all over the Earth, an analytical discussion based on principles worked out by Gauss more than a century ago will show whether the currents which produced these forces were inside or outside the Earth's surface (on which the points of observation lay). The answer is definite — the main source of disturbance is outside. Hence the currents which flow far above our heads are primary, and those within the Earth are secondary — induced by the others.

BUT what is the relation of all this to sun-spots? Common sense suggests that things happening in the thinnest part of the airy envelope of our little planet can hardly be the *causes* of the appearance of spots on the Sun, 93,000,000 miles away, and so large that the Earth could be dropped into the middle of the dark center of one and have a rim around it thousands of miles wide. Yet how can these spots affect the Earth?

Cumulative evidence has convinced everyone that the spots are not effective in themselves, but that they serve as a useful — and decidedly accurate — index of the varying general activity of the Sun. Near an actively changing spot, the Sun's surface is in turmoil. Bright regions, as well as dark, often appear, and, when these are seen at the edge of the visible hemisphere, eruptive prominences are frequently observed. Great masses of gas are raised high above the ordinary level of the chromosphere, and subject to rapid and extraordinary changes. The admirable motion pictures obtained by Lyot in France and McMath in Michigan show that the motions are very complicated. Often the luminous gas which goes up comes down again; but there are times when great masses of it are evidently driven clean away into space, at huge and increasing velocity.

If we follow such a mass of gas — say hydrogen — in imagination, we must conclude that, as it becomes excessively rarefied, it will be ionized — the electrons will cut loose from the protons. Such a swarm of electrified particles can no longer give out the familiar spectral lines, and will be invisible. But the attraction between the positive and negative charges will keep it from spreading out indefinitely. Suppose that such clouds of particles, flying away from the Sun at perhaps a thousand miles per second, should pass the Earth. Even a small magnetic field — like that of the Earth 50,000 miles away — has an extraordinary influence on the motions of charged atoms (and much more on electrons). They no longer move in straight lines, but at first in sweeping curves, then, as the magnetic field increases, their tracks become spirals around the lines of magnetic force. By the time they are a thousand miles from the Earth, they will be practically coming down these lines of force — though in narrow spirals — and will enter the Earth's upper atmosphere, mainly in the vicinity of the magnetic poles. They will naturally set the thin gases shining — as artificially produced streams of electrons do in vacuum tubes — will come on down until their energy is exhausted, and then stop. This accounts in a general way for the properties of the aurora — its appearance in the polar regions and the fact that the luminous clouds or

streamers rarely come lower than 60 miles above the ground, and never lower than 45. Separate patches and streaks in the cloud of particles account for the ever-changing clouds and streamers of an active aurora.

It is obvious, too, that the incursion of this swarm of charged particles into the atmosphere will ionize it — affecting radio transmission — and make it more conducting, so that considerable electrical and magnetic effects might follow.

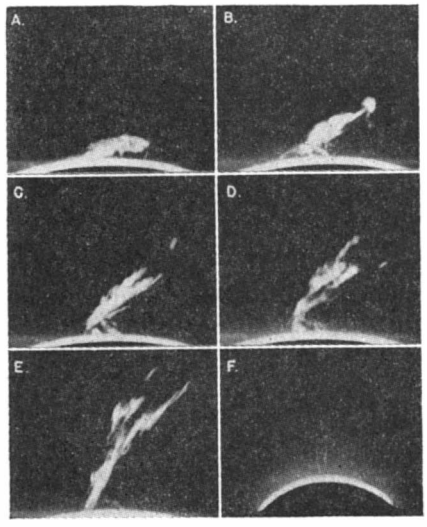
WHEN investigators pass from these qualitative considerations to a detailed attempt to explain the great and apparently erratic changes of field in a typical magnetic storm, the thing becomes very complicated, and no satisfactory detailed solution has yet been reached. The elementary theory indicates that the region where most of the particles come down should be but a couple of hundred miles from the magnetic pole, instead of 1500 as it is. The system of currents which produce the magnetic storm may account for this, but no one knows quite how. It is also not easy to see how a swarm of particles which has come 90,000,000 miles can contain denser patches as sharply defined as would be required to produce the narrow straight rays which so often appear in the aurora. But this seems to be no reason for giving up an explanation which is so satisfactory on general lines.

The regions of eruption on the Sun, from which the clouds are ejected, are usually, but not always, connected with spots — which explains without difficulty why the same is true of magnetic storms and aurorae on Earth. An additional effect, of a different type, has recently been well established. At various times, brilliant eruptions have been seen upon the Sun's surface, usually near spots. Far the brightest of all is one recorded by Carrington in 1859. He was making his daily drawing of the sun-spots visible on the disk when two patches of intensely white light suddenly broke out in the vicinity of a large spot group. Within a minute this had begun to fade, and a few minutes later they had vanished entirely.

Up to the present, no similar eruption, bright enough to be seen in integrated sunlight, has yet been recorded, but there are plenty of them which can be observed with the light of a suitable spectral line — preferably the red line of hydrogen.

In 1935 Dellinger pointed out that high-frequency wireless transmission had exhibited several sudden "fade-outs," involving great areas, but always on the sunlit side of the Earth, and suggested that they might be connected with solar eruptions. By good fortune, spectroheliograms had been taken at various observatories at the very times that some of these fade-outs occurred, and these showed that eruptions had actually happened.

On April 8, 1936 a very brilliant eruption was independently observed at Mount Wilson and in Peru, and disturbances in the ionosphere and the Earth's magnetic field were recorded at the same moment. This crucial observation has been confirmed on various subsequent occasions, and there is no doubt that these bright solar eruptions are accompanied by fade-outs in short-wave wireless signals, and by certain small but definite magnetic disturbances — quite unlike those of an ordinary magnetic storm.



A series of six spectroheliograms covering a period of 75 minutes and showing some of the extraordinary changes seen in eruptive prominences as mentioned by the author. The six views are frames from a continuity of about 500, made by McMath and Sawyer with the new tower telescope at the Lake Angelus station of the University of Michigan. The prominence lifts slowly at first, accelerates rapidly, reaches 500,000 miles above the Sun in frame E, then rushes into space at an exceedingly high velocity. In the Lyot coronagraph films one observes similar action—the prominence seems fairly to slip off into space and vanish in apparent nothingness. The effect on the viewer is one of awe

Since these phenomena occur at the very moment the eruption is seen, they must be produced by something which has traveled from the Sun to the Earth with the velocity of light — that is, by some kind of light itself. Visible light would not affect the upper atmosphere perceptibly; but a burst of ultra-violet light, of wavelength too short to get down through the air to the Earth's surface, would by that very token do something in the upper regions where it was absorbed. The changes which affect radio transmission take place in the D layer of the ionosphere, at an elevation of about 60 miles. Very short-wave light, like the strongest line of helium at λ584, would be absorbed by the upper layers, and not get down so far. But the great hydrogen line at 1215 — which is undoubtedly enormously the strongest line in its spectrum — would penetrate to about the right depth, and, when finally absorbed, increase the ionization.

KNOWLEDGE of the spectra of these eruptions is therefore important, but it is hard to come by. Richardson and Minkowski — who have made successful observations at Mount Wilson—say, "The observer is in a position somewhat similar to that of a man trying to photograph the corona without knowing when an eclipse will occur."

He must watch continuously, and have his instruments ready for instant use.

Working with the smaller tower telescope, these devoted observers watched the Sun visually with a spectro-helioscope, and, when an eruption occurred, had everything in readiness to photograph the spectrum instantly, on motion picture film, or, for the infra-red, on plates loaded in a special magazine. Between July and December, 1938, close to the time of sun-spot maximum, they recorded numerous small eruptions, but only five of the higher grades of intensity 2 and 3.

The visible hydrogen lines show bright in these eruptions, and are the most conspicuous feature of the spectrum. The calcium lines H and K, which are bright anyhow near sun-spots, appear in the eruptions, and in one specially bright eruption the infra-red line of helium, at 10830, showed bright.

This indicates clearly that these eruptions are primarily regions of strong emission from hydrogen, with probably helium too in the stronger ones. Now, by the very nature of hydrogen, an atom which has emitted one of the visible lines will go on to emit the great ultra-violet line. Could we get outside our atmosphere and photograph with this line, there is no doubt that the eruptions would appear as enormously bright spots on the surface of the Sun — which shines feebly in these short wavelengths. Working, as we do, at the enormous disadvantage of having to observe with the relatively weak lines in the visible region, we must catch only the greatest eruptions, which give out such a flood of ultra-violet light that they influence our atmosphere, far away.

Light of this intense hydrogen line is very powerfully absorbed by hydrogen atoms, and hence exerts a strong radiation pressure upon them. It is fairly probable that the pressure of radiation from ultra-violet bright spots, not so notable on the major eruptions, bears a large part in driving the eruptive prominences away from the Sun.

TANTALUM—NEW OLD METAL

Unsurpassed in Many Uses, Especially Chemical Equipment . . . Has Passivity of Glass, Strength of Steel . . . Hard Tools Made by Powder Metallurgy

By PHILIP H. SMITH

IF one is acquainted with the latest in chemical plant equipment, in electronic tube construction, or the science of metal-cutting and wire-drawing, tantalum is no mystery. But to many it is just a name. From now on, however, it is something to watch as a metal having great practical value.

Tantalum is a new, old metal. It is old because first noticed about a century and a half ago, although a hundred years had to elapse before it was isolated. It is new because it joined the community of commercial metals only 18 years ago, and that's yesterday in metallurgical time. In those 18 years, research had to cover a lot of territory. Methods had to be devised for producing tantalum on a commercial scale; physical and chemical properties had to be determined; ways and means for manipulation and control had to be perfected, and not until all this was accomplished did a curiosity become a practical tool of production.

If you think this a long time in which to get from the unknown to the known, you fail to appreciate the peculiarities of tantalum. The metal cannot be extracted from its ores by orthodox smelting or reducing methods. A chemical process is required. Nor can it be put into useful form by any simple process. The pure salts have to be reduced to powdered metal, which is then pressed and sintered in vacuum furnaces. When this much has been accomplished, special techniques must be used to weld, roll, or draw it.

The outstanding properties which recommend tantalum to the commercial world are: a remarkable resistance to corrosion and chemical attack, in which quality it surpasses virtually all other metals and alloys; an ability to absorb and retain gases at high temperatures in vacuum; the peculiarity of forming anodic films of unusual stability; and a strength comparable with steel.

The first commercial use of tantalum was in battery-charging rectifiers where its film-forming characteristic was capitalized upon. Shortly thereafter came anodes, grids, and other parts of electronic tubes. Its merit for these latter applications is unquestioned, but its position is challenged continually by less expensive substitutes.

Tantalum is having its greatest success in chemical plant equipment. Since most organic acids, salts, gases, alcohols, ketones, aldehydes, and esters leave tantalum unaffected, and the high strength of the metal permits the use of thin walled tubes and sheet, even when high pressures are to be used in processes, the chemical industry now has a material which couples the passivity of glass or ceramics with the strength of steel. Tantalum, therefore, is coming to be used in heat transfer equipment and in acid manufacture and recovery systems.

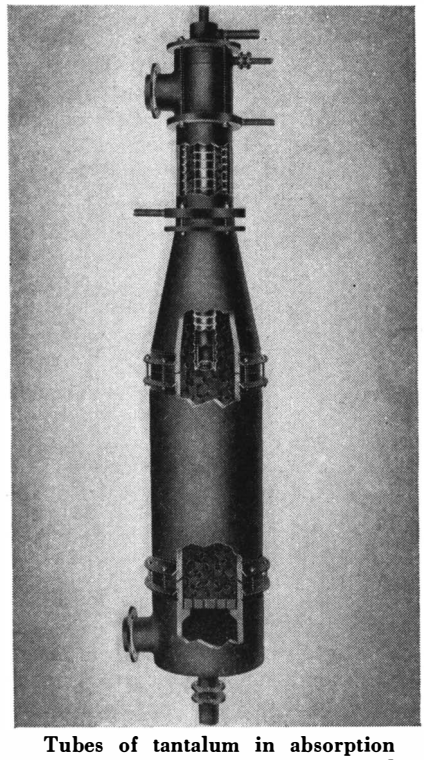
Many chemical processes use reagents which are extremely corrosive to almost all metals. Glass, ceramics and sometimes plastics can usually be used for kettles, tanks, or piping, but since these are poor conductors of heat, some other material must be used to get heat into or out of the corrosive fluids. For heating, cooling, and condensing operations, tantalum is not only inert to chemical attack, but each square foot of the metal will transmit as much heat as 15 or more square feet of the container material, or anything else which could be used.

COMPACT, highly efficient, hydrochloric acid absorption systems, fashioned of tantalum, are now replacing older, cumbersome systems. The new type does not require an isolated building to house it, because there are no escaping fumes to attack surrounding structures. When muriatic acid is produced as a by-product of a chlorinating process, full recovery of the acid can be had and this by-product made to yield a profit. In view of the ever-increasing importance of the chlorine compounds to the chemical industry, the use of tantalum equipment is certain to expand.

Before tantalum's inertness to acids could be given the practical twist there had to be long research into problems of fabrication. This could not be done overnight. Heating and condensing units require the material in tube form and tantalum could be neither drawn nor welded at the outset. When drawn through steel dies it tended to seize to the steel and lubricants were ineffective. Now tantalum, in carbide form, used as a die material serves the purpose.

The welding point of tantalum is about 6000 degrees Fahrenheit. If it is heated in air, it will burn at 2000 degrees Fahrenheit. To make welding practical required a method whereby the metal could be protected while undergoing the process. Furthermore, if the corrosion-resistant property of tantalum was to remain unimpaired, the welding union had to be made without solder. Today, tantalum can be welded to itself and to a number of other metals by electric spot, seam, butt, and roller processes, but not by torch welding. The operation is carried on under a liquid surface, with special techniques devised for both seam and arc welding.

The early days of radio gave tantalum a commercial momentum. Battery radio sets demanded rectifiers for the conversion of alternating current into direct current for charging batteries. Here, tantalum serves particularly well because of its unique electrolytic "valve" properties. When tantalum is used in an electrolytic cell with a dissimilar metal, such as lead, the flow of current forms a stable oxide film upon the surface of the tantalum. This film conducts current freely from the electrolyte to the tantalum, but not in the opposite direction,

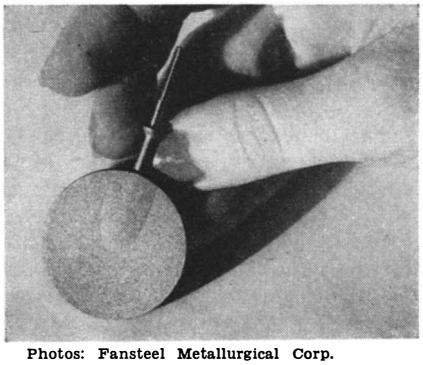


Tubes of tantalum in absorption tower resist corrosive action of acid

hence converting an alternating current into a direct one. Rectifiers employing tantalum are used in railway signal service, telephone switchboards, and fire alarm systems.

It is told that perfecting the tantalum rectifier came about through a fluke. When experimenting with a number of cells to determine why it was that current flow fluctuated so violently, one cell displayed the desired evenness. There was no scientific explanation for this until it was discovered that a tack had dropped into the electrolyte, and thus the addition of an impurity—iron—provided the stabilizing medium which put tantalum into the foreground. Even today, signal maintainers, when cleaning a tantalum rectifier cell, sometimes dissolve a few nails in the electrolyte.

Tantalum electrolytic condensers are the most highly efficient made, and the fact that they are self-healing puts them further in a class by themselves. When first made it was practice to take a sheet of pure tantalum, shot blast it to increase surface area, and then crumple it into condensed form. Present method uses



Photos: Fansteel Metallurgical Corp.

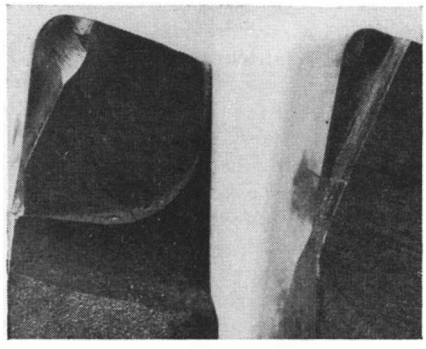
Porous tantalum elements for electrolytic condensers are "self-healing." If the condenser is broken down by over-voltage, film re-forms

the art of powder metallurgy in that powdered tantalum is compressed into a porous element. This gives a capacity per gram five times that of its predecessor. Furthermore, if the element is punctured by a high voltage, such as a stroke of lightning, it heals itself and goes on working. The porous type is cheaper to produce because manufacture begins with the powder and thereby skips ingot and sheet stages of production. It is suggested that the greatest use for these elements will be found in the communications field, but they can be employed in many others.

Thus far tantalum has been considered as a pure element, but the contribution to industry is by no means limited to the metal in this state. Tantalum carbide, a sintered product, and tantung, a cast one, are both serving the metal-forming industries, but just what they are and why they are being used for tools, dies, and wear-resistant parts requires going back a moment for auxiliary information.

Some Uses of Tantalum, its Alloys, Oxides, and Combinations

Electronic Tube Elements
Dies, Tools, Tubes, Rods
Rectifiers
Chemical Equipment
Acid Absorption Systems
Welding Rods
Electrolytic Condensers
Agitators, Spinnerets



Edges of cutting tools. Use forms a crater on tungsten carbide tool at left, not on tantalum carbide, right

Broadly speaking, there are three classifications of metal-forming tools. Arranged in an ascending scale of red hardness, these groups are:

High speed steels.
Cobalt-chromium-tungsten combinations.
Cemented carbides.

There are many varieties within each group and years of experience have pretty much fitted the tool to the job. When cemented carbides came on the market, tungsten carbide was hailed as an ideal tool for cutting steel, but it failed in its promise. It was extremely hard and would cut at high speeds, but it suffered from the phenomenon of cratering, or the tendency for a tool to wear away where the chip strikes as it leaves the cutting edge.

Tantalum carbide displays a marked resistance to cratering and when added to the other refractory carbides produced the first really suitable tool for machining steel. Tantalum carbide has a wetting or self-lubricating property which presumably explains its achievement.

Tantung is an alloy consisting of fine particles of tungsten and tantalum carbides imbedded in a matrix of chromium and cobalt, and is distinguished from carbide compositions by being cast rather than sintered. It lacks the ultra hardness of the carbide group, but is tougher, hence it fills a rather wide gap between the cobalt-chromium-tungsten group and the carbides.

The role selected for this new material to play is the cutting of steel, particularly for interrupted operations where a certain amount of shock must be taken and which would be likely to break down the more brittle carbides. In actual cutting operations it can take larger bites because of its toughness, but not at as high speeds as the carbides.

The fact that tantung is cast rather than sintered is significant. It suggests that tantung is more easily handled than carbides, and this is true in some particulars. The sintered carbides must be formed in soft state and then hardened to unalterable form; tantung can be given other shapes by welding. The extreme hardness, characteristic of carbides, can be imparted to surfaces to make them highly wear-resistant, by the simple expedient of laying down a tantung deposit with a welding torch. Thus, an almost unlimited field of usefulness is opened.

TANTALUM carbide is used in dies for much the same reason that it goes into cutting tools. Its hardness and wetting properties in the form of carbides give it special value. Tantung enters into die construction because it displays a great resistance to deformation under heat. It is used for large size dies, for heading and sizing dies, for certain extrusion types, and in general wherever high pressures and shock must be stood.

Tantalum is a high strength metal, otherwise it would be impossible for tubes of it having walls no thicker than 15 to 20 thousandths of an inch to withstand pressures as great as 150 pounds per square inch. Since chemical attack does not occur under conditions where tantalum is recommended, it is unnecessary to provide for loss of metal due to corrosion, as is commonly done when base metals are used. Therefore, thin walled tubes are safe at high pressures.

Strength and non-corrosive properties put tantalum into many applications. Thus we find agitators in mixing equipment being given tantalum-covered steel shafts and solid tantalum blades; aerators which have tubes and jets of the metal, and tantalum-protected pump shafts and valves. Spinning jets used in viscose process rayon manufacture have been made of tantalum, but these are used principally in countries where the shortage of precious metals offsets the low scrap recovery value of tantalum.

Just what territory tantalum may next pre-empt is any man's guess. Those who have worked most closely with it are loath to make predictions. It takes long and painstaking research to prepare the ground for small advance and there's still much to learn about this unusual metal. One can guess that whatever is new will utilize the unique properties already employed and which are not duplicated in any other metal or alloy. This would give tantalum more value and prominence in the industrial scheme.

What Is Death?

Science May Know When it Learns What Life Is . . . No Surgeon Ever Brought a Dead Patient Back to Life . . . We Do Not Die All Over, All at Once

By BARCLAY MOON NEWMAN

AFTER he is dead, can a man be brought back to life? Can a man die twice?

On an operating table lies a patient, already asleep under the influence of the anesthetic. A most delicate operation is imperative, to save the man's life, though he has been weakened seriously by a long illness. A slowly but steadily growing tumor has for months been exerting pressure on his brain.

It is dangerous to use the knife on so weak a patient. Yet it is dangerous to postpone the operation. The cancerous growth must be removed by surgery. Otherwise the tumor will in a few weeks be pressing on vital centers in the brain, and then suddenly the man will die.

The surgeon gets busy with his gleaming scalpel. The patient's pulse is under constant observation. It is very weak. Gradually it becomes still weaker. The anesthetic and the shock of the surgical knife prove too much for the strained heart. The nurse taking the patient's pulse warns the surgeon. Then, all at once, the heart-throbbing flutters out entirely. Instantly, the surgeon halts his cutting, and calls for the hypodermic needle kept ready at hand for just this emergency.

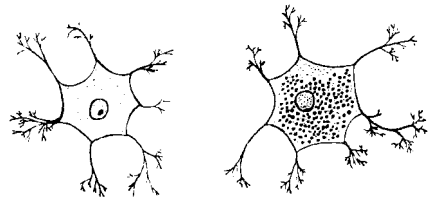
The hypodermic contains a solution of that most powerful stimulant, adrenalin. Calmly the surgeon takes the needle from the nurse, finds the proper point immediately over the heart, and firmly presses the needle through the skin and tissue — straight through and into the very heart muscle, now completely still. Adrenalin solution is injected into the heart tissue. The patient's heart has not been beating for several seconds.

ONLY a few years ago, before the discovery of the use of adrenalin, the man would have been pronounced dead.

But the adrenalin accomplishes a seeming miracle. Almost immediately after the injection, the apparently dead heart commences to throb again — very faintly, almost imperceptibly at first. Then the pulse becomes stronger and stronger. Amazingly, the normal heart beat is restored. The patient has been snatched from death. The surgeon can proceed. The removal of the tumor is accomplished successfully. The dangerous, almost fatal operation completed, the still benumbed patient is carried to his bed. His convalescence is necessarily very slow, but he finally makes an uneventful recovery.

Now, when the newspapers report such a remarkable life-saving feat, as in this case where adrenalin is used to restore the contractions of a seemingly dead heart, as a rule they say that the surgeon "brings a dead man back to life." Sometimes the patient is interviewed — after he has recovered sufficiently — and asked for his sensations while "dead." Weird sensations may be described, or the patient may say that he felt nothing.

What is the truth? Was the patient really dead when his heart ceased to throb? The truth is that no dead man has ever been restored to life. That is, death involves more than a mere, momentary



Nerve cells of an infant dying at birth and of a man whose death was attributed to "old age." Loading up with granules may kill the cells

halting of the heart beat. In fact, medical records list the cases of several persons who have had the extraordinary power to make the heart stop beating for minutes at a time. The individual would, when he voluntarily caused his heart to suspend its action, become unconscious. Then, after a brief period, his heart would start beating once more, and his consciousness would return. The most famous of these persons with varying degrees of control over the heart died recently — at an early age, following a severe heart attack which occurred a few days after he had made an astounding demonstration of voluntary heart control before a gathering of physicians.

Hence it is evident that death is more than temporary stoppage of the heart's contractions. In the case of the patient whose heart fails during an operation, only to have heart activity restored by adrenalin, the life-giving flow of blood pauses for only a very few seconds. When the heart starts beating again, immediately fresh blood, carrying the needed food and oxygen, courses through the arteries and other blood vessels of all the tissues, especially the most delicate tissues, those of the brain. The microscopic units, or cells, have merely been forced to reduce their vital activity to a minimum. Few, if any, tiny cells perish at such a time, even in the brain.

NOR are the patient's heart cells dead. They are merely somewhat less active than usual, their functioning reduced by want of nutrients and oxygen, by accumulating wastes, and by badly working nerve centers of control. They are alive, but not active enough—having insufficient food and oxygen—to make the powerful contractions necessary to the beating of the heart. As soon as they receive a sharp stimulus, they contract, make the blood recommence flowing, and thus supply themselves and the other tissues with required substances, so that quite active life can be maintained.

If the blood supply is cut off for more than a very few minutes, many of the microscopic units, or cells, of the tissues actually die. And if even small portions of vital tissues are killed, they drag the remainder of the body down into the abysm of true death, from which there is no escape—and never has been.

Brain cells are most rapidly killed. Other cells, after the supply of needed materials is shut off, die less speedily. Cells of internal organs, such as the liver or kidneys, may stay alive for hours, sometimes even for weeks. Cells of the intestine seem to be most hardy, and have been found alive more than two weeks following the death of the rest of the body.

Bodies, then, do not "die all over, all at once." In the light of this fact, what is death? Though the meaning of the term death is, strictly speaking, never altogether definite or clear, every day thousands of individuals are pronounced legally dead—and quite rightly so—because the heart beat cannot be restored after a reasonable elapse of time, and breathing also has evidently been halted without any chance of being restored. Further, of course, the body's tissues

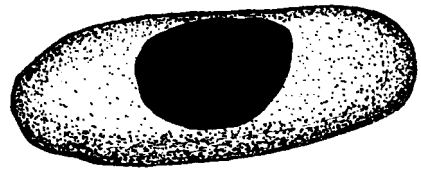
within a few hours become completely cold, and stiff—as rigor mortis sets in.

Nevertheless, days after an individual is legally dead—and perhaps buried—fragments of the inner organs could be found fully alive. The tiny hairs in the windpipe which sweep dust particles upward and away from the lungs during life, are frequently found still exhibiting their rhythmical sweeping motion—their rhythmic beating. This proves that the tissues inside the windpipe are still alive. Then, they in their turn perish.

Such living portions of dead bodies may be cut out and placed in glass flasks containing solutions of food and oxygen. Kept warm, and in the midst of this food and oxygen, and with contamination by microbes carefully prevented, these bits of tissues may be kept alive in the laboratory indefinitely. Moreover, at the Rockefeller Institute, methods of stimulating these living fragments have recently been discovered, and as a result these bits of tissue can be made to grow. Yet the growth is aimless, and never results in the production of a whole new organ or even anything more than a still microscopic piece of formless tissue. It would be possible for a wealthy man to provide for the keeping alive of whole sections of his body, following his death ("legal death")—though these sections would have to be kept alive as numerous separate and very tiny bits, each in an individual flask holding food and supplied with oxygen. Such test-tube life, it is thought, can be maintained indefinitely — probably for centuries — provided it is suitably cared for—by continually supplying fresh nutrients and fresh oxygen, and transfering the bits of tissue to fresh flasks once or twice a week.

TISSUES of cold-blooded creatures, such as frogs, salamanders, and especially very low forms of life—for example, many kinds of worms—are far more hardy than those of warm-blooded animals, such as mammals and birds. In the 18th Century, a biologist named Baker obtained some threadworms—microscopic worms having a threadlike appearance—after learning that these worms had been kept quite dry and seemingly quite lifeless for 27 years. After they were soaked in water, they began to revive, and soon were swimming actively in the water. This experiment is said to hold the record for suspended animation among animals. Plant seeds, however, may be kept even longer in a state of suspended activity, and then made to sprout when planted. Spores of molds and bacteria are believed capable of indefinite existence in dry, cool places—perhaps for thousands of years, though experiments showing the presence of living spores sealed for thousands of years, if not millions of years, in lumps of coal, are not generally accepted by a majority of conservative scientists.

There is no scientific test for death. Indeed, the most expert life-scientist cannot tell whether a dry seed is dead or merely dormant until he has observed the seed over a lengthy period to see whether moisture and warmth cause the seed to start sprouting. Thousands of scientists through the centuries have sought for a simple test for death. Today it is commonly believed by biologists and medical experimenters that there never will be a simple death test—at any rate, not until that far-off day when



Conditions under which death occurs differ widely for different types of living things. *Above:* A spore of a lower plant and, *below,* three kinds of bacteria. These may be cooled to absolute zero (459.69 degrees below zero on the familiar Fahrenheit scale), yet death may not occur. Numerous other simple organisms are "tougher" than humans, which are not tough at all

the secret of life is discovered. For, death is merely the stopping of the life processes, many of which escape notice and all of which are utterly mysterious.

Since there is no death test, frequently errors are made in the attempt to determine whether or not a person is dead. The heart action and the breathing may be so faint as to elude all efforts at detection, and meanwhile the body may grow fairly cold. Evidences there are aplenty that individuals pronounced dead have been buried alive by mistake. Thus, tombs have been opened and found disturbed within, just as though the buried person had regained consciousness and struggled to free himself. And of course at least some of the stories of a "dead" man suddenly sitting bolt upright on the undertaker's table are true.

Nevertheless, though there is no simple scientific test for death, scientists are quite certain that after the heart has definitely ceased beating during more than 10 or 15 minutes, a human being is dead beyond the shadow of a doubt. The problem is, however, to be sure that the heart has actually ceased its throbbing.

In cases where a person is nearly drowned, and is revived only after perhaps an hour of artificial respiration, the heart cannot have halted completely for more than a very few minutes, if it has halted at all. Very faint heart action can proceed without ready detection. Should the heart have stopped for a full ten minutes, resuscitation means that the individual is revived in spite of the definite and irrevocable death of many cells of the fragile brain—and the individual is thereafter demented, though he may live out his normal span of life.

RECENT experiments with dogs support this view. One scientist, Winkelbauer, bled dogs until the most refined electrical tests showed that the pumping action of the heart must have been completely stopped. If he waited not more than five or six minutes, and then quickly returned the blood to the animal by transfusion, a few of the dogs would recover. If he waited even two or three minutes longer, practically none of the animals could be resuscitated—though occasionally a dog could be brought back to life after as long as 20 minutes. (By "bringing back to life" is meant restoration of the full activity of cells whose activity has been brought to a low point by lack of oxygen—but whose activity has definitely not been terminated, even for a moment, by actual death.)

In instances where electrical recordings have been taken of the failing heart action of dying men, it has been found that electrical signs of a slight pumping action may persist for sometimes 20 minutes after respiration has seemingly been completely stopped and after the pulse has completely disappeared. Ordinarily, these dying men would be pronounced dead a quarter of an hour or more before true death of vital centers of the body!

In view of such findings, it is evident that many a drowning person may have slight heart action, though breathing has been stopped and the pulse has disappeared. Clearly, the person is not dead. But not only in cases of drowning but also in all other cases, when the heart's pumping has been stopped completely—brought to a dead standstill—then, usually after five to ten minutes and certainly after 20 minutes, all hope of resuscitation is gone. For, after these few minutes of lack of oxygen and nutrients, whole areas of the brain cease all life activity—that is, perish. And once dead, a cell or a tissue or an organ is "dead all over," and dead beyond recall.

A dead man cannot be restored to life. A human being cannot die twice.

It is clear that a knowledge of what death is must await the discovery of the secret of life. Meanwhile, scientists, while zealously hunting the mystery of life, must define death as the opposite of life—the absence of that world of activities which means life.

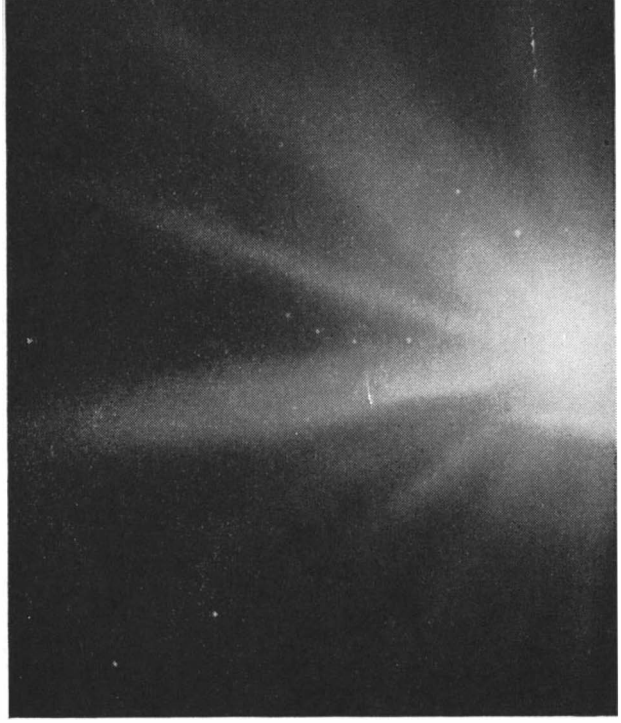


Figure 1: Left: An aurora of the S-curved curtain type, observed in Illinois in March. *Figure 2: Above:* Coronal type of aurora observed at Bar Harbor, Maine, in August

MARVELS OF

By WILLIAM CROWDER
Illustrations by the Author

SPECTACLES of such transcendent beauty as the aurora polaris, the parselenic rings and arcs surrounding the Moon, and the zodiacal light, are beheld more frequently in North American skies than is commonly believed.

Contrary to a widespread belief, the aurora may occur at any season of the year, not merely in winter. The phenomenon referred to in the northern hemisphere as the aurora borealis is the same thing which is called the aurora australis in the southern hemisphere; the term aurora polaris, or simply aurora, applies in general to both.

There are several type-forms of the aurora, a common type being the exquisitely colored, tenuous, folded curtain form shown in Figure 1 and in the upper portion of Figure 5. The commonest form of all, however, is the arch, shown in the lower part of Figure 5. The arch may be without color, a pearly kind of light, but more often it exhibits several delicate prismatic colors. At times it may become truly gorgeous. Though the position of the arch itself may remain comparatively fixed, its parts may pulsate. Sometimes it may send upward needle-like streamers varying in length and brilliancy.

More rare is the coronal type of aurora (Figure 2), conceded by most observers to be the most impressive of all auroral forms. It is seen almost invariably at or near the zenith, and it presents the aspect of numerous fanlike rays emanating from a common center.

When color is present in the different auroral forms, it is most usually apple-green. Although nearly all colors may be seen, those next in frequency are rose, red, lavender, violet, and deep purple.

Discoveries about the northern lights have completely

Figure 4: Left: The zodiacal light as observed in August, 1939, from Mexico. Cause, astronomical

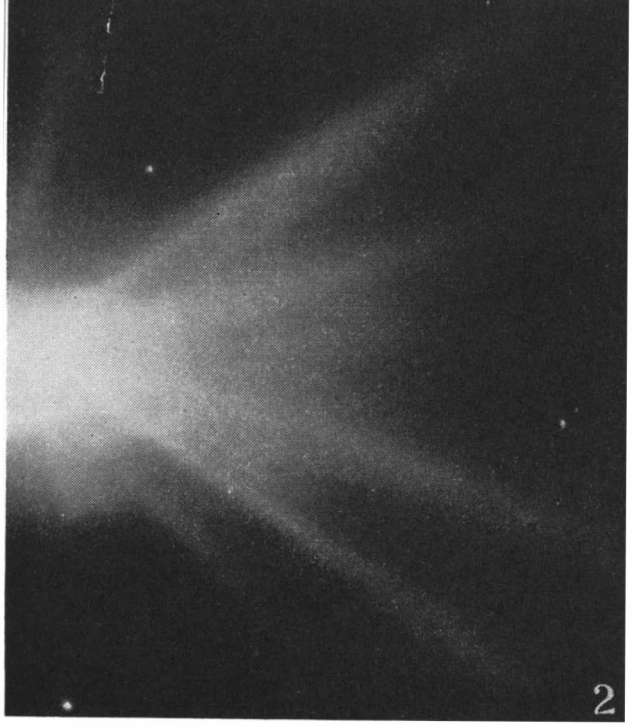


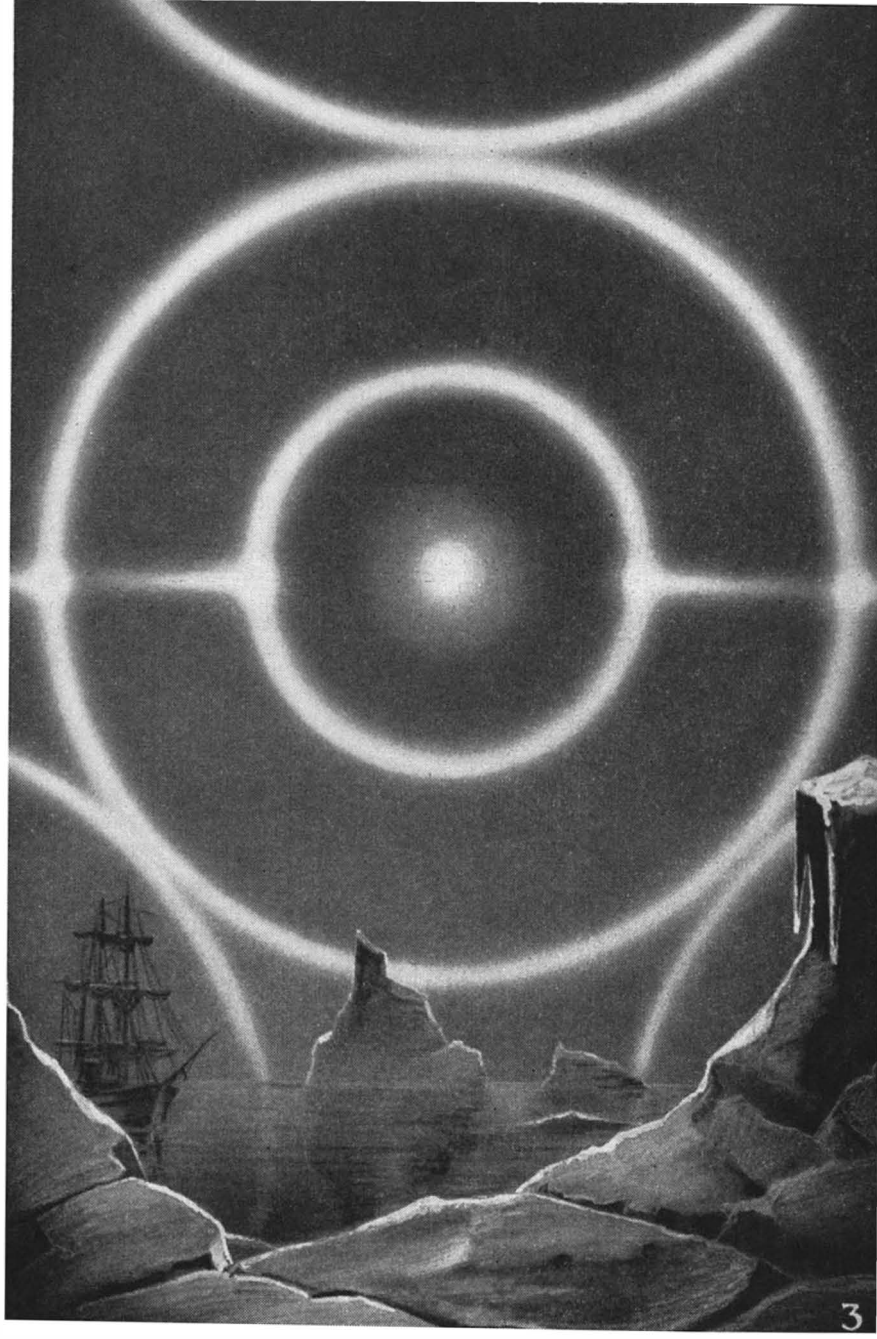
Figure 3: Right: **Moon, lunar halos and parselenae. Cause, refraction and reflection in ice crystals in the air (explanation is given in Humphreys' "Physics of the Air")**

THE NIGHT

Striking Natural Phenomena . . . The Aurora, Zodiacal Light, and Bizarre Types of Lunar Halos

changed previous concepts of these once mystifying spectacles, and several theories have been offered as a consequence. One theory supposes that the auroral light is produced by the bombardment of the molecules of rarefied gases in the upper atmosphere by the ultra-violet rays of the Sun. These rays knock the electrons from the atoms to which they belong; in short, the gases are ionized. These multilated molecules then move toward the Earth, where they are attracted along the magnetic lines of force and produce the effect we know as auroral light. Another theory differs only in that tiny electrified particles are violently projected directly from the Sun. These are attracted spirally along the magnetic lines of force toward the magnetic poles of the Earth.

The least height at which the aurora borealis has been recorded is 45 miles, the greatest height being some 600 miles. The greatest number occur near the lowest level. The distances of auroral forms from the observer, and their heights above the Earth, have been computed with exactness. Especially designed cameras equipped with wide-aperture lenses and using rapid emulsion films are utilized for this purpose. Simultaneously from several stations, sometimes from 20 to 50 miles or more apart, the exposures are made on the same auroral feature. These exposures are synchronized by means of telephonic communication between the operators, who wear headsets. The resultant negatives are so marked that they may be compared with one another. The position of each camera with reference to the aurora



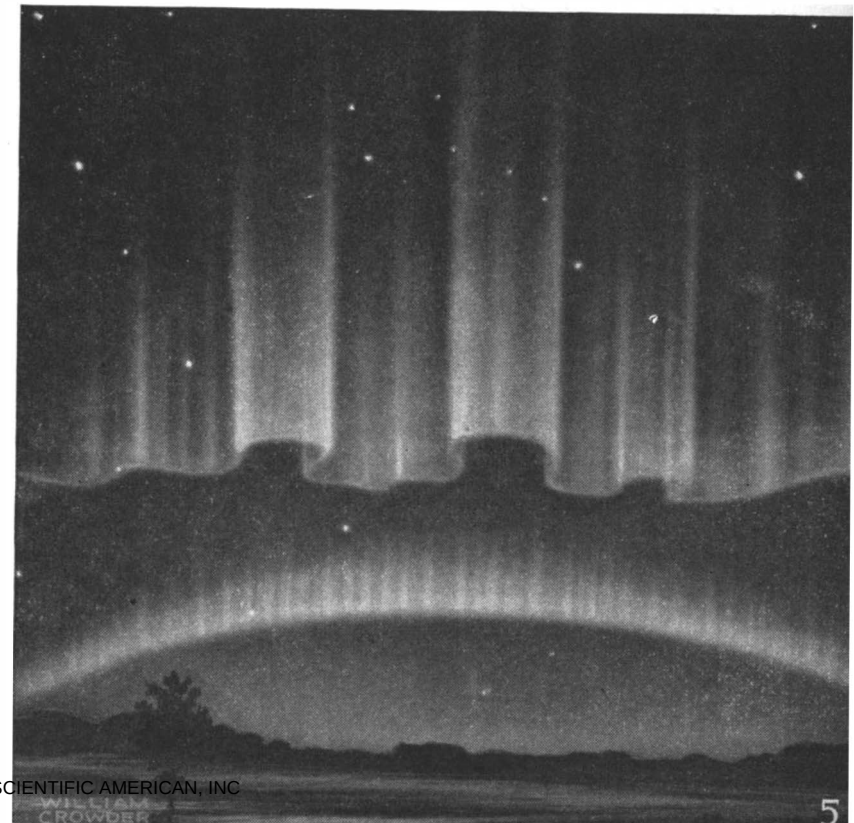


Figure 5: Right: Aurora, arch type with vertical streamers, curtain type above it. Seen from Iowa

and the background of the stars always shows a parallax, or shifting; the measured distance between two stations is the base line. In this way are secured two angles and the included side of a triangle. The rest is merely mathematical—the ordinary process of triangulation.

The latitude of maximum occurrence of the aurora borealis is not, as once was believed, at the region of the Earth's geographic Pole. The occurrence of greatest frequency is near the region of the magnetic pole, which is many degrees south of the North Pole, near the Arctic Circle in northern Canada.

On any clear, moonless night in the year the possibility is by no means remote that the observer may be the fortunate witness of a spectacle which, of all celestial thrillers, is second only to the total eclipse of the Sun—and this possibility also exists whether he lives in the latitude of Maine or that of southern Florida.

Another striking nocturnal marvel, in no way related to the aurora, is the phenomenon of lunar halo (Figure 3), to which similar solar halos are related because of identical cause—the refraction and reflection of light in tiny snowflakes or in needles of ice, most often when the clouds are low or when clear air contains the needles. The majesty and loveliness of either a lunar or solar halo and its secondary images are as inadequately describable as that of the aurora, with which they easily rank in beauty. It is now believed that the celebrated cross which Emperor Constantine perceived in the sky, about A.D. 313, and which persuaded his conversion from paganism, may have been part of a system of solar halos, two of which at right angles would form a cross.

IN the common form of fully developed lunar halo, two concentric circles are produced, with the Moon at the center, the inner halo having a radius of about 22 degrees, and the outer halo about 46 degrees. Passing horizontally through the Moon and through both halos is a track of light, the parselenic circle, of about the width of the Moon's diameter. On this horizontal track usually appear a number of secondary lunar images, the parselenae, the most brilliant of which are the two located near the intersections of the inner halo. The parselenae are brightest when the Moon is near the horizon. As the Moon rises, they move somewhat beyond the halos and assume flamboyant tails which are directed away from the Moon. All the colors of the spectrum are delicately exhibited in the halo; owing to the optical phenomenon of interference, however, the only decided tint is red, and this color is invariably located on the inner side of the rings. A parselena, being itself a secondary source of light, often very brilliant, may in turn have its own encircling rings, not included in the drawing. These secondary halos, however, are much fainter than the primary ones. In addition, there may be a magnificent circumzenithal arc touching the outer halo at its upper point, together with brightly colored tangential arcs touching the lower half of the outer halo. These, too, can be explained as refraction and reflection from the frozen crystals. Not all the details described may always appear in full and perfect form in any given display. Indeed, ideal perfection here is rather rare.

Water crystallizes in the form of regular hexagonal prisms, usually with plane ends but sometimes with hexagonal pyramids as terminals. Now, if we consider any two non-parallel faces of one of these crystals, it is clear that their combination must act as a prism, decomposing white light, which passes through them, into its constituent colors. The refractive index of ice, however, is such that no ray of light can pass through a prism of it having angles greater than about 99½ degrees. Therefore, the power to create the halo effect must be limited to pairs of faces whose inclinations are inferior to this. In the present instance, that would mean the alternate faces of the prism where the inclination is 60 degrees, and a face with a terminal plane whose angle is 90 degrees. Every such crystal, then, suspended somewhere near the line joining the eye and the Moon, must send to the former some definitely colored ray from each effective pair of surfaces. With the prisms having their axes in every possible direction, it is evident that the appearances produced must be symmetrical, and must therefore consist of circles around the luminary.

Taking now the inner halo, its appearance may be explained by supposing the colorless portion to consist in part of the recombination into white light of its multitudinously separated elements by minute prisms, and also in part from the following cause. If a prism, through which a ray of light is passing, be turned gradually on its axis, the refracted ray also turns, but at a gradually slower rate, to a point called minimum deviation, from which point it will retrograde increasingly faster. Hence, as we have assumed the suspended prisms in the atmosphere to be in all possible positions, those near the position of minimum deviation will contrive to refract light in the same direction, and their effects will be consolidated. All the others will cause a dispersion of light. As the red rays are the ones that lie near the point of minimum deviation, there is consequently a red circle around the Moon with an angular radius of 20 degrees, 50 seconds, the angular radius of minimum deviation. Inside this circle there will be no light; outside, the light will be somewhat colorless and feeble.

The explanation and appearance of the 46-degree halo are the same as for the halo of 22 degrees, except that its position depends on the right-angled prisms formed in the hexagonal prism.

Less spectacular perhaps than the other phenomena described, but none the less mysteriously impressive, is that marvel of the night which manifests itself as a strangely elusive ethereal glow, concentrated along the zodiac — the broad path in the sky along which the Sun, Moon, and planets appear to move — and which consequently is called the zodiacal light (Figure 4).

The zodiacal light, like the aurora, can be seen only on a moonless night. After the last vestige of twilight has vanished in the west, this phenomenon often appears in spring like a tenuous, luminous mantle of mist through which the stars seem to twinkle with almost undiminished brilliance. In autumn it is best seen in the east shortly before the first hint of dawn. Although not infrequently observed from higher latitudes, it is better and more often viewed from clear, arid regions in the tropics, where its subtle golden drapery adds more than another touch of mystery to the night.

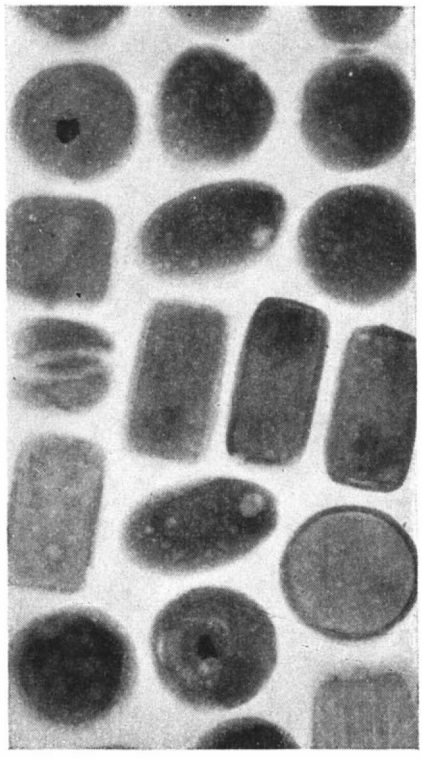
THE physicist has determined that the nature of this light is similar to sunshine. This discovery leads to the conclusion that the zodiacal light is in reality reflected light of the Sun coming from billions of minute meteoric particles moving in orbits of their own around the sun. and extending at least as far out as the Earth's orbit. While we seldom see the complete band of the zodiacal light. it extends all the way around the ecliptic. On it, directly opposite the Sun, is a brighter area, the *gegenschein*, or afterglow, some ten degrees in apparent diameter. In this area each particle may be thought of as at full phase (exactly like the Moon, though far smaller), and this accounts for its added brightness.

The rarefied nature of the material in this region would seem at first thought almost incredible. It has been estimated that the small particles reflecting the sunlight are somewhat less than a millimeter in diameter, and are spaced from one another at about an average distance of five miles. Therefore it follows that, if all these tiny bodies, distributed throughout at least nearly 100 million miles of radius, were to be condensed on the surface of the Earth, they would form a layer not exceeding one centimeter in thickness. In truth this material is so tenuous as to have no appreciable effect in retarding the speed of not only the planets, but also of the very tenuous comets that at times travel through its tremendous reaches.

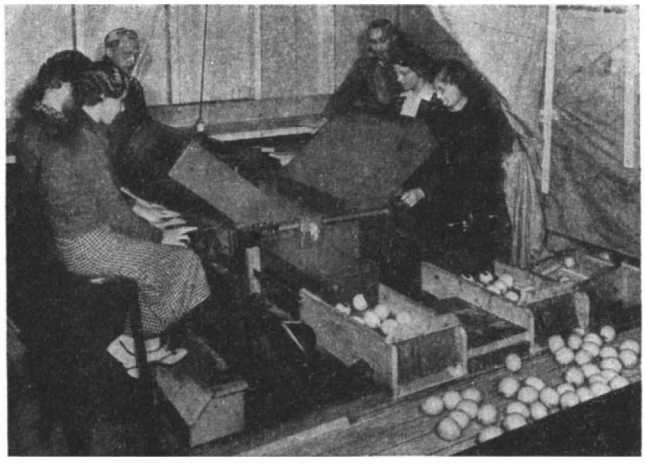
Foods X-Rayed

To Reveal Presence of Foreign Objects, Some Impurities . . . Also Condition of Products, Fruits . . . Fluoroscopic Inspection Widely Used

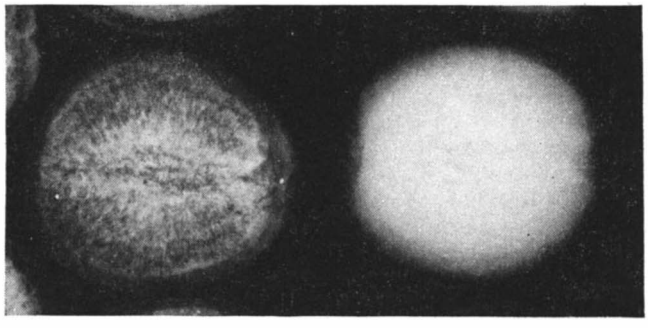
THE average person thinks of the X-ray as a medical tool. The technically minded person understands its importance in structural studies in engineering and industry. During the last four years this tool has made another important place for itself, this time in the food industry. The processors and packers of many types of food products have developed in recent years screens, sieves, magnetic separators, and have applied photoelectric cells to the job of detecting and removing foreign objects from all kinds of foods, but fluoroscopic inspection has proved to be superior to them all in some respects. However, the X-ray does more than show presence of impurities. In one case, three fluoroscopes, costing a total of $10,000, gave a saving of $60,000, which resulted when a large quantity of oranges which were scheduled for destruction were found to be undamaged by freezing.



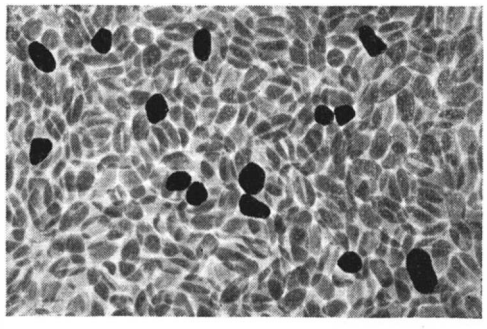
Right: To show how a box of candy gives up its secrets under the fluoroscope, foreign objects were inserted in some of the pieces of candy. The objects show up as irregular black spots in several of the candy pieces

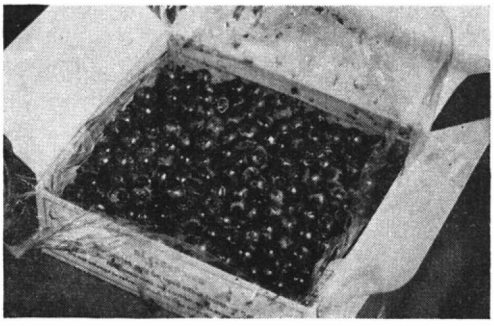


Below: Radiograph showing oranges as they appear on the viewing screen of a visual inspection X-ray unit. Images of even density show an even distribution of juice while the mottled images indicate frost-bitten or crystallized fruit. *Right:* Fluoroscopic inspection of lemons

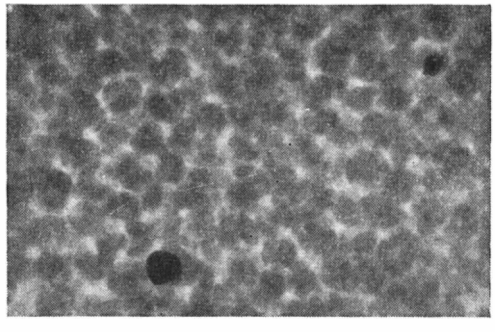


Left: A shallow box of shelled peanuts ready for salting. To the eye, it shows no unwanted objects but the X-ray shows presence of many small stones. These show up as in the picture of box at right





Pebbles can be present also in such foods as blueberries, without being seen, *left.* But when passed between the X-ray unit and the fluoroscope, *right,* the berries no longer hide the adulterants



Photos courtesy General Electric Co.

A Big Gun of Science

The Brasch and Lange Apparatus, Old-timer in Splitting the Atomic Nucleus, Faces a Revival with Improvements in Generating Artificial Lightning

By C. W. SHEPPARD

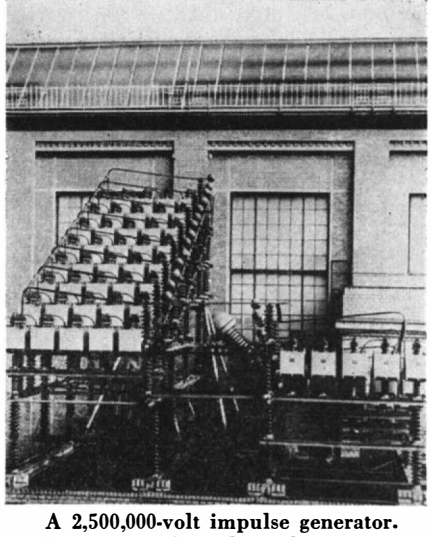
THANKS to the World's Fair and modern advertising, artificial lightning bolts, such as electrical engineers use for testing purposes, have become as familiar to Mr. and Mrs. American as their living-room rug. The development of any instrument of pure or applied science invariably leads to the subsequent discovery of unsuspected uses for it. In the case of the "impulse generator," as the machine for producing artificial lightning is called, one little-known use was the disintegration of atoms. Before we can understand this use, we must look back a few years.

In the middle 'twenties, a good deal was known about the outside of the atom. The behavior of the electrons, which move in complicated orbits about the central nucleus, was fairly well understood, hence scientists, looking for new fields to explore, were already turning to the atomic nuclei. They were trying to break them open and find out what was inside by shooting fast particles at them. Some success had already been achieved by using the alpha particles that shoot out of the nuclei of radioactive elements with velocities of about 20,000 miles per second; but many kinds of particles which scientists wished to use could not be obtained in this way. One method of reaching high speeds with these particles was to put them into an evacuated tube, where there were no air molecules to slow them down, and then to apply a high voltage. This would accelerate them to the desired velocity. However, the obstacle which held scientists back was the tremendous cost of high-voltage equipment.

IT was here that three pioneers of nuclear physics — Brasch, Lange, and Urban — took the bull by the horns. Between two peaks of the Monte Generoso, in the Swiss alps, they hung a long cable between two enormous chains of insulators. In this region, electrical storms are frequent, and they hoped to pick up enough atmospheric electricity for their purpose, either from direct lightning strokes or from the highly charged air beneath the thunderclouds. This hazardous improvement on Benjamin Franklin bore some fruit. Sparks were measured up to 60 feet in length, representing somewhere between 10,000,000 and 15,000,000 volts. Unfortunately, Urban, while working high in the air on th cable, slipped and fell to his death.

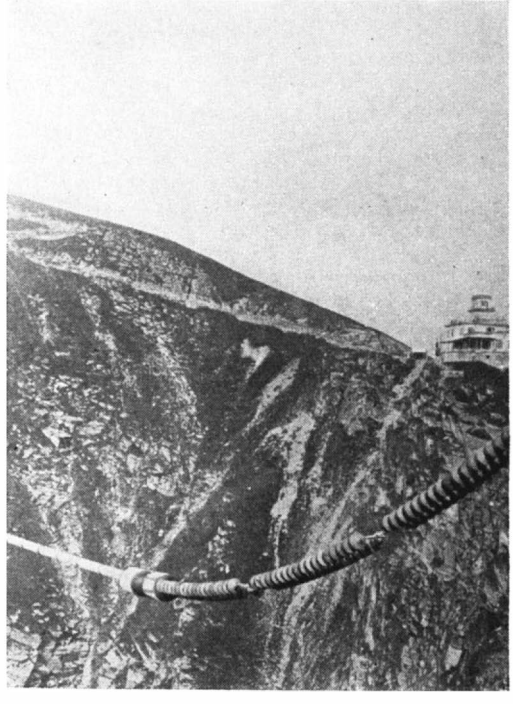
Brasch and Lange continued the work alone, but they soon managed to obtain facilities for making high voltages artificially, so they were able to put their umbrellas away and take their work indoors. Instead of a continuous alternating or direct current, as was used by other workers, they investigated the effect of sudden high-voltage impulses or "artificial lightning." These heavy electrical "surges" were produced by an apparatus already well known to electrical engineers and physicists. In this scheme, a bank of electrical condensers is charged in a parallel connection and then discharged in series. Suppose, for example, we charge 12 condensers in parallel, with 200,000 volts. If we then connect them in series, the voltage will add up to a resulting voltage of 2,400,000.

A very clever circuit is used to effect this process of parallel charging and series discharging. The bank of condensers is charged in parallel through tubes of glass or rubber filled with water. Unlike a metal wire, water will allow electricity to trickle in, but resists any sudden electrical surge in much the same manner as a pneumatic cylinder controls the closing of a door. As the electricity flows into the condensers, the voltage across them, which is proportional to their charge, likewise increases.



A 2,500,000-volt impulse generator. Discharge takes place along chain of spheres in the center of picture

At a certain critical voltage, a chain of spark gaps between the condensers flashes over and the entire bank of condensers suddenly discharges in series. Since the parallel connection is made through water tubes which will not transmit electrical surges, the sudden discharge is prevented from wrongly taking the original charging connection.



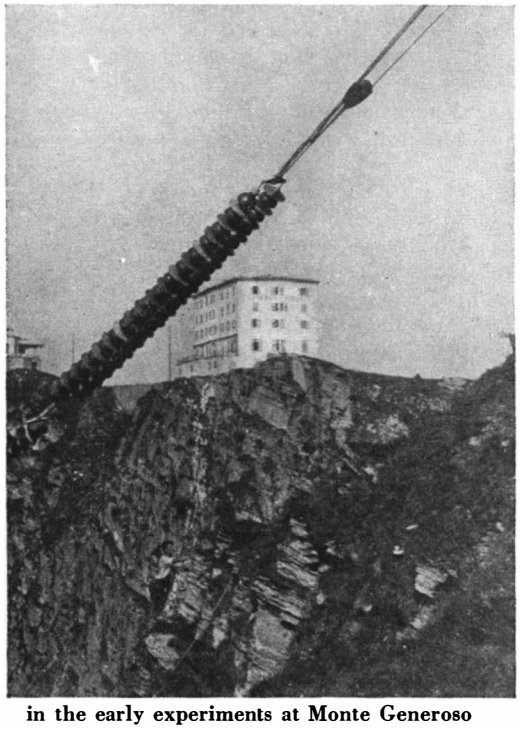
The lightning collector, 1½ mile long, used

When allowed to discharge across an external spark gap, an impulse generator makes a very impressive display. Due to the high current let loose, the discharge appears with a blinding white flash, accompanied by a report which makes the ears ring. If a block of wood is placed across the gap, it is blown into many fragments.

Having obtained the necessary high voltage source, Brasch and Lange next required a vacuum tube through which to shoot their atomic projectiles. For this purpose, they devised an ingenious and simple arrangement. Alternate rings of laminated paper and steel, separated by rubber vacuum gaskets,

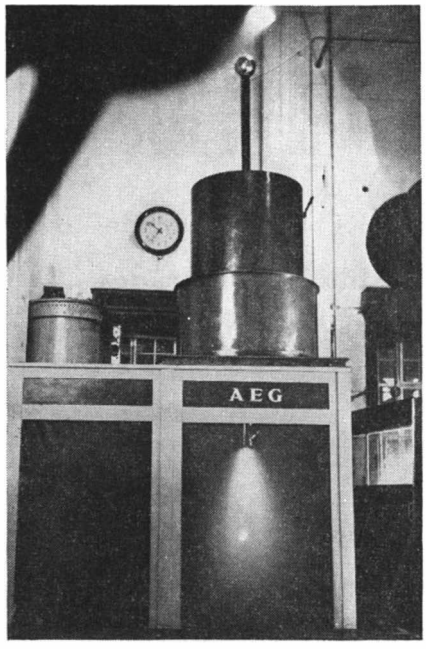
were piled one on the other to the required height and vacuum pumps were connected below. The tube was usually immersed in a tank of oil for insulation purposes. When oil was used, the tube could actually be designed less than knee high if it were to work at 2,500,000 volts. Such conveniently compact construction would not be possible unless one were making use of the impulse principle. With continuous current, gases would be produced in the laminated paper wall of the tube by the discharge, thus making a vacuum impossible. This does not happen in the case of the quick impulses, for, by the time appreciable amounts of gas have formed, the discharge is entirely over, and the pumps can clear the tube out before the next discharge occurs.

These two trail blazers did considerable pioneer work in atomic bombardment with their "heavy artillery."



in the early experiments at Monte Generoso

Shortly after the first history-making artificial disintegration experiments of the two English physicists, Cockcroft and Walton, at Cambridge, they checked the results with their technique and confirmed them. In numerous experiments, they bombarded atoms of many elements, using protons (nuclei of hydrogen atoms) for their projectiles. Although the impulse technique produces fair bombarding intensities when using protons, the most spectacular results are obtained with electrons It is true that a high voltage impulse lasts only a few millionths of a second; nevertheless, the current during that interval is at least 1000 amperes. For this reason, if we take a very conservative view, such apparatus, discharging once every second, has an output equal to a continuous current of one thousandth of an ampere or more. Measurements show that about one quarter of this can be converted into bombarding electron current. The power of bombardment of such a 2,500,000-volt impulse generator, then, would be a little less than one horsepower.



A blast of electrons from the bottom of the tube produces a strong, spectacular luminosity in the air

This power may not appear to be large, but when concentrated into a beam of electrons, it produces spectacular effects. A thin metallic foil can be placed on one end of the tube so that the vacuum is preserved. A small amount of residual gas in the tube becomes ionized by the discharge, liberating large quantities of electrons which shoot through the tube, traverse the thin foil and escape into the air. In this manner, beams of electrons can be shot many feet and can be seen as a blue glow in the air. If the electrons are allowed to strike a calcite crystal, it will fluoresce, giving forth bright orange light, with the same brilliance as a 40-watt electric lamp. Given one impulse, it will glow, or phosphoresce, so strongly that, after one hour or more, one may read by the light which it still emits. Although the electrons will traverse the thin metallic window without doing any damage, if they are allowed to strike a thick metallic plate, they will blast out large craters.

The impulse technique has been regarded in the past as a spectacular offshoot of physics. Its ability to do good work was questionable in the face of such competition as that offered by the cyclotron and the Van de Graff generator. At present, however, scientists are mulling over the possibilities of a Brasch and Lange tube supplied by a 10,000,000-volt surge generator which it is now quite possible to construct.

Let us consider one or two of the things which could be done with such an apparatus. It has important biological prospects due to its ability to accelerate electrons. In the treatment of tumors by means of X-rays, the biological action of the rays has been thought to be due to the fact that they knock out secondary electrons as they traverse the tissues. It is these electrons, and not the X-rays, which presumably produce the desired effect. Unfortunately, it has heretofore been necessary to go through all the roundabout business of accelerating electrons, bombarding a target, producing X-rays which can penetrate the tissues, and finally liberating other electrons which do the actual work. Producing both X-rays and subsequent secondary electrons is a very inefficient process. For this reason, a better way to approach the problem is to have a source of electrons which are fast enough to penetrate the tissues directly. This method is also superior because electrons can be focused by the use of electron "lenses," while X-rays cannot be focused by any method which has thus far been discovered by science.

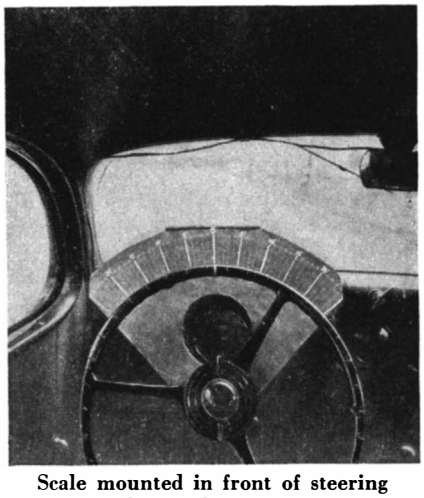
PRELIMINARY experiments with a 2,000,000-volt surge generator are at present under way in the high-voltage laboratory of the California Institute of Technology, at Pasadena. One object of these experiments is to try the effect of improved methods of making protons, to see whether they can be accelerated in the same large quantity as electrons. If this can be done, another important use for the impulse method presents itself. In 1933, it was discovered that, by bombarding certain nuclei with atomic particles, a sort of hybrid nucleus could be built up which was unstable and soon broke down in much the same way as do the nuclei of the naturally radioactive elements such as radium. This process is called artificial radioactivity. A use was soon found for this discovery. Small quantities of these artificially radioactive substances can be prepared and formed into chemical compounds. They may then be put into a living organism and their progress through the organism can be traced by following the course of the radioactivity with electroscopes or other detecting instruments. By the use of these biological tracers, much valuable information about the chemical behavior of living things has been obtained. The difficulty lies in producing large quantities of these radioactive substances. With sufficiently powerful charging equipment, the impulse generator can be speeded up to obtain several discharges per second. With a few hundred amperes of protons at each discharge, the Brasch and Lange tube will be a good source of biological tracers.

For Better Roads

Extensive Studies of Present Highways . . . Visibility . . . Grades . . . Curves . . . Traffic Quantity, Quality, Speed . . . Data Aid Future Planning

By THOMAS H. MACDONALD
Commissioner of Public Roads

SINCE the Federal government created the Office of Road Inquiry in 1893 to advise farmers how to build better roads, studies have been made continuously to learn how to build stronger and more durable surfaces. There have been few discoveries that have attracted widespread public notice, but progress has been continuous. Much of the work has been done in laboratories from which there have poured unending streams of small improvements that have completely changed the quality of our road surfaces. For example, the concrete roads built today



Scale mounted in front of steering wheel indicates degree of curvature

have twice the strength of the concrete roads of the same thickness built 15 or 20 years ago. The hit-or-miss construction of surfaces with gravel, sand-clay, and similar materials has been replaced by use of materials of known quality, and new methods of finishing these surfaces with bituminous materials produce smoothness and riding comfort of the first quality.

Within recent years, both the highway program and the field of highway research have been greatly broadened. The end of the pioneer period of road construction has been reached. During the pioneer period the main objective was to place a surface of some kind on the network of main highways. This job has been completed but the enormous increase in volume of traffic and in the speed of vehicles has brought about the necessity for modernizing many of the roads built in earlier years. There is need for surface widening and road straightening to improve sight distances and eliminate sharp curves. Grades need to be eased, grade crossings must be eliminated, and many other improvements must be made to bring our highways up to the standards required by modern traffic.

Attention can no longer be centered on the main rural highways alone. The congestion, delay, and accidents on approaches to cities and on the main routes through them make it imperative that city and suburban improvements be provided without delay. At the same time, many secondary roads must be surfaced to connect agricultural areas with main highways.

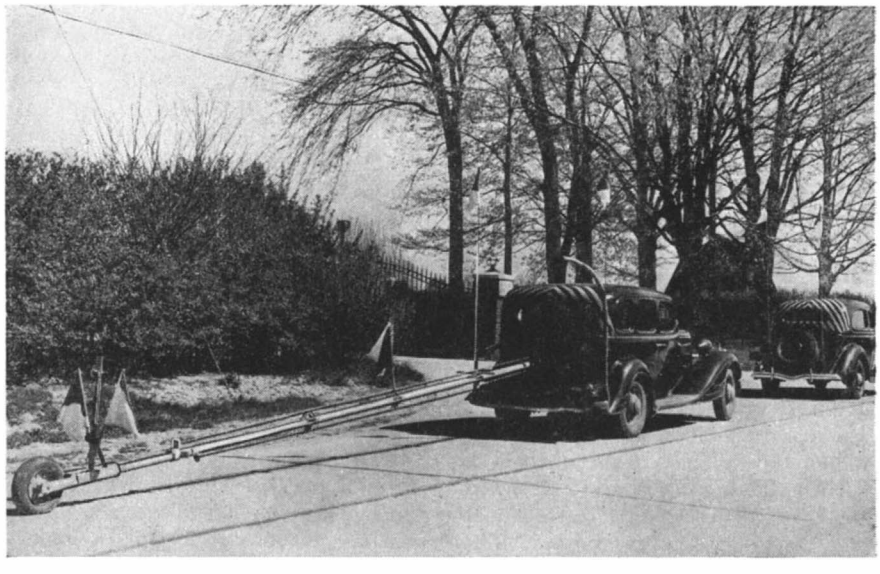
THE problems before highway administrators are complex. To aid in their solution the Public Roads Administration is co-operating with 46 state highway departments in conducting highway planning surveys. All highways are being mapped and detailed data are being collected on their condition of improvement and the volume and character of traffic over them. Studies are being made concerning the source of highway funds and how the funds are used. It is intended that these data be used in planning future highway improvements on a scale that will be adequate for future traffic and that the program be conducted on a sound and economic basis.

Special studies are being made to derive information to be used in establishing standards for surface width, traffic capacity, and sight distance. There have been many technical discussions of these subjects, but lack of data on the characteristics of vehicles in motion has clouded conclusions. Apparatus now in use is rapidly supplying the needed facts.

Efficient management of the 46 state highway planning surveys has required the rapid development of instruments to aid in collecting large quantities of field information quickly and cheaply.

A first requirement in the planning surveys was to inventory the existing highways to find where they were deficient in width, in surface type, in alinement, or in any other respect. Cars used in the inventory were generally equipped with special odometers reading directly to hundredths of a mile or with "footometers" in which a trailing bicycle wheel records distance in feet on a dial mounted inside the car.

Practically every mile of rural highway has been surveyed for excessive



Somewhat unwieldy but effective is this trailer boom developed in Michigan for measuring degree of curvature. Swing of the boom is registered within the car

grades, and those of 5 percent or more have been located and both the percent of grade and length measured. The varying grades common on hilly secondary roads were measured by approximation only, generally by sighting from the bottom to the top of the grade, using a homemade substitute for a hand level called the "grade board." The uniform grades found on primary roads were measured accurately and directly by a commercial instrument which had been developed for use as an accelerometer. This instrument, when mounted in a transverse plane, gave precise determinations of the rates of banking on curves.

Measurements of curvature presented somewhat more of a problem. The simplest and cheapest device, is designated as a "curvometer." This device consists of a calibrated scale mounted behind the steering wheel. Somewhat greater precision was obtained in some states by the unwieldy yet effective trailer or "trailer chord." The boom or chord swings behind the car in traversing a curve, and the amount of swing

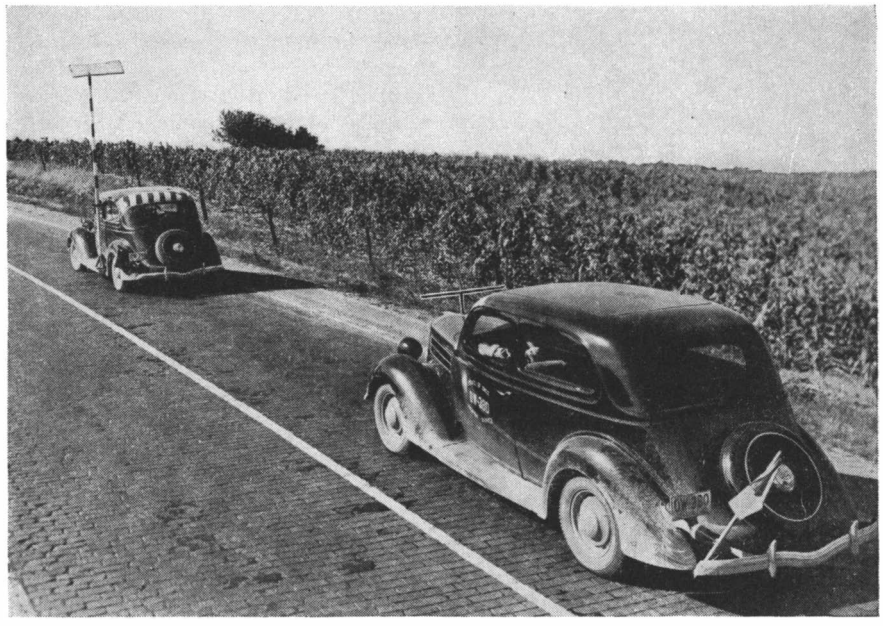
Permanent automatic traffic counter installed on a road in Maryland

is shown on a scale calibrated to read directly the degree of curvature.

One or two states adopted the aviator's directional gyroscope to determine curvature. This device, mounted in the front compartment of a car, shows the change of direction in rounding a curve; and the length of curve is shown by a "footometer." The degree of curvature can be calculated from these data.

One of the states most recently undertaking the work of measuring critical highway features has benefited from the work of earlier investigators and has incorporated a "footometer dial," a directional gyroscope, and an altimeter in such relative positions that all may be photographed by a permanently mounted camera at desired intervals, thus obtaining several types of data at the same time.

A means of measuring the distance the highway ahead can be seen, or "sight



Sight distance is measured by these two cars 1000 feet apart. At that distance, rear car's horizontal rod will cover all checkered spaces on other car's rod

distance," was developed early in the surveys and has been used almost without change in nearly all the states. The problem was to locate and measure the length of all sections of highway with sight distance less than 1000 feet and to determine the shortest sight distance on the section. Two cars are required, the front one being equipped with a specially designed stadia rod. A rod, mounted on the front of the following car, is of such diameter and at such height as to cover the entire stadia rod when seen by an observer seated normally in the front seat with the two cars separated by 1000 feet.

The two cars thus spaced proceed along the road until one disappears from the view of the other. The rear car is then at the beginning of a substandard section. By a similar procedure the end of the section is located. The difference in readings of the odometer at the beginning and end of the section gives the length.

WITH means provided for determining road conditions, the next step was to devise apparatus for use in studying how the roads are used. Measurement of the service a highway renders is important in deciding how well it should be improved. The permanent type of automatic traffic counter, developed by the Public Roads Administration, has satisfied this need. Installed at nearly 500 locations on both primary and secondary roads throughout the entire country, these instruments automatically count vehicles and detect the variation in traffic volume day by day and season by season.

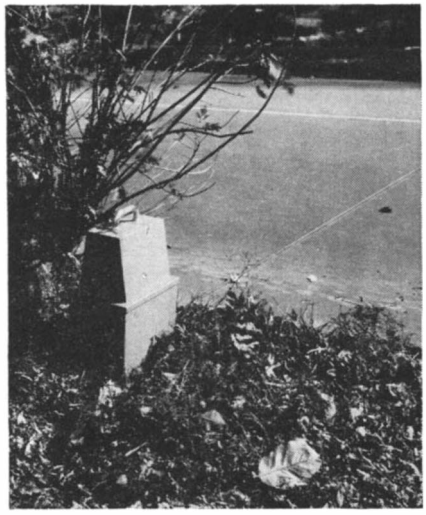
In the housing of each recorder, there are two photoelectric cells, on which light beams, placed on the opposite side of the road, are focused. When both the beams trained on these cells are interrupted by a vehicle, a circuit is energized, closing a relay which, in turn, operates an electric counter. The total shown on this counter is automatically recorded by a printing mechanism each hour. Both light beams must be interrupted simultaneously to actuate the mechanism. A pedestrian or cyclist, who cuts only one beam at a time, does not actuate the counter.

To supplement these permanently installed expensive machines, various types of portable counters have been developed, some by manufacturers and some by the Public Roads Administration. One of these counters is actuated by an electrical contact made in a strip laid across the road for detecting the vehicles. Vehicles passing over this strip close a circuit that, in turn, actuates the counter.

Engineers of the Texas highway planing survey have developed a portable counter in which a light beam actuates a photoelectric cell as in the permanent type, but current is obtained from a storage battery. This recorder uses a single light beam.

In cases where it is not necessary to know the traffic by hours, but only during the time the counter is installed, simple accumulating counters have been developed by the Public Roads Administration. In these, the passage of a vehicle actuates a pneumatic switch. A small rubber tube is laid across the road. As wheels pass over the tube, an air impulse passes through it and moves a diaphragm at its end.

In highway planning, there is need to know also the amount and kind of goods moving over highways, the weight of vehicles and their size. In the planning surveys, two separate types of weight studies were conducted. In one



Above: **A strip laid across the road actuates this portable traffic counter. When a car passes over this strip, an electrical contact is made, causing meter at right to register**

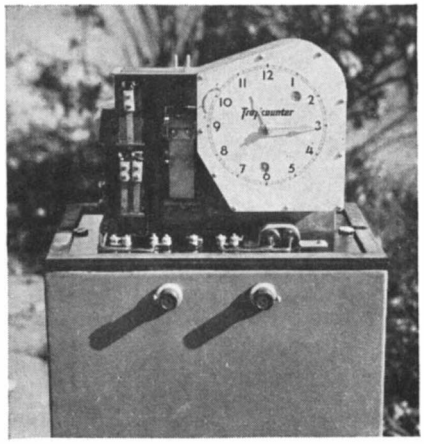
study, large-capacity pit scales were permanently located on a few representative routes in each state, and the weight, height, width, length, wheel base, and capacity determined.

An entirely distinct weight study was conducted on all the important roads in 46 states, using a commercial weighing device called a loadometer. In these studies, the flow of weight over the highway was desired to determine distances various agricultural commodities and manufactured products are hauled and in what proportion each commodity is found in the normal traffic. Such information is needed in discussing the economics of highway transportation and in determining the part the highway plays in the field of distribution of goods.

Special studies are being made to determine the capacities of highways of various widths, the times and distances required for passing maneuvers, and the normal driving practice under various highway conditions. The basic equipment used in all such studies by the Administration has been the graphic time recorder. Observers stationed at a key at each end of a measured section, close keys to actuate pens and record vehicles entering and leaving the section.

Data on vehicle speeds are useful for many purposes including highway design, enactment of legislation controlling speed, safety studies, and enforcement of speed restrictions. Observation of a considerable number of vehicles supplies these data. Highway capacity information, however, can be developed only from a study of the speeds of all vehicles on sections of highway. Field procedures, therefore, had to be developed to meet this requirement.

A new method has been developed that involves the use of an extremely ingenious speedmeter. This device has as its basic element a rotary stepping switch. This switch, similar to those used in automatic telephone switchboards, has a series of 50 points arranged in two tiers around the circumference of a semicircle. Each point is connected to one of a series of pens in a graphic-recording unit. A wiper arm, pivoted at the center of the semicircle, when energized by a self-interrupting magnet, sweeps over these points, always moving at a constant rate of speed. The action of the switch is

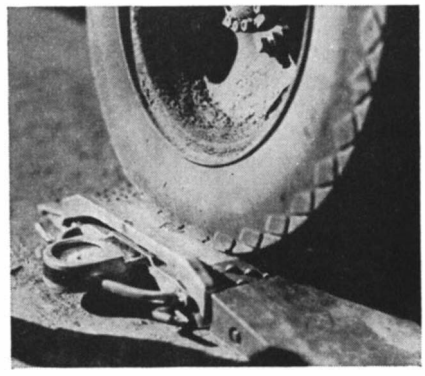


somewhat similar to that of a buzzer, but the arm, instead of moving rapidly back and forth between two points, moves ahead from one point to the next.

As a vehicle crosses a detector laid across the pavement, a relay is actuated and the switch starts rotating. As the vehicle crosses a second detector, generally spaced 24 feet from the first, another relay stops the switch momentarily and energizes the circuit connecting the point on which the wiper arm then rests and its corresponding graphic-recorder pen. The point the wiper arm has reached depends on the speed of the vehicle. The slower the vehicle travels the farther around the semi-circle the wiper arm moves before the second relay interrupts its motion. By noting the pen that has been thrown and referring to a conversion table the speed may be found immediately.

IN determining vehicle speed with the speedmeter, other apparatus has been used to record the transverse position of vehicles on the road surface. Positions of vehicles on the pavement are influenced by such factors as lane width, pavement strip markings, shoulder type and condition, and roadside objects as well as by the presence and speed of traffic in the opposite direction. Measurements of transverse positions were made with a contact detector laid on the pavement. This detector consists of steel strips held apart by a rubber arch similar to that used in refrigerator-door gaskets. As the vehicle passes over this detector, the arch is depressed, the strips are brought into contact, and an electrical circuit is closed. One of the metal strips is continuous for the length of the detector and acts as a common lead to all pens of a graphic recorder; the other is broken into 20 sections and an individual lead taken from each section. With these 20 sections connected to 20 pens of a graphic recorder, the transverse position of each wheel of a vehicle is recorded automatically.

A number of methods have been used to determine the time periods and distances required for vehicles moving at various speeds to pass other vehicles moving in the same direction, but none has been sufficiently inclusive to permit a complete analysis of the movements of all vehicles involved in all types of passings. Using graphic time recorders actuated by pneumatic road switches, the Public Roads Administration has



Portable loadometer used to weigh trucks to determine traffic loads

developed apparatus that makes a continuous record of the movements of all vehicles over half-mile sections of highway. Pens in six graphic recorders are connected to pneumatic detectors, each consisting of a rubber tube, covering one traffic lane with a pneumatic switch at its end. These detectors are spaced at 50-foot intervals on both sides of the road. In actual practice, a single tube is placed across the entire roadway but is plugged at the center line so that each half is an independent unit.

The charts in the machines used in these studies move at 36 inches per minute, to measure speed over the 50-foot section to closer than one mile per hour. With this precise speed measurement and an easily-interpreted record of the path of each vehicle, the determination of the exact times, distances, and speeds involved in all types of passing maneuvers is a simple but somewhat laborious procedure. These times and distances are essential elements in the establishment of sight distance requirements, but perhaps of more importance are the number and types of passings found in the normal highway traffic. The conditions under which passings occur both as to sight distance ahead and position and speed of other vehicles are of great importance in designing safe highways.

GOETHE LINK OBSERVATORY

Built, With Its 36-Inch Telescope, by Amateur Astronomers of Indianapolis . . . Financed by Local Enlightenment . . . Presented to Science

By VICTOR E. MAIER

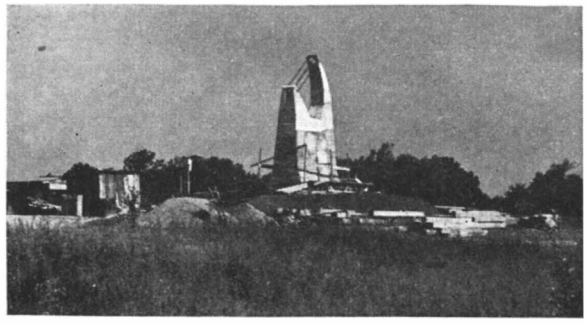
INTEREST in the study of astronomy has mounted with surprising rapidity as an indirect result of the publication, some years ago, of Scientific American's volumes, "Amateur Telescope Making" and "Amateur Telescope Making — Advanced." Comparatively few persons realize the important part these books are playing in connection with the science.

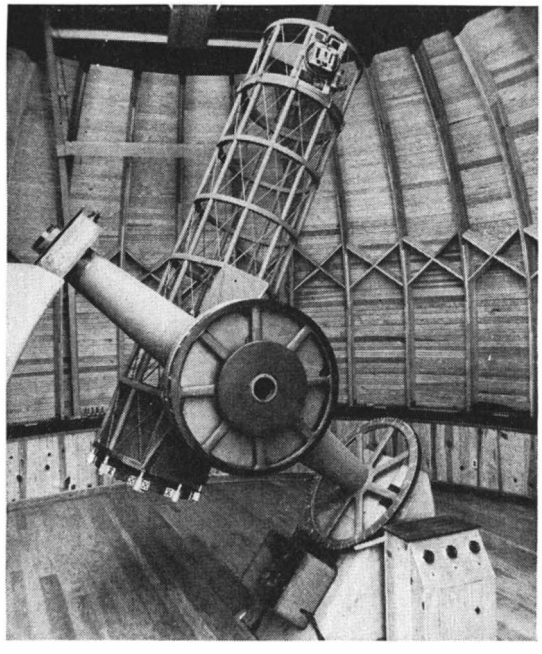
Among the many achievements of the 10,000 amateur astronomers who have made their own telescopes, most of them beginning with instruments six inches in aperture, is the new Goethe Link Observatory, at Brooklyn, near Indianapolis, Indiana, with its 36-inch reflecting telescope and five-inch auxiliary instrument. This observatory was founded, financed, and permanently endowed by Dr. Goethe Link, an Indianapolis surgeon. The large telescope was built and the observatory erected for the most part by amateur astronomers in the Indianapolis area. Its equipment has been offered free of charge to those who can best use it, especially to the colleges and universities in the vicinity of Indianapolis. Indiana University has supplied a research fellow to work full time at the observatory, which has also been visited by professional astronomers from all over the nation. It is also open to the general public on Sundays.

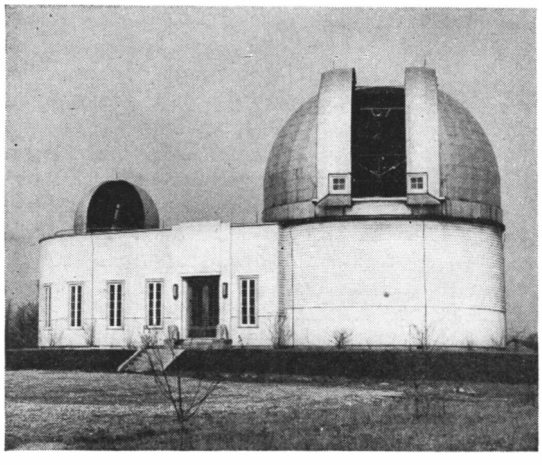
Right: Constructing the massive 30-foot, 200-ton concrete telescope pier

Center: **The main telescope, constructed by Indianapolis regional talent**

Bottom: **The observatory houses two telescopes, lecture room, workshop**







The idea had its start about six years ago when Samuel Waters, president of the Indianapolis Amateur Astronomers' Association, was giving informal lectures to the people of Indianapolis at the backyard site of his homemade telescope. Dr. Link, believing there was enough talent in the community to build a large observatory, set about to finance such an institution and work began.

Carl Turner, a mechanical engineer, of Indianapolis, obtained from the Corning Glass Works a 36-inch ribbed Pyrex mirror disk for Dr. Link. A machine for grinding the mirror disk concave and polishing it was built by Mr. Turner, who also undertook the construction of the mounting for the telescope. The task of finishing, or figuring, the spherical mirror disk to an accurate paraboloidal form was given to Charles Herman and V. E. Maier, both Indianapolis amateur telescope makers. The processes used were similar in principle to those set forth in the book "Amateur Telescope Making," the bible of the hobby, except that the disks of glass used as grinding tools for the main disk, instead of weighing about two pounds, as in the case of the average beginner's telescope of six-inch diameter, weighed 200 pounds. The same difficulties which perplex but fascinate the amateur who works on smaller mirrors were eliminated one by one until the mirror looked satisfactory under the delicate Foucault knife-edge test, which easily measures reflecting surfaces within an accuracy of at least one 500,000th of an inch.

After 30 months of work the mirror was approved and coated in a vacuum with aluminum, the newer kind of reflecting film which has supplanted the more familiar film of silver. In the meantime, work on the other parts of the observatory project has been practically completed.

The total weight of the larger dome, 34 feet in diameter, is 34 tons. The lower floor of the building, between the domes, contains an auditorium seating 150 persons, a dark room, astronomical laboratory, workshop, and a heated study room.

Especially interested readers and amateur telescope makers will find technical details on page 376.

Ghost Forests

Insects, Number One Forest Enemy . . . Make Ghosts of a Vast Number of Trees . . . Bark Beetle Heads the List . . . Other Insects, Man Combat the Pest

By RUTH RINGLE

CONTRARY to popular belief, the Number One enemy of the forest is not fire but insects. In the year 1932, for example, less than 50 million board feet of timber in California were destroyed by forest fires, while pine bark beetles ravaged 1500 million board feet! In the ten years between 1926 and 1936, the State of California, alone, lost $200,000,000 worth of timber through the activities of these insects.

One day there is a majestic forest of whispering pines, a wealth of scenic beauty as well as of timber. An infestation of bark beetles moves in, and in a few weeks many of the trees are dead; in some areas a whole forest of pines will become white, lifeless ghosts.

Pine bark beetles are not alien enemies that have slipped into our forests, unchecked by natural enemies. They are a native menace. For centuries bark beetles have periodically laid waste to pine forests, and in about 150 years a new forest would take the place of dead trees. Such is Nature's deliberate and protracted plan.

The destruction of great trees in their prime may suit Nature's plan, but it is disastrous to men; they cannot wait 150 years for natural replacements of the bark beetles' undoing. We also resent the esthetic and recreational loss to vacation lands.

Suppose a man buys a section of forest land as a summer home for his family. They build a cabin beneath the pines and spend one health-giving, happy summer there. The next year they return and find their trees dying. Bark beetles have ruined their investment in vacation resources. This family would not be philosophical about Nature's long-range plan.

Perhaps a few men pooled their savings and bought a rich stand of pine forest which they planned to harvest in true timber-conservation procedure, insuring not only a life income for themselves, but also a rich bequest to be handed down to their children. Then, before a single log had been cut, an epidemic of bark beetles swarmed in and changed their valuable forest to dying trees. There would be no consolation in the fact that Nature would replace the trees in 150 years.

The Bureau of Entomology and Plant Quarantine of the United States Department of Agriculture has tackled this problem in a thorough and practical way the last few years. They have set a corps of entomologists to study the bark beetle, learn its life habits, its friends and enemies, and decide on the best method of control.

THE western pine beetle, *Dendroctonus brevicomis Lec.*, and the mountain pine beetle, *Dendroctonus Monticolae Hopkins*, are the worst transgressors in ponderosa pine and sugar pine forests. These beetles are always endemic, constantly at their nefarious work, and only waiting for favorable conditions to become epidemic. Bark beetles fly to a pine tree and bore holes through the outer bark to the living tissue, the cambium layer which carries the sap or life blood of the tree, rich moisture, resins, and dissolved sugars. At first, the beetles are forced back by the protective flow of pitch, but so many attack a single tree at one time — literally thousands — that within a few days all the sap is exhausted and the tree can no longer fight against its enemies. Then the beetles move in. By pairs, they start boring tunnels through the living tissue of the tree, with a pocket-crib every so often in which the female deposits eggs. Soon the cambium layer is a network of these tunnels.

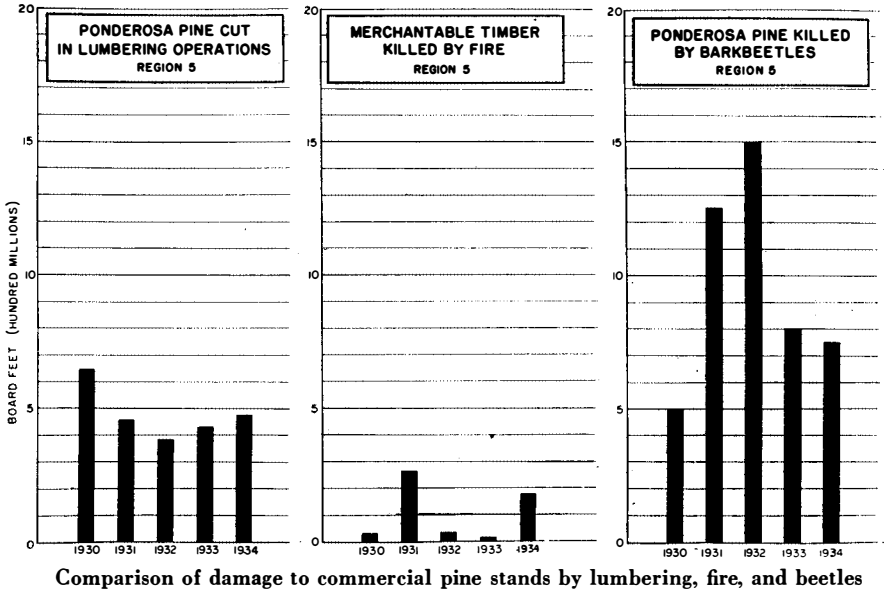
The eggs hatch into larvae which feed on the sugars and other substance of the dying cambium tissue, then become pupae. When growth is completed, the young beetles bore their way out of the dead tree, fly to another living host, and begin a new generation.

When endemic, beetles usually attack only trees which have been weakened by some other cause such as lightning or the attacks of other insects. The largest trees, also, when fully mature, do not have the tonicity to fight the bleeding tactics of beetles, so the most magnificent specimens of pine are constantly prey to bark beetle infestation. Young trees, however, are so tenacious — continuing a drenching flow of pitch — that beetles avoid them, except when the insects reach an epidemic stage. Then all trees are invaded.

Soon after the insects enter, the tree is no longer able to draw enough moisture and food elements to sustain life, and the pine needles turn to a sickly yellow, then a yellowish brown, and finally, before the needles fall away, to a red, rusty stage. The dead, whitened trees may stand for some years before they fall.

Besides being a scar of ugliness, these dead trees are a menace to neighboring forests. Dead trees magnify the danger of fire, from whatever cause, by providing added inflammable material to that already on the forest floor.

If logged within a few weeks after a bark beetle attack, trees can be salvaged for some lumber uses, but after about six months, the timber is worthless. The wood by that time is honey-combed by other insects. A fungus-caused "blue stain" discolors the tissues, and dry rot



Comparison of damage to commercial pine stands by lumbering, fire, and beetles

rapidly turns tough fibers to dusty pulp.

The problem of how to control the attacks of bark beetles was approached from two angles: surveys and laboratory research. By surveying the condition and number of beetles and other insects, and considering the weather factors, it can be fairly well determined whether or not an epidemic is imminent. If so. immediate control measures can be instituted.

IN the mountains east of Fresno there is an unusually fine stand of sugar pine, the most valuable timber material in the forest. This area was recently surveyed. Ground crews marked and mapped all infested trees in this forest while a supplementary reconnaisance from an airplane spotted dying trees by their red crowns. Then insect control crews entered these areas and felled all infested trees, many of which were over six feet in diameter and about 500 years old. The bark was stripped from each felled tree to expose beetles and larvae; then bark and log were set afire. Felling and burning trees that are hosts to beetles has been the most successful method of control so far discovered.

Three years ago the Bureau of Entomology and Plant Quarantine established two field research laboratories in the heart of pine forests, one near Yosemite National Park and the other near Lassen National Park. Bark beetles have received the primary attention at these laboratories because they are the most serious problem. Healthy trees were screened and beetles introduced so that the scientists could observe the actions of the beetles and the reaction of trees to the attack.

Then predators, enemies of beetles, were admitted to this living laboratory, and researchers had a ringside seat at a major forest bout. But it wasn't much of a fight, for bark beetles hardly raised an antenna in their own defense when attacked by a green trogositid or red-bellied clerid, their natural enemies.

A red-bellied clerid is about twice the size of the bark beetle he attacks, and he approaches his prey without hesitation, flips it over on its back and nips the beetle in a vulnerable spot. Then he proceeds to make a meal of his victim. The female clerid lays its eggs in bark crevices near holes bored by pine beetles. When these eggs hatch, the young clerid larvae crawl into the tunnels in search of bark beetle larvae on which they feast. This appears a perfect setup for adequate natural control of bark beetles. But beetles have one advantage; they outnumber their enemies and breed two or three generations to the clerids' one.

Forest entomologists are breeding both green trogositids and red-bellied clerids in their laboratories to determine the feasibility of large scale artificial rearing of these predators as a method of beetle control. These preying insects need careful raising, and as they breed but one generation a year, it is difficult to get enough trogositids and clerids to be effective against bark beetles in large areas.

Another factor in favor of the beetles is that clerids and trogositids do not depend solely on bark beetles for food. They like a varied diet, so that even if the predators were not outnumbered by the beetles, they could not be depended on to wipe out the pests. However, entomologists are still working on the problem and hope to find a way to breed these predators more economically and abundantly, or to discover other more practical and effective parasites or predators. Somewhere else in the world such a parasite may be found.

Other methods of control have been tried. Toxic oils that seep into bark and poison the insects and larvae are successful on thin-barked trees, but as pine bark beetles usually attack trees with thick bark, toxic oils are no threat to them.

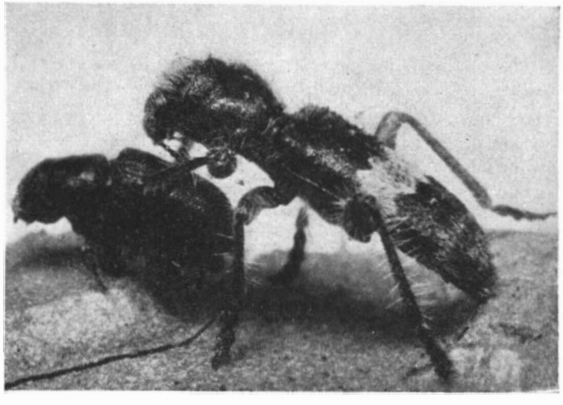
Entomologists are studying a bark beetle disease, an organism on the borderline between plant and animal life which sometimes wipes out an epidemic of beetles, but little has been learned. If this plague could be introduced by foresters when an epidemic of beetles threatened, it might be the simplest method of control.

It will probably never be possible to wipe out bark beetles completely, but even the control program now in use, felling and burning infested trees, if applied thoroughly and consistently, would prevent devastating epidemics. Wherever this method has been used, it resulted in a loss-reduction of 50 percent to 80 percent.

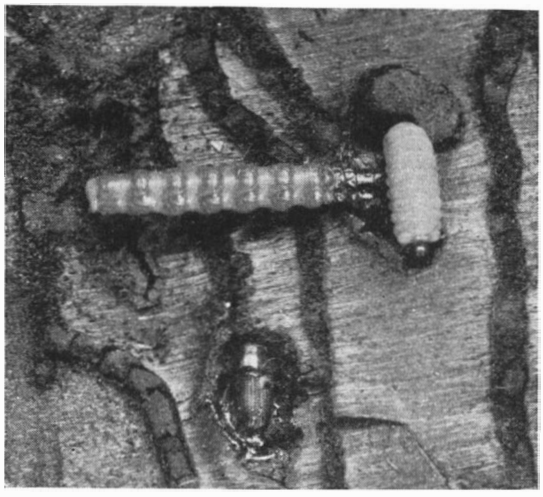
Aside from the loss of trees, these depredations of beetles entail further problems. Trees, above all things, are a natural control for floods and excessive soil erosion. Pine forests are an important part of our national wealth, and are the basis for many industries and jobs besides those of actual lumbering operations. But who can measure the esthetic loss? Great trees have been the inspiration of men since life began. And thousands of Americans seek refreshment and rest every summer in our forests.

Foresters agree that an effective control program must include plans for thorough and basic research, must be sufficiently wide in scope to include any territory from which infestations could migrate, and should provide for sustained effort over a period of years.

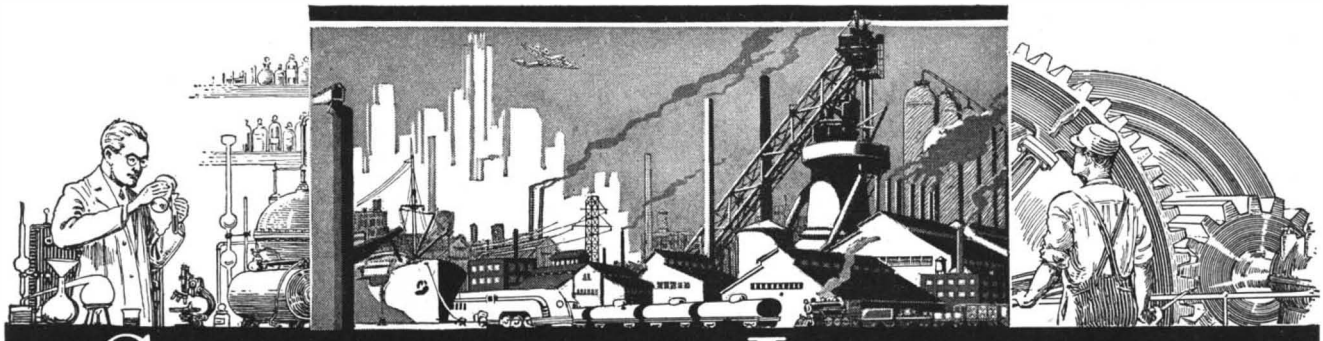
A forest of ghostly gray trees, all killed by an attack of vast numbers of bark beetles on the cambium layer of bark



Bark beetle in the grip of one of his natural enemies, the red-bellied clerid, which devours both the bark beetle and its larvae



Lower left: **Clerid larva feeding on beetle larva in tunnels beneath tree bark**



SCIENCE AND INDUSTRY

A MONTHLY DIGEST

Conducted by F. D. McHUGH

Contributing Editor
ALEXANDER KLEMIN

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

Indian Arrow Poison For Arthritis, Mental Disease

TWO powerful poisons, cobra venom and curare, the old Indian arrow poison, have been put to use in healing two widespread human afflictions — arthritis and the mental disease schizophrenia.

In schizophrenia, the Indian arrow poison protects patients from injury during metrazol convulsions which are used to shock them back to sanity. Good results with this combination of curare and metrazol are reported by Dr. A. E. Bennett, of Omaha, in the *Journal of the American Medical Association.* Dr. Bennett cautions against general use of the poison with metrazol until further experiments have been made. He has also been using it "with encouraging results" in treatment of children suffering from spastic paralysis.

Deadly cobra venom injected into the muscles of patients suffering from neuralgia and various rheumatic conditions caused slight or moderate improvement in a little over half the cases, Drs. Otto Steinbrocker, George C. McEachern, Emanuel P. La Motta and Freeman Brooks, of New York City, report. Other methods of treatment had failed to relieve almost all the patients. Patients with rheumatoid arthritis were helped more by the cobra venom treatment than those with other complaints. The venom was first given in small doses as recommended by Dr. D. I. Macht, of Baltimore, but larger doses were soon found necessary. — *Science Service.*

Enamels for Plastics

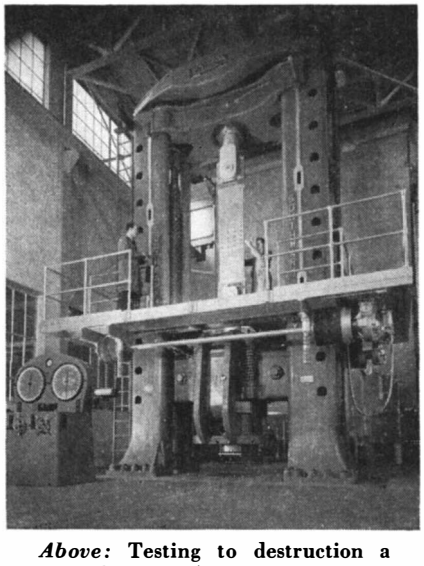
THE wide use of plastics in bulk for such things as radio cabinets, electric iron handles, and the like has long posed a problem to researchers. To put color in these plastics, expensive pigments are necessary. Yet Sherwin-Williams Company chemists felt that the color need not go deeper than the surface. They set about finding enamels that would do the trick, and have recently announced one called Kem Bakolescent in the irridescent form, and Kem Plastite in solid colors. These enamels work where formerly no coating would adhere to the smooth, greasy surface of plastic moldings.

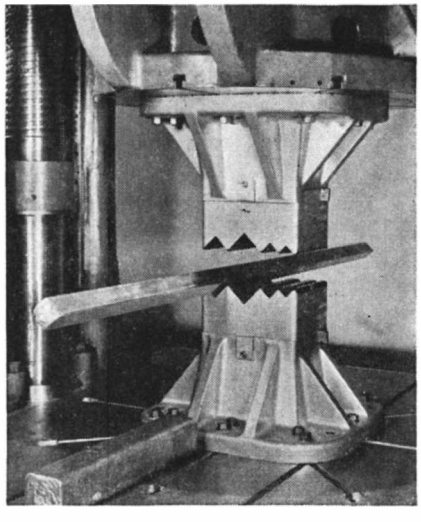
These new enamels can be dipped or sprayed on plastic parts, and combine any color of the rainbow with an extraordinarily long-wearing surface. Moldings which are now being finished with these new coatings are for vacuum cleaners, electrical wiring devices, and automobile parts.

Most Powerful Testing Machine

A NEW type of precision metal working machine, which is also the world's most powerful testing machine, was demonstrated recently at the Aluminum Research Laboratories.

This huge piece of equipment, called the Templin machine after R. L. Templin, chief engineer of tests of the Aluminum Company of America, is capable of exerting a force of 3,000,000 pounds in compression and 1,000,000 pounds in tension. Research executives point out that while it is not the largest machine of its kind, it is the most powerful, for it can exert these forces at speeds up to 36 inches a minute — faster than any other testing machine, and, since power equals force times speed, the claims made for the machine are evident.





Above: **Testing to destruction a riveted joint (in center of picture).** ***Right:*** **Press forging an aluminum ingot in the same machine**

The new machine, built by the Baldwin-Southwark Corporation, can be operated as an extrusion, forging, or forming press. In addition, it is provided with auxiliary equipment which will permit defining, within close limits, the relationships existing between the various forces involved in the plastic flow of aluminum throughout a wide range of conditions.

The over-all height of the machine is 40 feet, 4 inches, of which 25 feet is above the floor line, the rest below. It is 16 feet, 4 inches wide and 9 feet front to back.

Nodules for Insulation

HARD-SHELLED, light-weight nodules of processed and puffed clay that have been produced by the Kraus Research Laboratories are being used in several types of insulation. They may be used as a filler in building blocks, hollow tile, stucco, wall plaster, partition boards, and the like.

These nodules, which may average a quarter of an inch in diameter, are made of fatty clay or shale having high carbon content. If the clay or shale is deficient in carbon, the manufacturers add a solution of glucose, pitch, or soft coal finely ground, as gas forming substances. Sometimes it

is necessary to add Bentonite as a plasticizing agent, this material acting also as a flux. When heat is applied, the semi-plastic body stretches into a balloon-shaped piece because of the confined gases from the carbonaceous material. When properly heated the surface is glazed to a hardness that will withstand pressures used in the process of making building blocks.

90MM ANTIAIRCRAFT GUN

TO supplement the Army's 3-inch antiaircraft gun, a new 90mm weapon was recently announced by the War Department. Some comment regarding this has appeared in the daily papers but so far no technical details have been released for publication and probably will not be released. The size of its shell, 90mm, or slightly over 3.54 inches, will indicate its increased power over that of the three-inch.

Both the gun and its ammunition have undergone technical and engineering tests and have been standardized. Hence, some of these guns will be procured instead of three-inch type which are now being manufactured under current appropriations.

ROOF WATER COOLS

SINCE the time when primitive man finally crawled out of his cave home to conceive a habitation of his own creation, centuries of effort and millions of dollars have been expended in draining rain and snow water from rooftops.

Not until our present civilization and the recent developments of air conditioning did man begin adapting water as an insulation and seek means to hold it captive on roofs to turn back the sun's heat in summer and reduce the escape of inside heat in winter.

For the builders of commercial and industrial structures, the Koppers laboratories in Pittsburgh have developed roofs which are capable of holding pools of water for insulation. They have been found to reduce the temperature in upper stories as much as 10 degrees in summer. This is as great a change from outside summer temperature as has been found healthful in air conditioned buildings.

Structures with air conditioning, too, are using pool roofs because they make it unnecessary to dispose of water once it has circulated through the system. Now it can be pumped to the roof, cooled of its absorbed heat, and re-used over and over again.

RUBBER

ACCORDING to the *Chemical Digest*, of Foster D. Snell, Inc., "rubber" supplies are about 1 percent synthetics, 28 percent reclaim, and 61 percent crude rubber.

IT STARTED WITH MAGGOTS

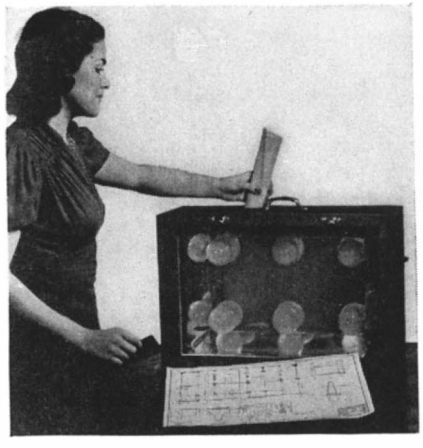
DURING the World War it came to the notice of medical men that bad wounds that became infested with squirming maggots of the blowfly healed much more rapidly than the same type of wound uninfested. Search for the reason finally centered upon a secretion of the maggots called allantoin. Further study found that one constituent of allantoin was the effective curative agent. This chemical was urea. Now it has been found that a still simpler chemical, ammonium bicarbonate, has the same effect as urea. Ammonium bicarbonate is formed naturally from urea by the action of an enzyme, urease. A 1 percent solution of this chemical is effective whether used as a wet pack or for irrigation of an open wound. Some of the conditions cleared up by the new treatment were: chronic osteomyelitis, diabetic and varicose ulcers, middle ear infections, stitch abscesses, infected lacerations, and other purulent wounds.

PORTABLE PRINTER

A NEW portable printer, announced by the Ozalid Corporation, was designed to use positive printing, dry developing Ozalid sensitized papers and cloths. It is claimed that it will reproduce engineering drawings, letters, reports, maps; in fact, any pencil or ink lines, typewritten or printed matter appearing on one side of a reasonably translucent sheet.

The light source consists of six specially developed lamps. A new feature is a dry developing chamber, which is conveniently located behind the metal reflector, utilizing the heat generated by the lights to vaporize the developing agent.

This light and portable unit can be carried from place to place, and used either in



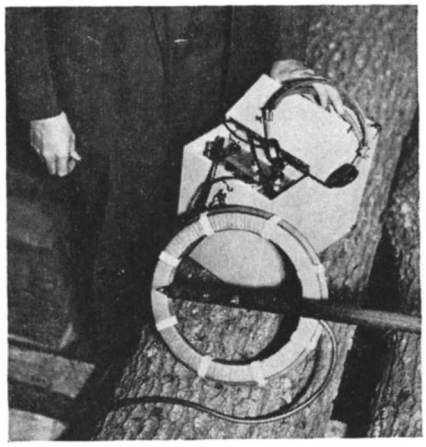
Printer, lid removed to show lights

the office or in the field on the job. Since no moist surface developing solutions are used, no washing, fixing, or drying is required. In an office, prints can be conveniently made at a moment's notice by any office employee. The cost of making prints on the Elpro Portable Printer is but a fraction of the cost of making such reproductions by other photo-copy methods.

TO DETECT METAL BURIED IN LOGS

A DEVICE for detecting spikes and other metal objects buried in logs has been developed by the Forest Service, U. S. Department of Agriculture. Metal objects in logs are potential causes of costly and sometimes fatal saw-smashing accidents.

The device was developed for use in connection with lumbering operations in New England, because an unusually high percentage of "blow down" timber in some sections hit by the 1938 hurricane was found to conceal old fence nails, hammock hooks, spikes, abandoned sugar sap spouts,



Exploring coil and detector box of device for locating hidden metal

and even sections of forgotten scythe blades. Near Vermont marble quarries miscellaneous bits of iron and rock, apparently blasted into the tree trunks and grown over, also have been found, as was a jackknife left perhaps by some initial-carver of other days.

The detector is easily carried by one man. When the exploring coil with which it is equipped is held near a log in which metal is imbedded, the device sets up a howl. By moving the coil the operator is able to locate the exact position of the buried metal. Armed with this information, the sawmiller then chops out the metal before the log goes to the saw and a possible crack-up.

The detector consists of a box about the size and appearance of a portable radio set, to which the flat, ten-inch exploring coil is attached by a six-foot, flexible wire. By means of a shoulder strap, the operator carries the box upon his hip so that adjustment knobs controlling batteries and circuits rest under one hand. The exploring loop, or coil, is handled with the other. Headphones are provided so he can better catch the detector's howl amid other sawmill noises.

When the instrument is turned on, an audio tone signal is set up in the headphones. By twisting the knobs, the operator balances out the signal. When the exploring coil is brought into the vicinity of any metallic object the balance is disturbed and the audio tone signal is heard anew.

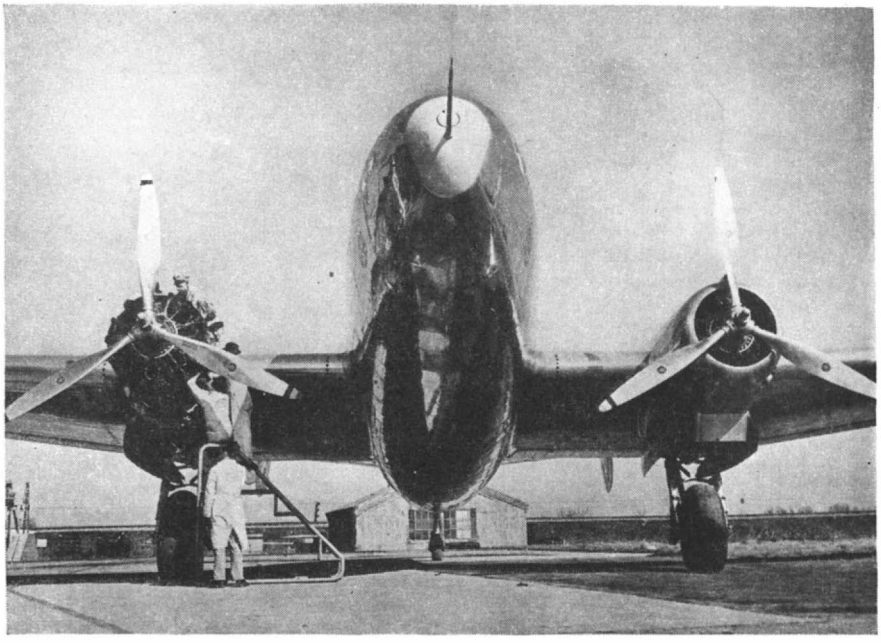
PEANUT BUTTER

THE oil does not separate from peanut butter when 2 percent of glycerin has been added. Glycerin is, of course, a food.

2000 DEGREES FAHRENHEIT—PORTABLE

A GENERAL utility torch of improved design has been introduced by the Utilitorch Company. Primarily designed as a weed burner, it also serves as a disinfecting torch, tar-pot heater, and pre-heater for welding.

Due to the fuels used — kerosine, distillate, stove and fuel oil — the coils on previous units became clogged with carbon and required frequent replacement. How-



Bow and side views of the largest twin-engine airliner

ever, a specially shaped generator on the new unit, known as the Utilitorch, provides easy cleaning by simply removing the generator shell and reaming out the carbon. Also, the new generator allows a more uniform application of heat to all the surfaces, giving greater fuel breakdown, more heat, and less carbon formation.

Both the generator tubes and generator shells are made of Inconel to withstand heats in the neighborhood of 2000 degrees, Fahrenheit. The Utilitorch is available in five models from the standard hand model to the giant model for tractor and truck attachment for burning weeds along highways, irrigation ditches, and canals.

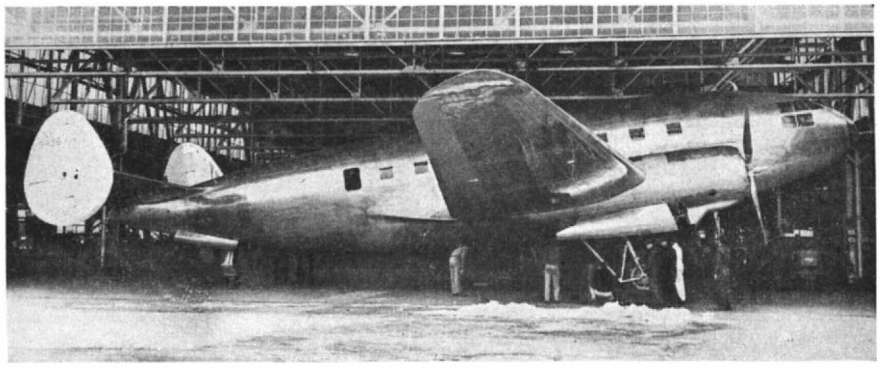
Largest Twin-Engine Airliner

MANY airline operators are of the opinion that to build four-engined planes is to lose operating economy; that two powerful engines give all the safety and reliability necessary; that a twin-engined plane will be more economical to operate, besides being cheaper initially. The experienced executives and engineers of the Curtiss-Wright Company hold the same opinion and have backed this opinion with the expenditure of perhaps a million dollars in the construction of a fine twin-engine machine.

The specifications are, briefly: 108 feet in span; 75 feet in length; 38,000 pounds in weight, fully loaded; 1000-gallon fuel capacity; 36 passengers by day and 20 in berths at night; two 14-cylinder Wright Cyclone engines with 15-foot propellers; top speed, 243 miles an hour; cruising speed, 210 miles an hour at 10,000 feet altitude.

We have become so accustomed to the fact that transport airplanes provide more luxurious accommodations than the best Pullman that it is hardly necessary to speak of comfortable and adjustable reclining chairs, sound-proofing, ventilation, heating, and so on. Let us concentrate rather on some of the novel features in the design of this new aircraft.

The airfoil has been so modified at the tip that aileron control can be retained below the stalling speed. Thus the plane can execute a three-point landing at minimum speed without "falling off on one wing." The flaps installed inboard of the ailerons move directly aft during take-off to improve the run and subsequent climb. On landing they are also revolved downwards to accomplish air braking. Blind flying technique will be further extended, and aircraft may then have to "mush" straight into the ground. In anticipation of such development, the gear is designed to permit landing with a rate of descent of 800 feet per minute, with the necessary cushioning provided by extremely long shock absorber travel.



The geometry of the landing gear has been so worked out that when the airplane is on the ground there is no possibility of the landing gear folding, even if the pilot applies power to retract it. As long, in fact, as the weight of the airplane is on it, the landing gear cannot be retracted.

It is a great help to the personnel to have only two engines to watch. To simplify their task further, Curtiss-Wright engineers have reduced the number of flight controls by one third. This has been accomplished with the aid of a "Tell-Tale" safety device which automatically checks the functioning of 50 major instruments, flashing a warning signal in one spot when any instrument is indicating a hazardous condition. To permit normal cruising at 20,000 feet with an equivalent "cabin altitude" of 6000 feet, pressure in the fuselage is obtained by the use of two centrifugal blowers in the engine compartment. An interesting aerodynamic innovation is to be found in the engine cowling. The air is introduced into the cowling at the front and circulated around the cylinders in the conventional manner. But after the air has done its cooling duty it is discharged through a single passage below the nacelle. It is reported that considerable reduction in drag is thus obtained.—*A. K.*

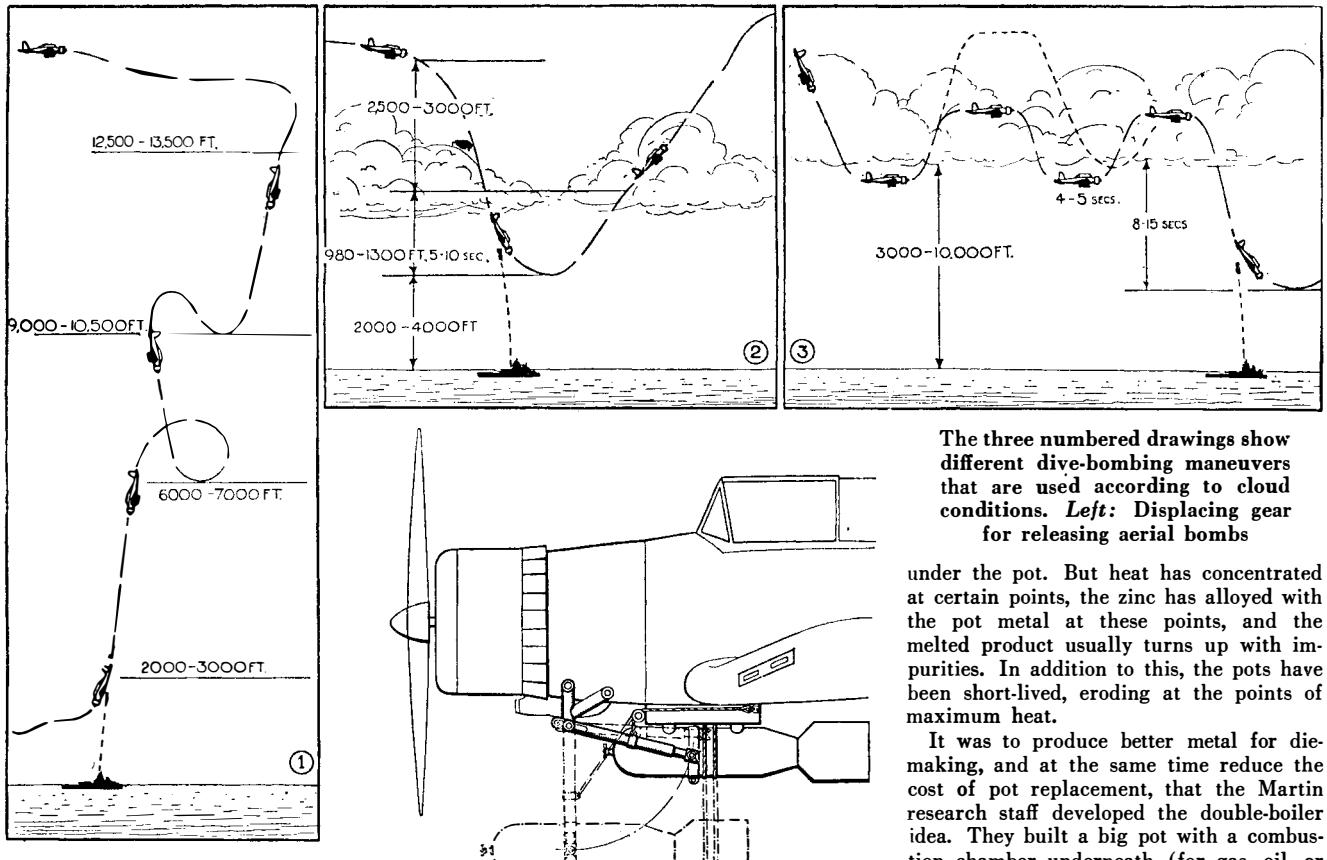
Safety Planes for Private Flying?

THE Civil Aeronautics Authority is doing a fine job in its various activities of safety regulation, aids to scheduled navigation on the airlines, training of college men in flying, and so on. But again and again rumors reach us from Washington that the C.A.A. will encourage private flying by sponsoring the construction of a miraculous safety plane, which will be cheap, efficient, and perfectly fool-proof. So good will be this new design that anyone taking flight instruction in the new safe plane will be permitted to solo or secure his first certificate in a shorter time than when using a more conventional machine.

Remembering the sad history of the $700 "flivver" plane, we pray that the Civil Aeronautics Authority will undertake no such adventure rashly. There is no such thing as a completely fool-proof plane and there never will be, just as there is no fool-proof automobile and never will be. Whenever an engineer deliberately undertakes the design of a "special safety" plane he fails. Safety of the airplane increases by evolutionary steps, slowly because each new idea has to pass through the various stages of laboratory experimentation, experimental construction, and long experience in service, before it can be fully accepted. Safety of aircraft advances always, but there can rarely be "jumps" or "sports" as the biologists term it.

Moreover, we are convinced from recent personal experience that the modern private plane is already remarkably safe, easy to control and maneuver. Quite recently, when given a chance to fly the Luscombe small two-seater, we noted with satisfaction the lightness of control and the stability that this typical light plane provides for the novice pilot. When the stick was pulled all the way back, the ship nosed up, oscillated one or twice, but never fell off on a wing. This behavior in itself is a real element of aerodynamic safety. When compared with the war time Jennies and other early training planes, the present state of the art savors of the miraculous.

What is far more important is good instruction of the student pilot on a sys-



The three numbered drawings show different dive-bombing maneuvers that are used according to cloud conditions. *Left:* Displacing gear for releasing aerial bombs

tematic, well worked out plan such as that of the C.A.A. program. Of equal importance is the indoctrination of all student pilots in avoiding over-confidence and showing off. Accidents in private flying, as analysis indicates, are not likely to be due either to structural or engine failure or the flight characteristics of the airplane, but to some rash or misguided effort of the young pilot, who after 40 or 50 hours in the air, believes himself to be equal of a Lindbergh or of an Al Williams. — *A. K.*

The Art of Dive Bombing

IN these parlous times we must perforce be interested in such gentle arts as dive bombing, and an article by H. F. King in *Flight* is illuminating.

Dive bombing is defined as the release of a bomb or bombs while an airplane is diving steeply towards a target. Previously, dive-bombing with heavy projectiles was regarded as of use only in attacks upon ships and in the Spanish war a single pilot is said to have accounted for the destruction of three large steamers. But the German attack on Poland showed the value of the method in attacking tanks, and generally in support of infantry. The speed of the dive increases the vertical velocity of the bomb so that its penetration is equal to that of a projectile released in level flight at a great altitude. Aiming for the target is of course much simpler than in bombing from great heights. Therefore, in spite of the fact that the dive bomber is peculiarly vulnerable to shell fire at low altitudes, dive bombing must remain a powerful aerial tactic.

The bomb itself, which may weigh as much as 1000 pounds (with heavy casing where penetrating power is required) is placed under the fuselage. A simple displacing gear, shown in the sketch, is operated to release the bomb. The airplane itself must have special characteristics. It must be strong enough to withstand the sharp pull-out which follows the dive, highly maneuverable so as to keep the anti-aircraft gunner guessing; it should preferably be a twin-engined machine to give the pilot better vision and facilitate clearing of the projectile; and, finally, it should be equipped with a double flap, one opening below and one above the wing surface to check the speed of the dive and thus secure better aim.

The technique followed is illustrated by the accompanying diagrams. In clear weather there is an approach from great altitudes, with intervening spirals. When there are some clouds the military aviator seeks to fly above the clouds and only penetrates the clouds to release his bomb. When there is an unbroken layer of cloud, he flies above, pierces it, and then flies through again until he is almost above the target.—*A. K.*

Industry Borrows from the Housewife

OUT of the kitchen has come the inspiration for the latest important development in the metals industry — the efficient melting of zinc in industry. The humble double-boiler with which Mrs. Smith cooks her vegetables to just the proper turn has been adapted, on heroic scale, to smooth the wrinkles from the brows of industrialists plagued with the expense and impurities of conventional methods.

Down at the Glenn L. Martin Company aircraft factory has been developed this useful system, because Martin uses much of the metal in making dies for bombers and over-ocean transport ships.

Heretofore, zinc has been melted simply by putting it in a pot and then putting fire under the pot. But heat has concentrated at certain points, the zinc has alloyed with the pot metal at these points, and the melted product usually turns up with impurities. In addition to this, the pots have been short-lived, eroding at the points of maximum heat.

It was to produce better metal for die-making, and at the same time reduce the cost of pot replacement, that the Martin research staff developed the double-boiler idea. They built a big pot with a combustion chamber underneath (for gas, oil, or coal) and covered it with refractory material. In this they melt lead and into the molten mass they dip another pot containing the zinc. Since the heat thus is evenly distributed over the pot, there is no tendency for the zinc to alloy with the pot, the metal is returned in molten form in a high degree of purity, and the inner pot is spared the eroding effect of the zinc at points of extreme heat.

Bonded Carbon Steel-Stainless Sheet

A NEW bonded sheet of carbon steel with a surface of stainless steel takes advantage of the cheapness of the former and the attractiveness plus corrosion-resistance of the latter. This new sheet is made by the Allegheny Ludlum Steel Corporation Plant and is called Pluramelt. The process produces single ingots of two or more compositions integrally bonded together. Wire can also be made by the same process.

The bonded material lends itself to standard shop practices as it can be fabricated in any of the usual methods.

Radio-Active Spark Plugs

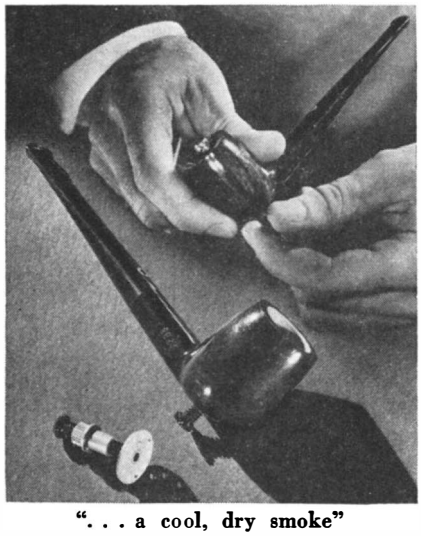
A METAL which has a commercial valuation of $2,000,000 an ounce is now being used in spark plugs made by Firestone. Polonium is the metal, and it is used only in minute quantity. As a result of this use, the manufacturers, The Firestone Tire & Rubber Company, claim better motor performance and quicker starting; and say, further, that many drivers using these spark plugs have reported appreciable savings in fuel.

The air around spark plug electrodes is

not normally a good conductor of electricity and must be broken down into ions by high voltage before it will conduct the spark between the electrodes. This ionization takes time and may contribute to the sluggishness of a motor. But, since polonium gives off 4000 times more alpha rays per second than radium, the polonium electrodes are emitting rays constantly in all directions, thus keeping the air in the spark gap ionized. It is, therefore, at all times a good conductor of electricity.

Under-Feed Stoker Aids Pipe Smoker

A SMOKING pipe with an under-feed stoker is the development of Briar Hill Corporation. This stoker, which can also be fitted to a smoker's present favorite pipe, is an aluminum screw-fitting in which



". . . a cool, dry smoke"

is mounted a screw topped by a perforated aluminum grate.

When the pipe is loaded the elevating screw is all the way down in the pipe, providing maximum tobacco capacity. As the tobacco burns down, the elevating screw is given a turn or two, raising the fuel. The elevator is thus run up, leaving a dead space below the grate in which juices can collect without affecting the tobacco's taste.

The Briar Hill Stoker promises the smoker a cool dry smoke with no accumulation of soggy heel in the base of the pipe.

How to Pile Industry's Coal

A THOUSAND tons of coal a day — that's the requirement of The Dow Chemical Company. And when any one industry's coal requirements reach figures as large as that, several major problems of handling and storage present themselves.

For three years now, this company's unique and revolutionary coal handling and storage methods have been attracting nation-wide attention. Wherever coal is used in huge quantities, these methods are either being studied or have already been adopted.

Until 1937, the coal was stored in conical piles of 8000 to 12,000 tons each. Coal was dumped directly from lake boats. Slack was piled loosely just as it fell, allowing free entry to air. In such a pile, natural classification soon caused a separation of fine and coarse particles, the former being more firmly compacted than the larger pieces. When a second load was piled on the first, the same thing happened; likewise with each succeeding load. In case of fire the layers operate like flues in much the same fashion as their counterparts in chimneys.

It was often found necessary to re-pile the coal in order to eliminate this fire hazard. This involved expense, but the cost was minor compared with the loss sustained when fires started.

Coal is now stored in horizontal rather than oblique strata. This eliminates the formation of flues and reduces the fire hazard. There is little need to fear spontaneous combustion since coal is packed so tightly that little of the fire-breeding oxygen can filter in. Without oxygen, the coal, of course, cannot oxidize. In the three years that Dow has been storing its coal thus, no rises in temperature have been noted, even after 18 months of continuous storage. Formerly the average rise was one half degree per day.

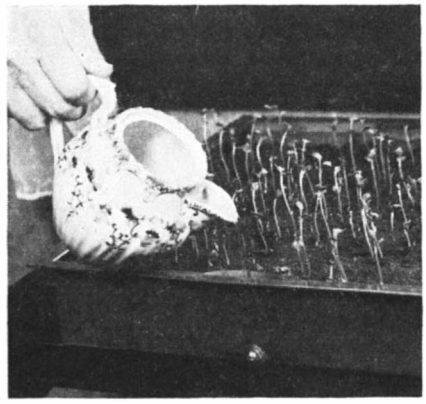
Equals Low Fuel Consumption Mark

THE low fuel rate of 0.545 pounds of oil per shaft horsepower, set by her sister ship the *Challenge* and believed a world record, has been equalled by the new *Red Jacket* on her official trial run. The ships are two of five cargo vessels completed last year by the Federal Shipbuilding and Dry Dock Company at Kearney, New Jersey, as part of the extensive construction program of the U. S. Maritime Commission. Both ships have General Electric geared turbine propulsion and are capable of developing 16 knots. They are single screw, 6000-horsepower, 92-revolutions per minute, with steam conditions of 440 pounds, 740 degrees, Fahrenheit, total temperature, and 1½ inches absolute back pressure. A sixth vessel is nearing completion, and Federal is starting construction of eight more such ships with the same type of propulsion.

Sub-Irrigated Seed Flat

A NEW type of seed flat designed for use in the home, the cold frame, the hot house, out-of-doors, or for purposes of research in the laboratory, has just recently been introduced by the Waterite Seed Flat Company.

Measuring 12 by 14 by 3 inches, it is made of rust-resisting metal and employs an entirely new method of watering which



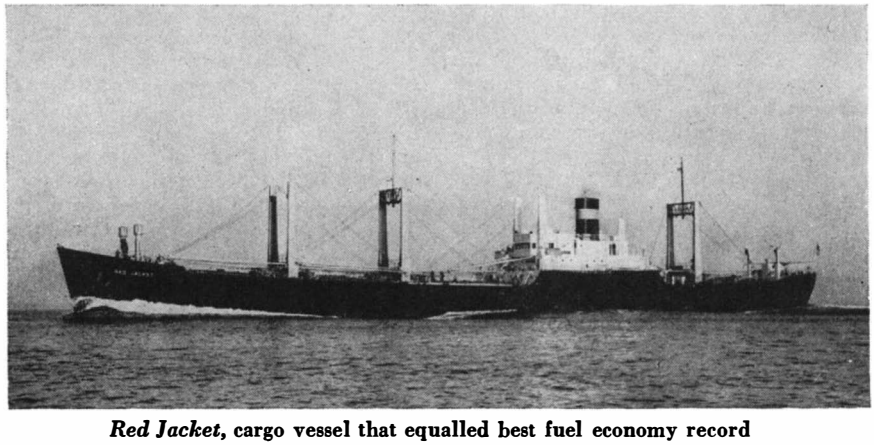
Getting water to the roots

allows for sub-irrigation without any messy leakage of soil or disturbance of seed or seedlings as so frequently happens with above-ground watering. An inner plate having widened openings at each end and perforations in the corrugations in the bottom, permits water to be poured in and seep up through the perforations right to the surface of the soil. Usually two or three quarts of water are sufficient for moisture to appear evenly over the surface. Then a screw plug in the bottom of the flat is withdrawn so that any excess water may be removed. Further watering is not usually necessary for a week or ten days. Air circulates through the end openings and the corrugations in the inner plate so that the soil is kept sweet and in good condition.

This new type flat is also excellent for transplanting as it is only by sub-irrigation that one can be sure water is supplied directly to the roots. Surface watering rarely penetrates more than ¼ to ½ inch and, naturally, dries out more readily than when sub-irrigation is applied to the plants. Any possibility of damping-off is avoided by sterilizing the soil in the usual manner. — *C. F. Greeves-Carpenter.*

Non-Drying Modeling Clay

MODELING in clay has disappointments other than the unexpected errors in appearance which the fingers of the modeler may unintentionally make. There is the problem of clay hardening. This may take place overnight if the unfinished model is not covered with wet burlap or unless some other means are employed to keep the clay surface soft enough so that additional clay will adhere firmly. Greatest irritation and expense to modelers



Red Jacket, cargo vessel that equalled best fuel economy record

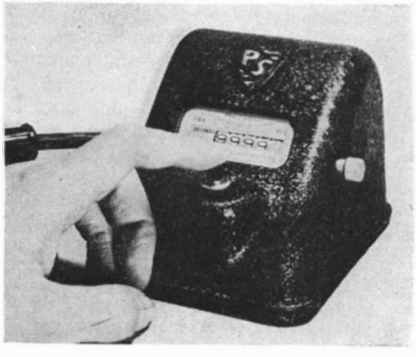
result, however, because the clay cannot be used over again once it has hardened thoroughly.

Manufacturers of articles molded from glass, metal, synthetic plastics, rubber, and similar materials may wish to use clay mixtures for producing "visuals" before production begins. This new clay mixture enables such manufacturers to save time by making alterations in the models instead of making new models because the usual clay types harden quickly.

To make modeling clay retain its plasticity for long periods, small quantities of glycerin and petrolatum are added. The glycerin attracts water to the mixture, keeps it soft; the petrolatum gives the mass the desired consistency. Either 00 Petrolatum or Amber Parmo is suitable for this application. The amount to use depends on the consistency desired. The amount of glycerin also may be varied, depending on the length of time the modeler wishes the finished model to retain its softness, or the number of times he wishes to use the clay. — Esso *Oilways.*

Electric Stopwatch

DIFFERING from the conventional stop watch, a new device, Time-It, made by Precision Scientific Company, has a direct-reading counter mechanism driven by a synchronous motor. The principle of operation is the same as that of the ordinary electric clock and the accuracy is said to be "equal to the cycle constancy of a 60-



cycle a. c. supply at 110 volts." The five-digit counter reads directly to 1/10 of a second and integrates to 10,000 seconds before running back to zero. Readings closer than 1/10 of a second can be interpolated and the counter can be instantly reset to zero from any reading.

Stopping and starting are by push button. A built-in brake eliminates "coasting" when stopping the timing operation. The device is said to be practically noiseless in operation. It should find wide use in all types of laboratories where exact controls are necessary.

White Chromium

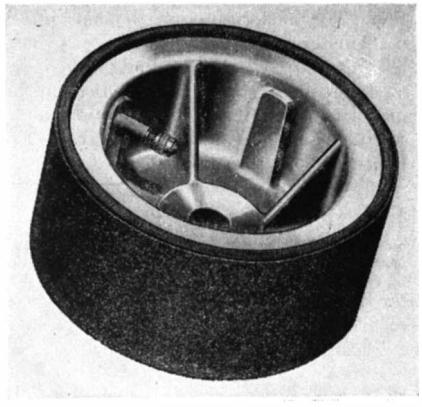
MANY firms are now actively studying the possibilities of white chromium solutions because of the saving in plating time, much better throwing power, lower current densities, and resultant improved production. A wider bright-plating range, along with lower current densities, reduce burned edges and rejections.

White chromium is flexible, very resistant to peeling, rust-proof, non-tarnishing, and white. Other concerns are investigating the promising possibility of white chromium for barrel and basket plating which would

result in unprecedented savings as a consequence. The conversion of ordinary chromium solutions to white chromium solutions is a simple matter requiring mere addition of a special patented compound "Triskalite" to the original solution under certain conditions.

Sanding Drum Has Inner Tube

A SANDING drum which relies on an inflated rubber inner tube to hold the abrasive band in place is being manufactured by Mall Tool Company. Finer finishes, with less danger of tearing the work or putting excessive wear on the abrasive



Air pressure holds the band

bands, are promised. The Mall Pneumatic Sanding Drum is easy to apply to any flexible shaft machine, bench grinder, or aerial grinder.

The drum is a lightweight aluminum casting, having a special, flat rubber tube mounted on its outside face. A fabric band and the belt of abrasive material are slipped over the deflated tube and into correct position. Then a few strokes with the air pump inflate the tube, and the belt is held firmly in place.

The Mall drum can be fitted with any one of several grades of abrasive belts, from very coarse to very fine. The light weight of the aluminum drum is a great advantage when the device is used on a portable grinding tool that must be hand-held and carefully manipulated in grinding castings and finishing fine surfaces. — *Aluminum News-Letter.*

Lake Bromine

THE American Potash and Chemical Corporation is installing facilities at its plant at Trona, California, to recover bromine from products resulting from the evaporation of Searles Lake brine.

The bromine concentration in Searles Lake brine is about 12 times that of sea water, and since large quantities of brine are processed in the Trona plant for the recovery of potash, borax, soda ash, salt cake, and other chemicals, a considerable amount of bromine is available. During 1939 over 1,000,000,000 gallons of brine entered the Trona plant, carrying nearly 10,000,000 pounds of bromine, or an average of over 13 tons of bromine per day.

Theoretically, the main Trona process is a cyclic one of alternate concentration and fractional crystallization in which the brine is ultimately evaporated to dryness, with separation and recovery of the various salts

contained therein. Thus, in certain of the concentrated liquors, the bromine concentration reaches 100 times that of sea water. It is from such concentrations that the bromine is to be recovered as a by-product.

Desk Organizer

A HORIZONTAL filing cabinet for use on a busy executive's desk, where he can keep important papers that will need attention in the near future, has recently

In this horizontal filing cabinet there is a choice of 45 standard titles for identification of contents

been developed. Known as the Miracle Desk Organizer, this compact filing cabinet is equipped with classified folders large enough to take legal-size papers.

"Case Hardening" Concrete

IT has been discovered that if concrete forms are lined with absorptive, finely textured material such as Fir-Tex insulating board, the concrete will develop a hard, dense surface which might be called case hardened. The absorptive board case hardens the surface of the concrete by removing trapped air and excess water. Concrete formed with these boards possesses a very dense, voidless, outer layer extending to a depth of about one and one-half inches.

Tetanus Toxoid

TETANUS is one of the most serious problems of wartime medical science. An open wound may pick up the germ from soil, manure, or ordinary highway dust.

Commander W. W. Hall, U. S. Navy Surgeon, recently announced that a toxoid for vaccination against the disease has proved so successful that after injections of two doses eight weeks apart, the individual becomes a walking antitoxin factory. He says, further, that the entire Naval Academy personnel has been vaccinated against this disease and if wounded, will never again need to be injected with horse serum or face the danger of serum reaction.

More Shaving Science

THE Mellon Institute fellowship of the Magazine Repeating Razor Company is enabling E. J. Casselman to investigate the variability in safety razor blades and its causes on the one hand, and the variability in shaving conditions on the other, including their relations to user satisfaction. (Mr. Casselman wrote for Scientific American, November, 1937, an illuminating discussion of some of his findings.)

It has been found that there are some 31 variables in shaving conditions that influence user satisfaction, of which the more

important are: time of beard softening, temperature of softening water, hydrogen-ion concentration of soap or other medium, time elapsed since prior shave, and condition of skin and hair as influenced by fatigue, by sunburn and windburn, and by dietary factors. The variation introduced by these factors is roughly twice as great as that in the over-all quality of new razor blades as produced by the better blade makers. A study conducted in supplement to this investigation has shown that there are some 24,000 hairs, each about 0.006 of an inch in diameter, that the typical man has to shave on his face and adjacent portions of his neck. The effective length of most safety razor blades may be considered to be divided into 240 segments, each 0.006 inch long. It follows that the minimum amount of work required of each such segment in an average "once-over" shave is to sever 100 hairs. Still more work is required in the usual case where the skin is shaved over more than once. The degree of hair softening by the facial preparation before shaving determines in part how many hairs can be cut before the blade becomes too badly dulled for further use.

MILEAGE

THE United States has far more high-speed railroad mileage than any other country. Today, runs scheduled at 60 miles or more per hour total 65,034 miles, of which 54,956 are completed daily. Runs booked at 70 miles or more per hour cover a total distance of 8068 miles.

To Keep Cats Away

A BOON to owners of cats is Pussy Scat, a new powder which keeps cats off chairs and beds and away from curtains, table legs, and other objects on which he likes to use his claws. Pussy Scat is sprinkled lightly on or around the places that the cat must avoid. It is harmless, invisible, and odorless to humans when used in accordance with the instructions. Yet the cat smells it, and stays away. It ends the shedding of hairs on chairs, beds, rugs, and so on, and prevents other "cat damage" in the house. Pussy Scat is made by the Sudbury Laboratory, makers of indoor and outdoor dog repellents.

Sprayed Mirrors

SINCE mirrors were first made, the silver reflecting medium has been applied to the back of the glass by a slow process of flooding the glass with the solution by hand. The solution then must remain on the glass surface for 20 minutes to an hour to secure a satisfactory deposit of silver. After a long period of research, the Peacock Laboratories, Inc., a division of Libbey-Owens-Ford Glass Company, have developed a new process which involves spraying of the solution on glass as it passes down a production line. With this process, 12 square feet of silver film can be deposited on a glass surface in less than 60 seconds according to *Chemical and Chemical Engineering News.*

Two overhead containers hold a silver ammonionitrate solution and a specially

developed reducing agent. From these tanks, the two solutions are forced by compressed air through a two-nozzle spray gun. The nozzles permit the sprays to meet about seven inches in front of the nozzles so that the two solutions are atomized. It is at this point of mixing that the silver starts to precipitate.

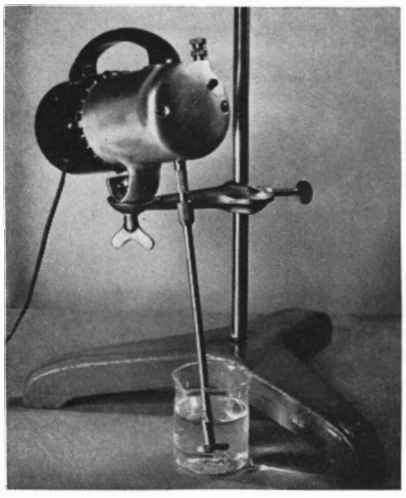
The hazard of chemical and handling damage occasioned by the variable of human skill is reduced to a minimum, since the glass plates, after being placed on the slat conveyor and washed are not touched by the operators until completely processed.

The silver reflecting medium deposited on the glass surface by spraying is said to be extremely white and brilliant, and to reflect greater detail, truer colors and distance. It is a tough, tight, dense, homogeneous film with durability and longevity.

Versatile Laboratory Mixer

DESCRIBED as an "all-around laboratory mixer" the Model "F" Laboratory Mixer has been announced by the Mixing Equipment Company.

Aside from its portability and ease of handling, the chief feature of this new



Increasing torque with slow speeds

mixer is its adjustable speed friction drive. It provides constant horsepower at the propeller and increasing torque with slow speeds. A turn of a conveniently placed thumb screw increases speed up to a maximum of 1750 revolutions per minute, or decreases speed until the mixer is barely turning over.

The new model, mounted on a special ring stand clamp, may be used on beakers as small as 300 cubic centimeters without spilling or "throwing out" contents. They have been used on tanks up to 20 gallons in size to produce gentle agitation. A convenient carrying handle makes it easy to use as a hand mixer without clamp or stand.

This mixer is recommended for use with inflammable materials since the motor is totally enclosed.

Optical Test for Cancer

A NEW optical test that tells whether a person has cancer and whether, after operation, that cancer has been successfully treated, is claimed by Dr. M. W. Mettenleiter, New York surgeon, connected with

St. Clare's Hospital. In a preliminary series of 325 cancer cases, the test is reported to have proved 96 percent correct.

Developed from German studies reported over the last 30 years, the Mettenleiter test involves the measurement of the densities of a number of samples of the person's blood serum by use of an interferometer. The blood serum from the patient is mixed with an extract of human cancer cells from a patient known to have carcinoma of the breast.

Varying amounts of the suspected patient's blood serum are placed in four test tubes containing equal amounts of the cancer extract. After incubation and settling, the densities of the four dilutions are obtained, and plotted out graphically. The curves are reported to show a characteristic difference between cancerous and the non-cancerous blood serum. — *Science Service.*

ALCOHOL

PRODUCTION of ethyl alcohol for December, 1939, was 22,080-109 proof gallons, while the production of specially denatured alcohol was 10,502,486 wine gallons. For the corresponding month in 1938, the figures were 16,780,614 and 8,372,981, respectively.

INK CRUST SOLVENT

PRINTING plates, type, fountains, halftones, and other printing equipment often become coated with hard incrusted ink, but a new solvent called Fedroid instantly removes such incrustations, leaving no residual odor or film of grease. This material is a compound of several chemically pure solvents and will not injure fabric, wood, paper, or the operators' hands. It leaves metal surfaces bright and clean without pits, etching, or other effects of chemical action.

WEIGHT GAIN AND LOSS IN WOMEN

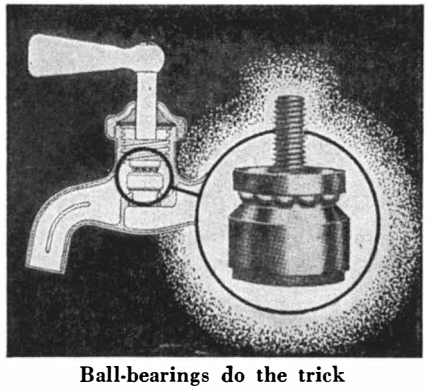
A REGULAR gain in weight of about two pounds during one week in every month, with subsequent loss of this gained weight, occurs in about 50 percent of women as a result of monthly variation in sex hormone activity, according to Dr. George W. Thorn, of the Johns Hopkins School of Medicine, Baltimore. This weight gain, unexpected and perplexing, has caused much discouragement to women on reducing diets and even to the physicians prescribing the diets, Dr. Thorn pointed out. The two pounds gained is due in part to retention of excess quantities of water and salt, as a result of the regular change in sex hormone activity. — *Science Service.*

NO MORE LEAKY FAUCETS

DO YOU know anything more annoying than the steady drip of water from a leaky faucet? Well, did you ever do anything about it, besides trying to twist the faucet down tighter? If you're like most of us, you put off installing a new washer as long as possible. However, one designer *did*

do something about the problem—he developed a faucet that stood up under several million closures.

The faucet and valve which successfully survived this unusual laboratory test work on a ball-bearing principle. The upper race of the bearing is attached to a bolt which, in turn, becomes part of the stem assembly. The lower race turns freely on



Ball-bearings do the trick

this bolt and holds a soft neoprene washer in position. As the faucet and valve are turned down, the bottom race of the bearing rotates with the upper race until the washer touches the valve seat. Thereafter, the bottom race does not turn. On further turning, the soft washer compresses against the valve seat to effect a leak-proof seal.

There are many advantages claimed for this ball-bearing faucet and valve. A few of them are: the mechanism prevents faucet dripping, saving owners considerable expense; it reduces fuel costs and saves replacements and annoyances; it eliminates rotative wear caused by twisting the washer tightly down on a metal seat; the faucet can be opened and closed by mere fingertip action; this smooth up-and-down action, instead of violent twisting, permits the use of a soft neoprene cushion. It has been found that the neoprene washers can withstand extremely hot water for an indefinite period of time.

Metal Etching Solutions

FOR etching aluminum and its alloys, Dr. B. Egeberg and N. E. Promisel recommend, in *Metal Industry*, that freshly polished and cleaned specimens be warmed in hot water and treated immediately with the following etchant: Nitric acid, 1 volume; hydrofluoric acid, 2 volumes; and glycerin, 3 volumes. White metals such as tin, lead, antimony, bismuth, and their alloys, as well as Britannia metal, may be etched with the following: Nitric acid, 1 volume; acetic acid, 3 volumes; and glycerin, 15 volumes. After etching, rinse in running water and dry in an air blast.

Chemical "Ice" for Skating

FOR many years attempts have been made to develop a chemical ice for year-'round skating rinks. Some success has been had with such simple chemicals as sodium hyposulfite, which is the commercial hypo used by photographers. Skating surfaces made by using some of these products have been satisfactory to a degree but all have had certain disadvantages.

There has now been brought to a high point of perfection a combination of chemi-

cals called Iceolite. This is claimed by *Chemical and Chemical Engineering News* to be the first substance which permits year-'round, unrefrigerated ice skating. It was conceived by Bessie Pastor Berliney some years ago and is now manufactured by the Iceolite Corporation.

Iceolite has a number of advantages, not the least of which is that it has better wearing qualities than natural ice and may be re-surfaced easily and inexpensively. Exceptional durability and fast glide are characteristic. Furthermore, it is harmless to person and clothing. Its standard color is a light water green but other colors may be supplied.

Baked Aluminum

A BAKED aluminum finish of exceptional beauty and resistance is a new development in industrial finishing. Called Heresite A-313, it is made by Heresite and Chemical Company. The appearance is that of tarnished silver and it is, therefore, attractive for household devices such as radiators, pipes, washing machine parts, refrigerators, and many other types of apparatus such as auto heaters, fans, blowers, airplane parts, and the like.

The new finish has excellent adhesion and high resistance to mechanical abrasion and weathering. It is said to have withstood successfully 450 hours of continuous exposure to salt spray, a test that would badly injure an ordinary coating.

New Power to the Farm

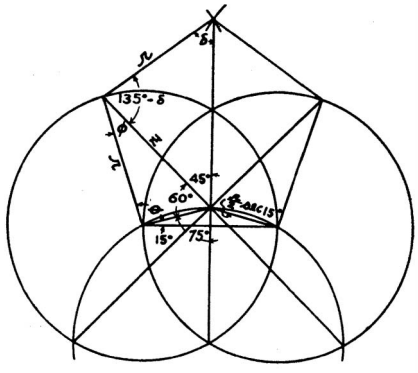
WITH new two- and three-plow tractors, today's small-acreage farm can be completely power-equipped for less than $1500. The new small models will mechanize 3,000,000 more farms, it is estimated, and will supplement larger tractors on 3,000,000 bigger farms.

Tractors are rapidly attaining higher standards of engineering and refinement. More powerful and economical to operate, trimly streamlined, with self-starters, enclosed cabs, rubber tires, and other appointments, they are replacing older models.

Solution to the Problem of the Pentagon

LAST of Lieutenant-Commander Kaplan's series of 14 problems, beginning in the April, 1939, number, skipping to the September number of the same year, and appearing regularly thereafter in this department until last month, has the following solution:

Consider the triangle shown in the sketch,



whose angles are θ, φ, and 60°. From the sine law, we have

$$\frac{\frac{r}{2}\sec 15^\circ}{\sin\varphi} = \frac{r}{\sin 60^\circ}$$

which reduces to

$$\sin\varphi = \tfrac{1}{2}\sec 15^\circ \sin 60^\circ$$

or

$$\varphi = 26^\circ\text{-}38'\text{-}02''$$

Adding this value of φ to 60° and subtracting from 180° gives

$$\theta = 93^\circ\text{-}21'\text{-}58''$$

and

$$\theta + 15^\circ = 108^\circ\text{-}21'58''$$

which is the value of the angle of the pentagon at either extremity of the base.

Completing the solution of this triangle, we have

$$\frac{z}{\sin\theta} = \frac{r}{\sin 60^\circ}$$

Taking next the triangle whose angles are δ, 45°, and 135°—δ, the sine law again yields the relation

$$\frac{z}{\sin\delta} = \frac{r}{\sin 45^\circ}$$

Combining and eliminating z from the two equations,

$$\sin\delta = \sin 93^\circ\text{-}21'\text{-}58''\ \sin 45^\circ\ \csc 60^\circ$$

and

$$\delta = 54^\circ\text{-}35'\text{-}47''$$

Two other angles of the pentagon will have a magnitude, each of

$$135^\circ - \delta + \varphi = 107^\circ\text{-}02'\text{-}15''$$

and the angle at the top will be

$$2\delta = 109^\circ\text{-}11'\text{-}34''$$

The construction is not exact, and is in error by the amount the angles fall short of or exceed 108°.

The pentagon problem shows a construction for a regular pentagon, which is attributed to Albrecht Durer, German painter and engraver, who lived from 1471 to 1528. It is not an exact construction, but it is a very good approximation. The method of executing it is so simple and practical that none of its accuracy is lost in the process.

FIRST of Lieutenant-Commander Kaplan's now completed problems were the five proposed in the April, 1939, number, page 219, these being entitled The Problem of the Crossed Ladders, The Problem of the Spheres, The Problem of the Barge on a Rock, The Dog and Rabbit Problem, and The Second Dog and Rabbit Problem. More problems were published as follows:

September, 1939, page 171, Problem of the Circular Pasture.

October, 1939, page 236, Problem of the Cylinder.

November, 1939, page 301, Problem of the Weights.

December, 1939, page 361, Problem of the Swimming Dog.

January, 1940, page 42, Problem of the Square.

February, 1940, page 110, Problem of the Chord and Arc.

March, 1940, page 173, Problem of the Medians.

April, 1940, page 237, Second Circular Pasture Problem.

In every instance except the first, the solution to these problems was published in the number following the dates stated above.

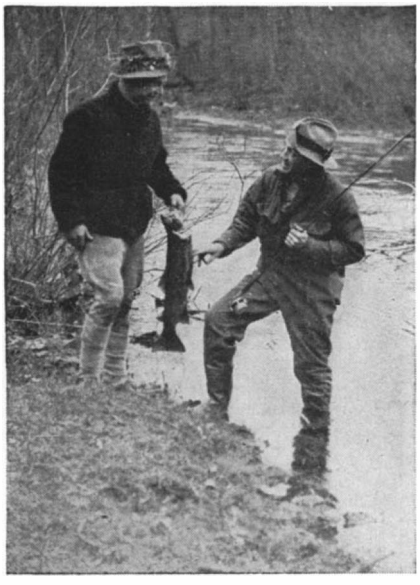
YOUR FIREARMS and FISHING TACKLE

Conducted by A. D. RATHBONE, IV

INTEREST IN FIREARMS *is traditional with American men; fishing tackle is a requisite of one of the world's oldest occupations. Scientific development of guns and tackle, in the use of which millions yearly find sport and recreation, fathers this monthly department, which welcomes correspondence from readers.*

WELCOME, FISHERMEN!

GENTLEMEN of the angle, we welcome you to this gathering place of nimrods and fishermen! With this issue, the gun fanciers move along on the bench to make room for their brother sportsmen, the clan of rod and reel. And yet we strongly suspect that many of you who have been visitors to this monthly round table on arms and



ammunition need but to glance in your shaving mirror of any morning to find simultaneously the reflection of both an angler and a hunter.

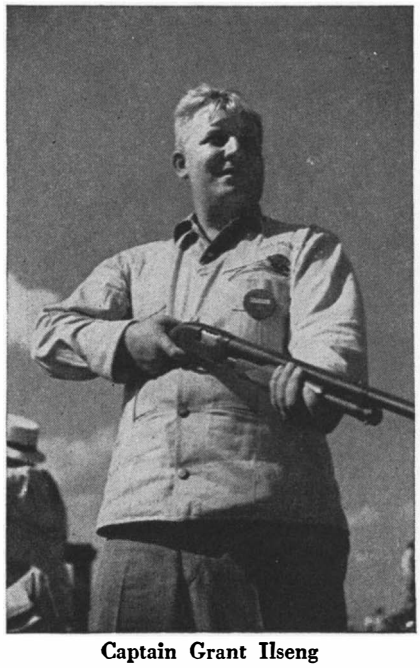
We take our sports in season, we Americans, and come fall or winter, we think of upland game and deer, of wildfowl and indoor range targets. When spring, with her outdoor stimulus, bursts upon us, our thoughts may stray from the category of trajectories, loads, long shots with scatterguns and the reverberating roar of indoor pistol and rifle fire to realms piscatorial. True, the shotgun enthusiast comes into his own with the nice weather and the flight of skittering skeet and trap targets. Outdoor ranges are active, woodchucks must be wary indeed to avoid the ardent rifleman, but many a gun addict is lured from the smell of powder by memory of Izaak Walton's immortal, "Oh, sir, doubt not that angling is an art. Is it not an art to deceive a trout with an artificial fly?"

All these occupations have come to be parts of our lives largely through scientific development and research. Without science, the knight of the bowing rod and the devotee of the trigger would alike miss many of the pleasures which are their's. Accordingly, from now on this department will strive to offer to both hunter and fisherman news, developments, and controversial grist for their respective "hot stove" mills. Welcome, fisherman! Hail, gunner!

IN THE SPRING—SKEET

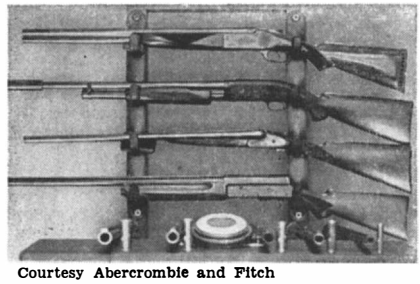
TO Mrs. Gertrude Hurlbutt, Montana rancher's wife, went a $100 prize in 1926 from *National Sportsman* and *Hunting and Fishing* magazines for christening their newly sponsored shotgun sport "skeet"—Scandanavian derivation, meaning, "to shoot." To arms and ammunition makers, clothing manufacturers, silver smiths and the U. S. Treasury have, since then, gone annually hundreds of thousands of dollars for guns, shells, "birds," traps, shooting jackets, uniforms, insignia, sportswear, cups and other trophies, and Federal excise taxes on shotguns and shells To innumerable fields and clubs go regularly 80,000 skeet devotees of all ages, both sexes, in any kind of weather, from humble homes and magnificent mansions, to "shoot a round of skeet."

Evolved in 1915, introduced in 1926, skeet's still sky-rocketing popularity continues to please its sponsors, delight gun and munitions people, contribute its share of Uncle Sam's special taxes, and intrigue new competitors. From modest and scattered inceptions at Ballardvale, Massachusetts; Edmonds, Washington; and Valhalla, New York, skeet clubs are numbered in



Captain Grant Ilseng

thousands, have attained to sumptuousness and social status of country clubs, number among ultra - democratic memberships butchers, bakers, candlestick-makers, who contest shoulder to shoulder with bankers, executives, auto manufacturers. International accolade has been accorded skeet by adoption in Belgium, Canada, England, Egypt, France, Germany, Norway, Sweden, South Africa, South America. Credit for skeet's universal appeal goes to its sportive



Courtesy Abercrombie and Fitch
Skeet guns

competition, its year-'round opportunities to duplicate field shooting conditions for practicing bird hunters, the inherent desire to fire a gun, and the never outgrown, adolescent thrill derived from deliberately smashing something.

Named Captain of the 1939 All-American skeet team, big, blonde Grant Ilseng hails from California, participates in tournaments all over the map, holds such titles as the Great Eastern 20-gage, the California State 20-gage, small-gage, and high-over-all, and boasts a season's all-gage average of .986 on 1550 targets. Illustrative of types of guns which will powder millions of birds in 1940 are the Marlin Model 90, "Skeet-king," over-and-under; the Winchester Model 12, repeater; the Francotte Model 25, double barrel; the Remington "Sportsman" automatic. To benefit skeet neophytes, "Bob" Nichols, *Field & Stream* firearms editor, has exhaustively covered the subject in his book, "Skeet, And How To Shoot It."

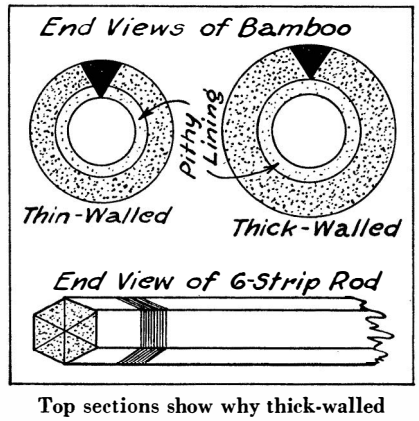
WHO'LL RAISE THE CANE?

IT'S possible that your favorite trout, bass, or salt water fishing rod traveled much farther before it came into your possession than it has since, for Tonkin cane, that sturdy, virile, properly flexible backbone of America's choicest rods, is grown in China. The Waitsap area, near the borders of Kwangtung, Kiangsi, and Hunan provinces, some 175 miles north of Canton, is probably the birthplace of your favorite rod. Although bamboo grows in many sections of the tropics and subtropics of both hemispheres, none of the growths offers the necessary rod-making qualities found in cane from the Waitsap area, where climatic conditions produce almost perfect bamboo, Calcutta cane advocates notwithstanding, and where our future delicate "fishing poles" are known locally as "tsing lee poles."

For many years Tonkin cane was systematically harvested by the Chinese populace and carefully seasoned in enormous compounds, comparable in an Asiatic way to American lumber yards. It was then rafted down the Bambus River to Canton, transferred to Hong Kong-bound river boats, then re-loaded again for its transpacific voyage. Today, however, to a large extent, the Chinese have been driven out of Waitsap and the Japanese govern the land where grow our future split bamboo rods. Reports differ as to harvest, and, consequently, as to imports of Tonkin cane under present circumstances. One importer claims no Tonkin is being cut or stored. A well-known rod manufacturer says that although Tonkin is popularly supposed to have ceased coming into this country a year or two ago, the Japanese now control the entire crop, employ Chinese labor, and that thus far there has been enough on hand to supply the makers of high-grade rods. Be that as it may, there seems to be agreement on the score that our future supply of Tonkin cane could and may be threatened.

When the much traveled Tonkin cane gets into the hands of the good rod manufacturer, it is split, not sawed, because, by splitting, the natural grain of the wood is followed and a stronger rod results. If you were to cut a section out of your rod, you would probably find it composed of six triangular strips of bamboo, neatly matched as to similar grain, and, if it's a really good rod, the inside apex of the triangular pieces of split bamboo would be hard and firm, like the outer edge. Without this stout heart, your rod would be flimsy and spineless. To avoid such wilting action, manufacturers of quality rods use only butt pieces of Tonkin in which the bamboo wall is of sufficient thickness to permit splitting the triangular strips without encroaching on the pithy lining of the cane.

Having mentioned that you would probably find your rod composed of six triangular strips, it's apropos to state that this type of construction is used by rod manufacturers today after exhaustive tests and because it has proved most satisfactory throughout the years. Behind the adoption of the six-strip rod, however, lies a brief history of



Top sections show why thick-walled cane is best for rods. Lower drawing: How rod sections are fitted

these fish-begetting instruments. In 1847, a Mr. Little, of 15 Fetter Lane, London, and rod maker to his Royal Highness, Prince Albert, began making rods from "three rent pieces." Thomas Aldred, another Londoner, inaugurated his three-strip process about the same time. An Easton, Pennsylvania, gunmaker, Samuel Phillipi, brought out a four-strip rod in 1862, and was followed eight years later by H. L. Leonard, of Bangor, Maine, with a six-strip construction. The well-known Hardy Brothers, of Redditch, England, offered their six-strip rod in 1882.

But getting back to present-day methods of rod manufacturing: Nodes, which are the regularly spaced knobby parts of the bamboo, are staggered in assembling the triangular strips so that no two nodes will

come opposite each other. When strips are split for rod construction, these small areas of tough cross grain must be spaced so they will alternate in any given section. And speaking of sections, rod makers cannot emulate the assembly line of auto manufacturers. They do not build a supply of butts, pick up any mid-section from the rack, and end up with a casual tip, or tips. No, sir! When you buy your trout rod from your favorite dealer, you may rest assured that if it bears the name of one of America's leading manufacturers, it has been properly matched as to grain, and that it is the product of a careful "tailor-made" process. Likewise, the strips have been selected with an eye to exact fit at each ferrule, so that it has been unnecessary to cut down the bamboo to attach the ferrule.

As to which rod, how long, what weight — that's a story in itself. The decision rests on many things, including type of fish, lake angling or stream fishing, and the size of the latter. Are you going to fish fresh water or salt seas? Will it be wet or dry work for trout? Or is it salmon? And it can be bass, pickerel, panfish. An outstanding factor is the preference of the fisherman, himself, toward the "feel" of a rod. Nevertheless, you can't go wrong on a product of any of the several widely known American manufacturers, each of whom offers extensive and expert advice on rod selection and a satisfactory variety from which to choose.

"All-American" Trout Flies

THERE is probably no more controversial subject among anglers who use artificial lures than, "Which are the best flies?" A year ago *National Sportsman* printed one of our stories entitled, "What Fly, Mr. Fisherman?" and accompanied it with a ballot and an invitation to the nation's trout anglers to designate their choices. They were asked to name the six dry flies, six wet flies, and six streamers or bucktails they had found most productive. The poll drew replies, some most emphatic, from 23 states and named 319 different patterns. Using a point system of scoring, it was found that Royal Coachman was the decided favorite in both dry and wet classifications. The idea back of the story and its sequel (*National Sportsman*, March, 1940) was to attempt to simplify the perplexing problem of selection of trout lures, of which there are over 10,000. We figured that if enough of the country's trout fishermen told us which flies they had found most successful, we would have something to offer toward settlement of that ever ponderous question.

With that in mind, we sent the completed data to The Weber Lifelike Fly Co., who promptly furthered the idea by printing a folder depicting both national and regional results of the survey. They capped this by packaging "The All-American Fly Selection," incorporating the six winners in each of the dry, wet, and streamer-bucktail categories within one box. Now we don't for a moment contend that possession of a set of "All-American" flies is a panacea for all trout fishing ills, and neither does Weber. Like the choice of a rod, individual preference and experimentation will, within certain sensible limitations, ultimately determine which flies you like best. As one voter in the survey so aptly put it, "The manner in which the lure is presented and worked has made many a poor lure productive and many a good lure fruitless." However, several fishermen have told us that the survey helped, and if you'd like one of the Weber folders showing complete results, just let us know.

Pot-Shots

AT THINGS NEW

W. R. ("Bill") Weaver, maker of that sensational 1-power shotgun 'scope, as well as the famous Weaver 330 and other 'scopes for small and large bore rifles, has announced a substantial reduction in the prices of his scattergun 'scope. This product has proved such a boon to beginners and to others who want to improve their shooting that the demand has increased to the point where production tools and quantity manufacture have become possible, thus bringing about the new price of $19 on the Type T mount, which formerly sold for $27.50. The type B mount, which used to sell at $31, can now be had for $22.50.

When Kipling wrote, "Boots—boots—boots —boots—movin' up and down again!" he, of course, had in mind the incessant tramping feet of an army, but the quotation could as well refer to the army of trout fishermen who slosh up and down the nation's streams and rivers. Without a good pair of boots the trout angler is lost, There's nothing which so literally and figuratively dampens the Waltonian's ardor as the constant trickle of ice water into the rubber casing about his pedal extremities. With that in mind, the Goodrich Footwear Division of the Hood Rubber Co., Inc., announces a new wader-top boot with light, flexible rubber legs extending well above the knees to provide longer wear and reduce danger of snagging. Special fabric, coated with highest grade rubber compounds, is used in body portion for lightness, flexibility, and long wear. Another feature which will be welcomed by every angler who has at some time slipped and gathered himself a bootful of water is that these waders can be turned completely inside out, right down to the insole. In a unique pamphlet called, "Fishing Facts and Fancies," the Hood people display all their wares and offer some authenticated "tall" tales, such as the one about the catfish found in a tree, 40 feet above ground; the salt water denizens of New Hampshire's fresh water lakes. Drop us a card and we'll send you a copy.

Ithaca Gun Company announces a new member of its popular "Model 37" family. New arrival is Ithaca Model 37R, a repeater, available in 12 gage with 26, 28, 30, and 32-inch barrels; in 16 gage with 26, 28, and 30-inch barrels; in 20 gage with 26 and 28-inch barrels, all with any standard degree of choke. Outstanding feature of Model 37R is "dead level" solid, raised rib with no dip, no sway, no ramp to interfere with true sighting plane. The "dip" found at rear end of sighting rib on several makes of popularly termed "rib-shotguns", causing difference in height between top of rib and top of frame, has been eliminated in Ithaca's Model 37R, thereby establishing absolutely straight sighting plane from the breech to the very muzzle of the barrel.

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

Aping the Masters

"GEE, I wish I could light a subject that way," is an expression one often hears from amateur workers as they admire the pictures of professional photographers. The fact is that the difference between professional and amateur lighting is largely a matter of volume, although other factors must be taken into consideration, such as a difference in subjects and make-up, the fact that professional lighting results are frequently aided by after-work on the part of the retoucher, and a difference in the quality of the light provided by professional equipment and that available to the amateur worker.

Acting on the suggestion of Norman A. Schuele, an enthusiastic amateur photographer and Advertising Manager of Revere Copper and Brass, Inc., we recently interviewed Bruno of Hollywood, and then retired to our own modest studio to see what could be done about it. Bruno, as you may know, is a specialist in the art of movie

Virginia Wilson
By Bruno of Hollywood

glamor. In his studio in New York, he is known as the man who makes them "look like Hollywood" even when they "come in looking like New York." He achieved his national reputation while in Hollywood, where he made a specialty of photographing stars and would-be stars. The technique that he employed in this work he brought with him to New York.

Mr. Bruno has been kind enough to permit reproduction of two of his pictures as examples of the "straight" and the "glamor" techniques he employs. The picture of Lorraine O'Day is an example of the first, and that of Virginia Wilson, of the second. The latter had the simplest lighting: a 1000-watt spotlight directly overhead and a 1000-watt diffused floodlight far back in the room. The distance of this latter light must be adjusted to provide just that amount of light that will suitably fill up the shadows without interfering with the lighting effect provided by the spotlight. An approximation that may be employed by the average worker is shown in our illustration, in which a Photoflood-type spotlight was used overhead and a No. 1 Photoflood bulb in a Kodaflector set back of the camera at an angle of about 30 degrees to the subject. Little attempt was made to duplicate the Bruno picture except as to light placement. Since it is not usually practical for the amateur to use a spotlight directly over the subject, the spotlight used was directed overhead as nearly as possible.

The Lorraine O'Day portrait was lighted in considerably more complicated fashion. Two 1000-watt flood bulbs were placed six feet from the subject at an angle of 45 degrees to the latter and eight feet high. A 1000-watt floodlight was placed at the same angle on the other side of the face but lower and twelve feet away. A 1000-watt spotlight was used for the head and a 2000-watt spotlight illuminated the background. In our example, we substituted two No. 1 Photofloods for the light six feet from the subject, but because an eight-foot extension was not available we used one about 6½ feet high. For the shadow side-light 10 feet away from the subject, we used a No. 1 Photoflood. A Photoflood-type spotlight was used instead of the 1000-watt spot used by Mr. Bruno and for the background we used a No. 1 Photoflood illuminating a monks-cloth background.

An exact reproduction of the lighting as seen in the print cannot, of course, be claimed for our examples, because, in addition to the necessarily more efficient light-

Virginia Wilson lighting

ing units of the professional, there is also the factor that the professional's prints were made by contact instead of the enlarging method usually employed by amateur workers these days, and also because the professional's prints must usually be retouched, at least in a moderate way.

Our thesis, however, is based on the fact that, although necessarily modified because of difference in lighting equipment, the amateur worker may copy the lightings of the professionals and successfully achieve

Lorraine O'Day
By Bruno of Hollywood

the lighting effects of the latter. Chiefly, it is a case of light placement and light volume. Professional lighting effects can be studied and the various lights identified by studying the shadows cast by the subject's nose, lower lip, chin, and so on. Practice of this kind will help you to arrange your lightings and to achieve satisfactory illumination of your subjects.

Dentists and Photography

THE part played by photography in the professional as well as the leisure life of the dentist was surveyed in the March issue of *Dental Survey*, in which it is stated that "thousands of dentists are numbered among the most enthusiastic camera fans to be found anywhere."

"Photography has a particular appeal for the dentist," the article says, "for through it he can make a hobby serve him as a tool in his daily work. Pictures can be used to the greatest advantage in patient education as a simple, effective means of showing the importance of dental care. Projection of slides brings home lessons that the dentist can never inculcate by demonstration or word of mouth. The patient's own case can be personalized in a way that wins him at once to the necessity of adequate treatment.

"One dentist has made an album of 'before-and-after' pictures which he uses to demonstrate to patients what different types of restorations will do for them by the improvement that has been accomplished for other patients.

"Color photography has recently come into its own and now enables dentist photographers to achieve even more remarkable results. With the still camera it gives them the most accurate record of the stages of their important cases. The method of treat-

Lorraine O'Day lighting

ment can be followed with the motion-picture camera, operated by an assistant, and in the class room, at clinics and dental meetings, motion picture photography in color helps spread undergraduate and post-graduate education by demonstrating in practice what has already been studied in theory."

Apartment House Darkrooms

THE vogue that started in New York City some time ago of providing apartment house tenants with community darkroom facilities has gained considerable headway. The latest innovation is the provision of fully equipped darkrooms for the East Side apartment house dwellers living in the buildings owned by the Tishman Realty & Construction Company.

"Each building," *The Foto Review* reports, "will be equipped with a spacious darkroom designed to appeal to both beginners and advanced amateurs. The room, mechanically ventilated, will be supplied with modern equipment, including stainless steel sinks, two enlargers, printing machines, developing tanks and trays, safe-lights, timers, trimmers, scales, and graduates to assist in the production of good photographs."

Avoid Ridicule

IF some amateur does poor work because he cannot do better just yet, be chary of ridiculing him; he may outstrip you later. In any event, there is neither charity nor good taste in making fun of the work of one's associates in the camera hobby. Yet it has come to our attention that in at least one club the pictures of one worker were laughed at when exhibited to the club members, to the great discomfort of the worker concerned. One member, not the victim, was so upset by this attitude of the club members that he resigned. What if his turn should come next?

There is no doubt that a general club is bound to have a number of members who are rank beginners and turn out what may appear to be astonishingly poor stuff when compared with the work of the more advanced members. However, the advanced members need only look back a few years and recall how bad their first efforts were.

But it is easy to forget. A person joins a camera club to get help and not to be laughed at every time he makes a false step. Helpfulness should be the motto and no club will be worth anything at all unless, instead of laughing at the mistakes of individual members, the better and more experienced workers volunteer advice that will set the erring worker on the road to better picture-making.

VISITORS' PICTURE ALBUM

SAMUEL E. LESSER, New York, submits what he believes to be a new idea in picture-making and picture-collecting. He writes:

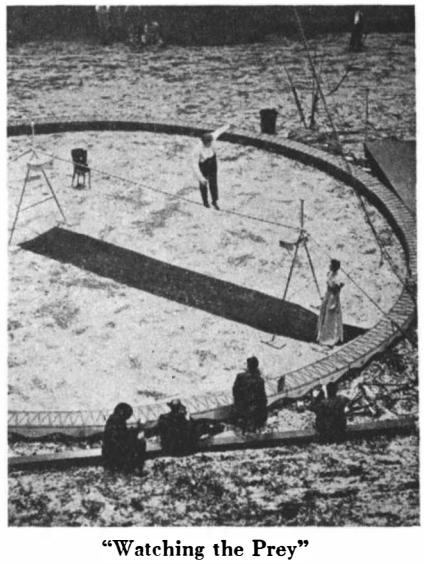
"I am in process of making 8 by 10's of pictures of all my friends who visit us, and relatives and other people who enter our lives more than transiently. When the whole is completed (which may take a year or so), I shall bind them up in a permanent book of record. Really the old-family album streamlined for modern purposes."

PICTURES AT THE CIRCUS

THE availability of extreme speed films makes indoor circus shots more feasible than formerly. It is now possible, under spotlighting effects, to shoot as fast as 1/100 and 1/200 of a second at *f*/3.5 or *f*/4.5. The accompanying illustrations were made with an *f*/2.9 lens wide open at 1/200 of a second, although the results showed that a higher shutter speed or smaller lens opening could have been used if desired. The exposures were made about 50 feet away from the camera and the wanted section enlarged to 8 by 10.

In the case of acrobats "flying" through the air, we found a handicap in the fact that the spotlights were turned off during the action, doubtless in order not to handicap the performer, and turned on again when the subject reached the other side. Of course, such subjects have to be left alone because there is not enough light available during the flight to make an exposure possible at the short shutter speed necessary.

Many subjects do not require fast exposures, however, and may be taken as slow as 1/25 and 1/50 of a second. Also, even fast action may be "stopped" if the shot is made just as the subject reaches his objective or when he is momentarily suspended



"Watching the Prey"

"Mid-Air Stunting"

in space before coming down again. This calls for careful watching and quick shooting. The shot of the acrobat in the five-man somersault, for example, was made just as the subject reached the shoulders of the fourth man in the "human ladder," after jumping from the spring board below. The shutter speed was 1/200 (the fastest the camera possessed). If a faster shutter speed

"Five-Man Somersault"

were available, 1/500 would have been attempted as the man was flying up, although 1/1000 would probably be necessary.

Pictures such as "Watching the Prey," which shows a tight rope walker performing while news photographers sit around waiting for an opportunity to make a startling shot, may be had at 1/50 of a second and even slower.

KODAK AT 1940 FAIR

ESTIMATING a total attendance of nearly four million visitors during the World's Fair in 1939, the Eastman Kodak Company has announced extensive improvements on their Fair Building for this year that are expected to attract an even greater attendance, according to Kodak officials. Among the changes are a complete new front and an enlarged entrance foyer to the Great Hall of Color; a special salon in the Hall of Light for the continuous and elabo-

rate presentation of the Kodak style show; "startling tricks in photography, along with other thrilling demonstrations" to be presented during the fashion show intermissions; the addition of two model living rooms in one of which will be projected full color home movies and in the other "still" pictures in natural color; changes in the photographic gardens, as well as other improvements.

Camera Clubs Grow

AT last we have been able to obtain a figure closely approximating the number of camera clubs in this country. After an extensive survey, the Eastman Kodak Company has found that this total comes to 9000. Adrian TerLouw, who kindly passed this information on to us, added however, that this was only the known total and that the actual number exceeded this considerably. Clubs are springing up all the time and many active groups do not announce themselves as clubs, preferring to remain "incognito."

New Background Cloth

PHOTOGRAPHICALLY useful materials are frequently to be found in other than strictly photographic stores, as our readers have doubtless found out for themselves from time to time and as we have occasionally intimated by announcements in these columns. One of our latest finds is a cloth material known as Inca, which we understand is being widely used by professional photographers where large backgrounds are required. This material, the color of which is a light tan or cream, comes 9 feet (108 inches) wide and sells for only $1.75 a yard.

Technical Adviser

FORMERLY instructor at the New York Institute of Photography, with many years of both professional and teaching experience, Morris Germain, A.R.P.S. has been appointed Technical Adviser for the Penn Camera Exchange, New York City. Mr. Germain's task is to assist the store's customers in their photographic problems and in the use of equipment.

One of the features of Mr. Germain's association with the store is a series of talks

Photo by Saul Germain

Where serious amateur photographers may learn from a professional

on various phases of photography. The opening gun was fired recently when Mr. Germain gave a talk on the fundamentals of lighting in photography. An index of the popularity and helpfulness of Mr. Germain's talk is the fact that the lecture had to be repeated a week later to accommodate the overflow of visitors who had to be turned away the first time for lack of space. The accompanying illustration shows a section of the audience, as flashed by Mr. Germain's son, Saul Germain, a journalistic photographer. With Mr. Germain on the platform is Miss Ilse Hoffmann, who served as Mr. Germain's model for the occasion.

WHAT'S NEW
In Photographic Equipment

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

DUO SPOT-FLASH ADAPTER ($6.95); Designed to fit most makes of synchronized flash equipment, for exclusive use of G.E. No. 5 flash bulb ("Mighty Midget") in directed flash photography. Supplied with removable ring. With ring in reflector, angle of light is 50 degrees and claim is made that ordinary flash exposures can be achieved at about same speeds and apertures ordinarily used with larger standard bulbs such as G.E. No. 21 and Wabash Superflash No. 2. With diffuser ring removed, pictures can be made at distances up to 100 feet or more. Spotlighting possible because adapter is designed to use all available light as directed beam rather than normal flood. Reflector designed to project beam of light having approximately 30-degrees spread. Diffuser ring re-directs part of beam over wider angle of approximately 50 degrees.

KALART CONCENTRATING REFLECTOR ($1.95): New type concentrating reflector designed for use with new midget bayonet base flash bulbs. Furnished complete with built-in ejector. Said to double light efficiency of bulb. Guide stem keeps reflector in correct position so that light will be properly directed. Reflector made of spun aluminum with highly polished reflector surface. Bayonet base bulbs automatically centered when placed in socket. Reflector may be used with battery cases of all makes.

PERFORATED PAPER ENVELOPE: Defender now packaging all photographic papers in new, easy-opening envelope. Envelopes made with double perforation across flap of envelope: mere rip and tear gives quick access to contents. Perforated opener available in all sizes up to and including 11 by 14 inches.

BEE BEE FOLDING POCKET SUNSHADE AND FILTER HOLDER ($2.50): Compact, adjustable sunshade with provisions for mounting filters. Springs open instantly at touch. Adjustable feature allows use of one sunshade and one set of filters on more than one camera. Available in four sizes, as follows: No. 1 fitting lens rims from 19mm to 26mm diameter; mounting 34mm filters; closed, 1⅞ by 2 1/16 by ½ inches; opens to 1 7/16 by 2 1/16 by 1 9/16 inches. No. 2, fitting lens rims from 26mm to 33mm; other specifications same as for No. 1. No. 3, fitting lens rims from 33mm to 39mm; mounting 46mm filters; closed, 2⅜ by 2 9/16 by ½ inches; opens to 2⅜ by 2 9/16 by 1 15/32 inches. No. 4, fitting lens rims from 39mm to 45mm; other specifications same as for No. 3.

ARGOFLEX TWIN LENS REFLEX CAMERA ($35, complete with leather carrying strap; all-leather carrying case, $5 extra): Takes 12 pictures size 2¼ x 2¼ inches on standard 8-exposure roll. Viewing lens and objective lens identical—75mm, f/4.5 triple anastigmat, color corrected. Shutter speeds from 1/10 to 1/200 of a second, time and bulb. Built-in sunshade. Direct vision finder for eye level action. Highly polished first surface reflecting mirror. Depth of field scale.

NEW MODEL MCM PHOTOMETER ($4.85): New type direct reading automatic dial requiring no manual adjustment. Does not have to be preset for different paper speeds. Sensitivity "booster" increases visibility of spot, permitting faster and more sensitive adjustment, particularly in dark areas, and makes user view spot from same angle.

SCROLLETTE ADJUSTABLE PICTURE HOLDER (Jr., $1; Sr., $1.50): Self-adjusting picture holder that does away with ordinary picture frames. Can be used horizontally or vertically as table easel, or hung on wall. Made of genuine phosphor bronze and available in natural polished finish or satin chromium. Made in two sizes: Junior holds any picture from 6 to 9 inches; Senior from 10 to 14 inches.

BURTON FRESNEL SPOTLIGHT ($7.95; bulb extra, 85 cents): Housing molded of Bakelite. Stand of heavy cast metal, equipped with four rubber legs and tripod attachment. Head removable from base; can be used separately. Where height required, can be used with light stand or tripod. Optical system consists of two-inch Fresnel lens with cylindrical diffusing glass in adjustable mount with highly polished reflector.

NEW CYKON, CYKORA SURFACE: Designated as Matte White, is neutral white and provides smooth, even surface devoid of sheen or texture. Suitable for pictorial views, landscapes, portraits, still life, and other subjects. Available in three grades in both Cykon and Cykora emulsions.

CHARDELLE METEOR-FLASH SYNCHRONIZER (complete with one tip, 14-inch cable, and torch unit plus calculator, $9.95): Mechanical type unit, precision made. Manufacturer's claims: smooth-operating, guaranteed not to impair action of even most sensitive camera shutters. One of chief features is automatic, safety retractable plunger permitting Meteor-Flash to be set for next exposure before shutter is set, and vice versa, plus following: 5½-inch aplanatic adjustable polished chrome reflector; powered by two No. 925 Eveready batteries; quick change, sure-contact socket; synchronization at any shutter speed and with any bulb; fully reliable; exposure calculator (recently reviewed in these

Britelite Triple Duty Screen (Size 30 by 40 inches, $10; 40 by 40, $12; 36 by 48, $13.50): May be used in standing, sitting, or hanging position. Comprises three units: three-piece tripod extending to 6½ feet; beaded screen with black masking border contained in map case with welded L bracket; rod which permits screen to be placed in standing position on table or other support. Changing position of screen from standing to sitting or hanging accomplished in few seconds.

Fedco Adjustable Developing Tank ($1.85): Features Red Top cover which locks securely on inside, thus making it light-tight. Pitched spiral loading reel, provided with metal prong which catches center core, holds reel firmly in place, giving correct size for film being developed, and prevents film from slipping or sliding. Furnished with tank is combination thermometer-agitator; provision made for inserting it into center core. Tank durable and chemical-resistant; stainless steel and molded Bakelite. Spiral reel adjustable to all sizes film from 35mm to size 116.

Mercury Copying Stand ($17.50): Permits Mercury camera to be used conveniently for photographing small objects or flat work at close range. Principal parts include baseboard with vertical support tube at one end; arm for supporting Mercury camera with lens facing down towards the board; set of extension tubes for bringing lens into focus at close range; ground-glass focusing screen. Four extension tubes and shim available which may be used for photographing fields from 9 by 11½ inches down to ⅜ by 31/64 of an inch. Tubes may also be used in combinations. Arm adjustable up and down on tube and may be rotated. Camera holding bracket may be moved up or down on arm by means of micrometer screw.

Eastman Film Kodaguide (10 cents): Provides data on all Eastman sheet films, miniature films, roll and pack films in general use. Data include identification of film type, color sensitivity, Kodak speeds, Weston and General Electric meter settings both daylight and tungsten, notching code chart, chart showing monochrome rendering of colors by each film type under tungsten light, and daylight and tungsten factors for eight commonly used filters (K-1, K-2, X-1, G, A, F, B and C-5) when used with each film type. In addition, spectrograms of all film types and spectral transmissions of all filters charted in full color.

CAMERA ANGLES ROUND TABLE

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

***Q.* I have been fooling with depth of focus indicators and find my calculations at variance with all the cameras I have tried. Is there some difference in the spread of a scale for a camera lens from that of a thin lens of the same focal length?—J. M. P.**

A. By "spread of a scale" we presume you mean depth of field for any given lens stop and object distance. The depth of field is dependent on the circle of confusion or the degree of definition, as you know from your calculations; on the focal length of the lens — the greater this is, the shallower the field; on the size of the lens stop and the distance of the object focused upon. Lens thickness or thin-ness is not a factor.

***Q.* What is "metol-poisoning," its symptoms, and how may it be prevented? How effective is colored cellophane as filtering material?—T. R.**

A. A skin irritation experienced by some photographic workers when handling solutions containing metol or a similar chemical. Local irritation and cracking of the skin are the symptoms. Washing hands with soap and warm water after handling chemicals and solutions, and the wearing of rubber gloves, are the best precautions. It is said, however, that not more than 1 out of 500 persons experience trouble from this source. Colored cellophane might be used as filtering material over light sources but is not advised for use over the lens.

***Q.* For some time I have been interested in casting plaques in high relief in plaster. Is there a practical photo relief method?—W. L. H.**

A. A method of photo relief practiced by a Professor Namias and described by E. J. Wall, in his "Dictionary of Photography" follows: "An ounce of fine gelatine is soaked in 3½ ounces of water, and the vessel is heated in a water bath until all is dissolved, after which 1 fluid drachm of glycerin is stirred in. The mixture, having been strained through fine muslin, is poured on leveled glass or metal plates, 1 fluid drachm being allowed for three square inches of surface. When dry the coated plates may be kept any length of time, and sensitizing is performed by soaking a plate for 15 minutes in a 6 percent solution of ammonium bichromate, and drying in the dark. Exposure under a negative in the printing frame should be continued sufficiently long to give a fully detailed image in brown, the time required being about the same as would be involved in making a print on ordinary print-out paper. On soaking the exposed plate in water the relief is produced, and the plate can be moulded with plaster or with a waxy composition upon which an electrotype is made. If the swelled relief be very gently heated there is such a redistribution of the gelatin as makes the relief persist after the gelatin stratum is dry."

***Q.* I would like to know where to obtain data on the printing of color films suitable for submission to magazines. Any information you have available as to the type of print suitable for printed reproduction will be appreciated.—L. B. K.**

A. Magazines will accept Kodachrome and Dufaycolor transparencies from miniature sizes up for purposes of reproduction. As you know, in both instances processing is done by the makers of the films; in the case of Dufaycolor this may be done by the photographer. Keith Henney's book, "Color Photography for the Amateur," describes the various methods of color printing and the recently published "Photographing in Color," by Paul Outerbridge, an outstanding worker in color, will give you all the information you need.

***Q.* I tried developing my first roll of film in a tank and found only one negative came out. This negative was in the middle. The ones at the beginning of the roll were completely clear of any sign of pictures while the ones at the end of the roll had signs of appearing. Also, when I am printing, a patch of brown appears on about 90 percent of my prints. Could you tell me the cause and the correction?—G. F.**

A. Undoubtedly, the blanks on your roll of film were due to extreme underexposure, or failure of the shutter to operate. The ones at the end of the roll had evidently received a brief exposure but too short to provide a useful image.

The brown patches may be caused, among other things, by dirty dishes or measures, or improper fixing. In the latter instance, this may be due to failure to keep prints moving in the fixer and to keep them submerged in the bath.

OUR BOOK CORNER

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THE CYCLOTRON

By W. B. Mann, Ph.D., Univ. of London

COMPACTLY, this little book explains the cyclotron in language neither popular nor abstruse but intermediate, suitable for readers who remember some part of their physics. (92 pages, 4 by 6½ inches, 31 illustrations.)—$1.60 postpaid.—*A. G. I.*

PAPER CHASE

By Alvin F. Harlow

SOME philatelists collect those little colored bits of paper for one reason and some for another. An artistic eye sees their art, a mercenary eye their money value, while to some people stamp collections merely represent evidence of the acquisitive spirit. No matter in what category the collector or would-be collector belongs, this new volume, subtitled "The Amenities of Stamp Collecting," tells about all there is to know of the history of stamps, of philately, cancellations, processes of engraving, kinds of collections that are and can be made — and all in so lively and interesting a vein that even the rankest amateur will find it good reading. (353 pages, 5¾ by 8½ inches, numerous illustrations.) — $2.85 postpaid. — *F. D. M.*

SCIENCE FOR THE WORLD OF TOMORROW

By Gerald Wendt

DESIGNED for the reader who would like to survey quickly the whole broad field of science and consider briefly the applications of science to his everyday life, this book affords a superficial but interesting source of information. The writer has skimmed the surface and, in his own words, "looks forward to the world of tomorrow by trying to understand the forces which have produced the world of today." (316 pages 5½ by 8½ inches, a large number of photographic reproductions.) — $2.85 postpaid. — *A. P. P.*

FUR, FEATHERS AND STEEL

By Reuben R. Cross

FEW men have been so fortunate as to accumulate the mental storehouse of knowledge of things of the outdoors as has this author. Fewer still have had the gift of words and the willingness of spirit to pass on some of this knowledge to their fellows. In this volume, the author, who qualifies as woodsman, ornithologist, botanist, entomologist, hunter, and as one of the most far-famed tiers of trout lures, gives you his conception of the last-named of his many arts. Dedicating this, his latest book on fly-tying, "To those anglers who never become so engrossed in their art of casting and killing trout that they cannot pause to listen to the song of a warbler, or admire the beauty of a delicate wild flower," he tells and shows you how to concoct the most enticing and efficient lures from fur, feathers, and steel. (78 pages, 5 by 7½ inches, 16 photographs, 11 line drawings.)—$2.10 postpaid.

—*A. D. R., IV.*

THE BOOK OF DIAMONDS

By J. Willard Hershey

CURIOUS lore, properties, tests for genuineness, and synthetic manufacture are the things about diamonds treated in this rather more popular than technical work containing, nevertheless, a great deal of general diamond information. (142 pages, 6 by 9¼ inches, illustrated.) — $2.10 postpaid. — *A. G. I.*

MR. TOMPKINS IN WONDERLAND

By G. Gamow

SIX fantastic scientific adventures in which a noted physicist puts in racy narrative form the weird results of some of the modern concepts of the curvature of space, quantum mechanics, velocity of light, and so on. Will vastly fascinate the whimsical, and is also entirely scientific. Mr. Tompkins, the hero of the adventures, finds himself in an odd, topsy-turvy world! (91 pages, 6½ by 8¼ inches, illustrated.) — $2.10 postpaid. — *A. G. I.*

RED LANTERNS ON ST. MICHAEL'S

By Thornwell Jacobs

WE digress from science long enough to mention this novel by a close friend of Scientific American, Dr. Thornwell Jacobs, President of Oglethorpe University, and originator of the noted Crypt of Civilization. It is the epic story of a poor boy during the period immediately preceding the Civil War and progressing through that ghastly conflict. It takes its title from old St. Michael's in Charleston, South Carolina, as the story is set almost wholly in that state. Our verdict on this book is that it is an enthralling addition to the rapidly growing list of historical novels based on the Civil War era. A departure from usual novel-publishing practice is the large number of reproductions of old woodcuts and drawings contemporary with the period covered by the story. — $2.60 postpaid.

SEX AND LIFE

By Dr. Eugen Steinach

IN which the noted Dr. Steinach, summarizing his life work at 80, for the first time tells the popular reader about his method of rejuvenation through reactivation of the sex glands (the so-called "Steinach operation") and tells it in the form he prefers, rather than the often perverted form of the sensational press. (252 pages, 6 by 9 inches, 67 illustrations.)—$3.85 postpaid.—*A. G. I.*

THE TOOLS OF THE CHEMIST

By Ernest Child

THE subtitle of this volume, "Their Ancestry and American Evolution," just about describes its scope. As is the case with most such books covering the long perspective, this is a fascinating outline of progress for all those even slightly interested in chemistry. The ancient woodcuts and numerous illustrations showing processes enhance its value as a reference work. One section is devoted to biographical notes on some famous distributors of apparatus. (220 pages, 6 by 9 inches, numerous illustrations.) — $3.60 postpaid. — *F. D. M.*

THE ORIGIN OF SUBMARINE CANYONS

By Douglas Johnson, Prof. of Physiography, Columbia University

A CRITICAL review of the several hypotheses that attempt to explain these odd geomorphological phenomena, with a detailed exposition of the author's hypothesis of submarine spring sapping. (126 pages, 6 by 9¼ inches, illustrations.)—$2.60 postpaid. — *A. G. I.*

MR. PITT AND AMERICA'S BIRTHRIGHT

By John C. Long

WITH the problem of preservation of democratic principles so acute, it is an invigorating experience to read of William Pitt's life-long fight in the English House of Commons to re-establish those principles in Anglo-Saxon existence for all time. The author dissects middle 18th Century British political life to depict Pitt's spurring influence on the lesser

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satellites of his time, a thoroughly democratic influence which resulted in reclamation of the Magna Carta "from the archives." In swift-moving, graphic manner, the author carries his subject from William Pitt, the boy, through his rise in Parliamentarian circles, his ascendancy to leadership in the Whig party, and through one of the great crises of his life, his victorious fight for freedom of the press. (576 pages, 5¾ by 8½ inches, including notes, bibliography and index, with 41 illustrations and 9 maps.) — $3.60 postpaid. — *A. D. R., IV.*

FAITHS THAT HEALED

By Ralph H. Major, M.D., Professor Pathology, University of Kansas

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OUTSTANDINGLY readable is this new survey of the general field of the sciences, a book from which the reader may learn its background both in the present and past. The literary style is unusually good. All common branches of science are treated. (420 pages, 5½ by 8½ inches, 219 illustrations.) — $3.10 postpaid. — *A. G. I.*

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SECOND edition of a college textbook of genetics, written by an author whose articles in Scientific American, among our best, prove his flair for lucid exposition. Genetics, of course, is not a subject that can be romped through in popular style but is definitely difficult, hence if the author happens to be a good writer the student's task is lightened that much. The new revision brings this rapidly striding and significant subject up to date. (452 pages, 6 by 8¾, 164 illustrations.) — $3.60 postpaid. — *A. G. I.*

GENERAL PHYSICS

By Robert Bruce Lindsay

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TELESCOPTICS

A Monthly Department for the Amateur Telescope Maker

Conducted by ALBERT G. INGALLS

THE opening part of the account which follows will be found on page 347, the purpose in dividing it between two parts of the magazine being to present there only the general details of the Goethe Link Observatory, such as are likely to interest all the magazine's readers, reserving the more technical parts for special followers of the telescope makers' department. The author of the present account, Victor E. Maier (1306 Parker Ave., Indianapolis, Ind.), is known to amateur telescope makers everywhere, for he has long been active in the hobby. The 36″ Goethe Link reflector is believed to be the largest telescope built by amateurs since this magazine gave an ancient but nearly extinct hobby its renaissance in 1926 by publishing an instruction book. The old lines between amateur and professional telescope makers have largely dissolved. Nearly all the great professionals were men who started small and, generally working by themselves, simply developed the art through character, perseverence, tenacity. Few had much help. Many amateurs among the thousands who had followed the hobby have now learned to do large work equally well and through the same approach. The professional, who works at it all the time, can beat the advanced amateur in speed. Some amateurs, because they do not have to make their living through the work, can afford to take more time, and thus have done better work than some professionals. The description by V. E. Maier continues:

"The observatory stands on a high promontory 25 miles southwest of Indianapolis, near the small village of Brooklyn. From it the Indiana terrain is visible for 40 miles. The building is framed of oak posts and beams cut from the forests not far distant; 13 tons of steel beams were also used in construction, arc welding being employed wherever possible.

"The designers of the observatory and its equipment have sought to include the best features of all the observatories, together with as many innovations as could be used profitably. The design of the building itself was inspired by Russell W. Porter, who generously sent one of his famous thumbnail sketches to Indianapolis. Details were drawn up by A. F. Pittman, an Indianapolis 'TN.' The larger hemispherical dome, 34 feet in diameter, is framed of wood fastened to a 12″ I-beam dome ring. It rolls on tapered roller bearings, and is driven with an endless cable fitted with a unique shock-absorbing device. The 34-ton dome is rotated adequately by a ½ h.p. electric motor. The broad slot opening, nearly three times as wide as the mirror, permits easy manipulation between the dome and the telescope. The zenith is accessible in any azimuth of the opening. The shutters weigh one ton each, and are activated by push buttons and a ¼ h.p. motor. Dome and shutters are covered with interlocking sheets of steel terneplate and aluminum paint.

"The 36″ Goethe Link reflector has several features that are thought to be new. The concrete pier was poured before the building was erected. It is anchored to bed rock to prevent vibration or future misalinement. The steel bearing boxes for the polar axis are bedded directly in the concrete, making the pier a direct part of the telescope mounting. The pier was checked with a transit instrument at frequent intervals during the pouring operation, and though its top is 30′ above the ground level, it has since been found to be within one millimeter of its correct position. The bearings have an adjustment of ½″. The pier, with 8″ reinforced concrete walls, is hollow inside, and this provides a 'strong box' on the first floor of the observatory.

"The polar axis is made of arc-welded steel plate instead of the usual castings.

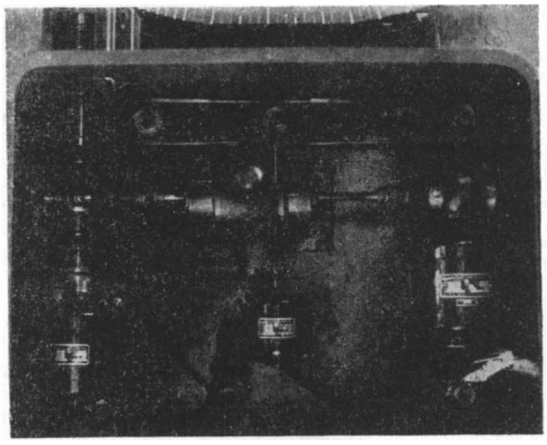

Figure 1: **The telescope drive in its box**

Two sectors were cut from a flat plate and rolled into cones. These are internally braced with fins welded in at the points of greatest stress. The larger ends of the cones are bolted to a cube of nickel-steel, through which the declination axis passes at right angles. The unit is free from flexure and has five times the necessary strength. Each end is fitted with an 8″, Timken, high-precision, tapered roller bearing. The 2000-pound counterweight is rigidly attached to the polar axis. The saddle, in which the optical tube rests, is a standard 18″ channel braced with a number of small fins welded in to make it rigid. The declination axis is a standard steel tube that permits the projection of the Cassegrain cone through it. The Cassegrain image may be observed only 2′ from the center of rotation.

"Movement of the telescope is accomplished entirely by electric motors. These drive two large gears that contain some new ideas. The right ascension gear has a bronze tire shrunk on an iron center. It is 50″ in diameter and has 400 worm teeth cut in the bronze. The 48″ declination gear is made from the same pattern, but has a ring of internal teeth bolted to its side. The outside of this gear is machined and marked with a setting circle. Circles and gears are combined in the same piece. The declination gear is driven

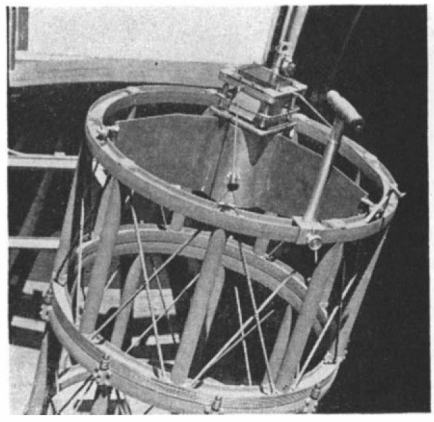

Figure 2: **Upper end of the tube**

by two 1/20 h.p. motors working in unison and driving four pinions mounted in the stationary counterweight.

"The glass-enclosed drive (Figure 1) which controls the telescope in right ascension is simple, quiet, and all in one compact unit. Exposures of an hour at the 15′ focus have been made, with no noticeable drift of the star from the cross-hairs. Worm gears are used throughout, to attain quietness. A 1/12 h.p. synchronous motor, shown at the right in this figure, drives the 50″ R.A. gear (part of which shows at the extreme top in the illustration) through a differential and four reductions—8 to 1, which is built in the synchronous motor, 16 to 1, 50½ to 1, and 400 to 1 at the large worm gear—to gain the sidereal rate. The small motor (center) turns the differential box in either direction and at any required speed, but when the differential is stationary the telescope does not noticeably depart from the ideal clock rate. The differential is used only when special rates are desirable, such as exposing star trail checking plates or guiding on some object that does not have the sidereal rate.

"The motor shown at the left in Figure 1 is a ¼ h.p., high speed setting motor which is thrown in and out of engagement by an automatic electric clutch located in front of it. The whole driving assembly was designed by C. D. Turner, V. E. Maier and A. F. Pittman. Dual controls are mounted on the floor of the observatory and on the observing platform. The accuracy of the drive is attained through the use of multiple thread worms. With these any desired ratio may be obtained. The second reduction in this train, for example, consists of a double-thread worm driving a gear with 101 teeth, providing a ratio of 50½ to 1.

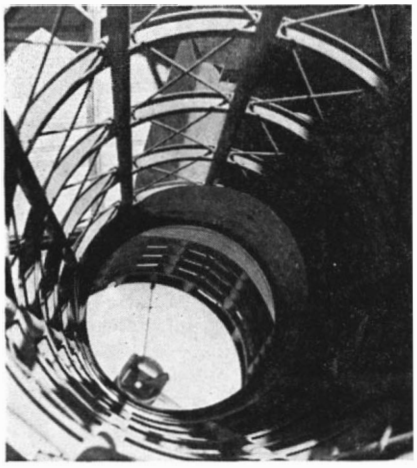

Figure 3: Looking down the tube

The use of multiple thread worms seems to be a new idea—at least it was evolved independently in Indianapolis. Through a suitable choice of ratios, the clock rate was lengthened 25 seconds per sidereal day to compensate for atmospheric refraction.

"The control panel, shown in the central illustration on page 347, has three knobs which control R.A., Dec., and dome movements. The variable speed, reversible, motors are controlled by rheostats driven by the control knobs. These enable the operator to set the telescope at high speed or to give it just a touch over a small angle. There are no manual locking devices, and the rheostats make it impossible to start the instrument with a jerk or to subject it to undue stresses.

The optical tube (Figures 2 and 3) is made entirely of Lynite, Alclad, and Zeppelin Tube—all aluminum alloys. The tube contains over 500 pieces, all drawn together by an ingenious arrangement of tension struts. Flexure has been adjusted out of the tube by adjusting the tension at the proper points. The chief advantage of the Lynite tube is its mobility and freedom from bulkiness. Inertia and momentum are reduced to a minimum and the drive consequently can handle it much more smoothly. Had it not been for the many weight-saving devices incorporated in the instrument, its moving weight would have been more than double its present value—5200 pounds. All the accessory parts are made of aluminum or stainless steel, to eliminate troublesome rust which tends to occur in an unheated dome. The accessories, as well as the mounting, were all made by C. D. Turner.

"Figure 2 also shows the upper end of the telescope, with the plateholder used at the prime focus. The upper section of the tube rotates on adjustable Torrington needle bearings shown in the same figure. and the Newtonian plateholder can be turned to any convenient position. Guide stars are sent to the small telescope mounted on the rim of the tube. The double-slide plateholder makes guiding convenient and simple. This device is to have a coma-corrector installed, at the suggestion of Dr. Harlow Shapley, to flatten the field over the 4x5 plate. Figure 3 also shows a view down the tube. The curved sheet just above the aluminized mirror surface is a stainless steel cover which curves to the inside of the tube when it is raised, and straightens out again when it is lowered on the mirror cell. The cover has a chamois skin gasket. A tiny spot in the center

of the mirror is paint, applied to aid in collimation. The prime-focus plateholder can be seen reflected from the mirror's surface.

"Another piece of equipment that is different is the observation platform of the larger dome (Figure 4). Its design was evolved chiefly from Dr. E. F. Carpenter's platform at Steward Observatory, Tucson, Arizona. The chief difference lies in the

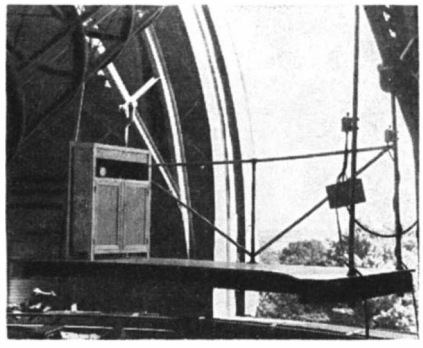

Figure 4: The observation platform

method of supporting the load. This platform, which has a capacity of six persons, is supported by two long steel arches which span the inside of the dome on either side of the shutter opening. They stand on the dome's steel base ring, and are also strong enough to contribute to the support of the dome's wooden superstructure. The wooden platform floor is suspended from two straight tracks welded, like chords, to the arches at the correct incline. The platform, with its rollers, is pulled up and down these tracks by steel cables and a ½ h.p. motor. The hoisting mechanism is mounted in the upper part of the dome, back of the opening. The dead weight of the platform is relieved from the hoisting mechanism by a counterweight on the opposite half of the steel arches. The entire assembly is independent of the dome and would operate as well if it were standing by itself. It allows access to any point reached by the upper end of the telescope. There are no blind spots with this instrument. The switches and wires at the right, in Figure 4, operate the dome, platform and telescope. There are no wires on the telescope tube.

"The second, or small, dome (Figure 5) houses a 5" Zeiss triplet apochromatic refractor that matches the performance of instruments many times its size. This telescope has a full complement of accessories, including those for solar work. The smaller dome is made in two halves, so that much of the sky may be seen at one time. One half is just an inch smaller in radius than the other. This dome is framed of steel channels rolled to radius and welded into place. The inside of the dome is covered with Sprayoflake, a patent heat insulator, sprayed on with a hose. This keeps the interior comfortable during hot summer days.

"Except for the study room, which is well insulated and is heated electrically, the observatory building is not heated. It has its own water system and fire protection. The interior has hardwood floors, panelled knotty pine walls, and beamed ceilings. A spiral staircase leads to the large dome and telescope, and a smaller stair to the other dome.

"The administration of the observatory has been invested in a non-profit corporation called the Goethe and Helen Link Foundation for Scientific Research. Its purpose is to advance the science of astronomy in the state of Indiana. Dr. Link has endowed the observatory with a permanent income. Dr. James Cuffey, the first astronomer from Indiana University to hold the position of research fellow at the observatory, has already published work done with this instrument. Dr. B. C. Getchell, astronomer at Butler University, Indianapolis, uses the observatory, as do many teachers in central Indiana. Samuel Waters, who originally inspired its creation, is president of the Foundation. The writer, an Indianapolis 'TN,' supervised and coördinated the work of construction, and is employed as director of the observatory.

"The builders of the observatory are indebted to the many members of the astronomical profession who have aided in its successful completion.

"All agree that the spirit of unity and co-operation created by Scientific American's two 'Amateur Telescope Making' volumes is chiefly responsible for the existence of the new Goethe Link Observatory. With regard to the mirror, about which another 2000 words might be written, a Hartmann test, reduced by Dr. James Cuffey of Indiana University, disclosed a 'Hartmann criterion' of .066 second. (Those who have memorized 'the book' will recall that this figure represents the least diameter of the cone of rays, approximately in seconds of arc, reflected from the mirror's surface.) This mark is but 0.016 second from the record set on the McDonald mirror. Greater accuracy is not necessary, as the inherent diffraction in the instrument enlarges the apex of the cone to twice this amount even with perfect atmospheric conditions. The mirror was aluminized by Leroy M. E. Clausing.

"The 8½" by 12" flat also was made by Charles Herman and V. E. Maier."

IN almost no time, after the publication of "ATMA," describing the Richest-Field Telescope which shows the maximum number of stars possible in one field, these

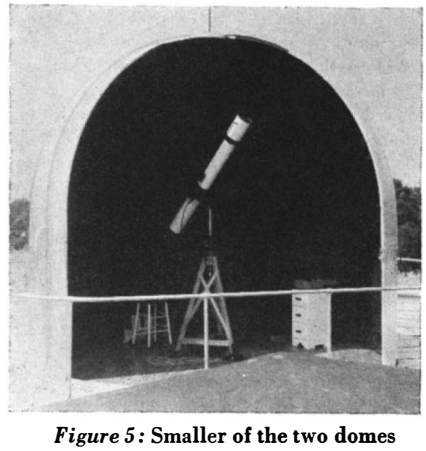

Figure 5: Smaller of the two domes

"RFT's" were being made by the hundreds and everybody was acclaiming them as superlative. Most of these were of 6" size but Figure 6 shows a 12½" RFT, the one nearer the reader, made by J. F. Simpson, a medical and X-ray technician at Garrison General Hospital, Gastonia, North Carolina, and set up on a roof. It is an *f*/5 and Simpson says it "shows most beautiful star fields, while the Orion nebula is more brilliant than I have ever seen it. When look-

ing at the Moon, it is actually necessary to hold your hat over the mouth of the tube to cut down the superabundant light."

The other telescope, mounted tandem in a long yoke of corner-welded angle iron filled in with two-by-fours, is a 12½" Cassegrainian. These two make just the right combination for non-contortionists: the Cassegrainian higher up and used from below, the Newtonian below and used from

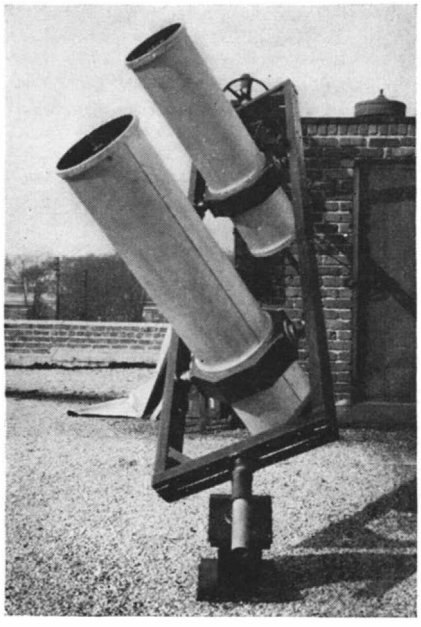

Figure 6: Simpson's new equipment

above. The tube of the RFT turns in the solid trunnion ring shown to place the eyepiece wherever most convenient.

Simpson formerly had the 12½" Cassegrainian and an 8" RFT mounted in tandem on the same roof (described in the March, 1940, number) but each in a fork instead of a yoke. This lacked stability, but the double yoke affords great stability, he now testifies. Simpson's intention is to link the two tubes together with a rod (detachable whenever desired) so that they will always cover the same field.

OF side interest to "TN's" is a recent improvement in commercial silvering of ordinary looking-glass mirrors, developed by Peacock Laboratories, Inc., 54th St. and Paschall Ave., Phil., Pa., a Libby-Owens-Ford subsidiary. Old method was to wash the glass, go over it with tin chloride, wash this off, lay the glass on a heated table and pour on, from a pitcher, the mixed ammonia-silver-nitrate-plus-reducing solution, using 8 oz. per sq. ft., and wait 20 to 60 minutes for the coating. New method employs a two-nozzle spray gun. Emerging from it in a spray, the two solutions meet and mix 7" in front of the nozzle, and continue to the glass. The glass is sloped and moves on a conveyor belt, greatly speeding up the work. Claims are that 1 oz. silver nitrate silvers 30 sq. ft. of glass, showing how wasteful our telescope mirror methods must be — or were before aluminizing took the lead.

NEW clubs of amateurs: The Amateur Astronomer's Club, S. Rasmussen, Cor. Sec., 720 Westover Ave., Norfolk, Va. Telescope Makers of Central California, Jos. A. Mello, Sec., Suite 222, First Nat'l Bank Bldg., Madera, Calif.

CURRENT BULLETIN BRIEFS

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

MARVELS OF THE ELECTRIC EYE is a 16-page illustrated pamphet which describes a number of uses for photo-electric-cell control systems. It covers such applications as conveyor control, automatic lighting, burglary protection, color sorting, and so on. *United Cinephone Corporation, 43-37 33rd Street, Long Island City, New York, New York.—Gratis.*

TWO DAYS—TWO WEEKS is a 96-page vacation guide to the United States, Canada, and Mexico. It lists in compact form national parks and forests, state parks, major resort areas, ways to vacation, ways to travel, and tells how to obtain further information on specific subjects. The listings are as comprehensive as possible and in most cases include a summary of costs. *Harian Publications, 270 Lafayette Street, New York, New York.—50 cents.*

AERO-THREAD ENGINEERING STANDARDS AND TECHNICAL INFORMATION is a 16-page booklet which describes and illustrates uses for a new screw system employing an anti-friction thread lining. The information contained would be of interest to all manufacturers who use screw parts where maximum strength and reliability are desirable factors. Request Bulletin T-1. *Aircraft Screw Products Company, Incorporated, 25-12 41st Avenue, Long Island City, New York.—Gratis.*

GEOLOGIC ANTIQUITY OF THE LINDENMAIER SITE IN COLORADO, by Kirk Bryan and Louis Ray, Harvard University anthropologists, is a 76-page general round-up of existing facts about this famous site of early Folsom man. *The Smithsonian Institution, Washington, D. C. — 35 cents.*

TELEVISION RELAYING is a reprint of an address by Dr. W. R. G. Baker in which is put forth a brief description of the General Electric Television Relay System. It outlines the reasons why relays are necessary for this work and tells something of the operations of a relay circuit in upstate New York. *Radio and Television Division, General Electric Company, Bridgeport, Connecticut.—Gratis.*

HOW TO ORGANIZE A SCIENCE CLUB is a 36-page illustrated booklet that describes just how to go about the organization of a science club. It also tells of some of the work that has been done throughout the country and presents illustrations of the activities of organized clubs. *The American Institute of Science and Engineerings Clubs, 60 East 42nd Street, New York, New York. —Gratis.*

TENITE MOLDING is a 40-page technical handbook on the methods employed in molding Tenite articles. Thoroughly illustrated, it contains a discussion of different types of molds, mold construction, molding temperatures, and molding pressures. Diagrams and detailed explanations of eight typical mold designs are included. This booklet is available to manufacturers, molders, and designers. Please request it on your business letterhead. *Tennessee Eastman Corporation, Kingsport, Tennessee.—Gratis.*

RECEIVING TUBES, pamphlet 1275-B, presents a chart of RCA receiving tube characteristics and socket connections. The data on all RCA glass, glass octal, octalox, and metal types are presented in numerical-alphabetical order. *Commercial Engineering Section, RCA Manufacturing Company, Incorporated, Harrison, New Jersey.—Gratis.*

CHEMICALS BY GLYCO is the latest edition of a comprehensive 96-page catalog describing glycol and glyceryl esters, emulsifying agents, special emulsions, synthetic waxes, synthetic resins, and a number of specialties of wide interest and application. A section is devoted to suggested formulas and other information for the manufacturer of numerous types of products. *Glyco Products Company, Incorporated, 148 Lafayette Street, New York, New York. — Gratis.*

HERCULES DIESEL ENGINES is a 16-page illustrated pamphlet which gives a concise yet comprehensive explanation of modern high-speed, heavy-duty Diesels. Handled in question and answer form, some interesting comparisons are presented between Diesels and gasoline engines as well as between the two-cycle and four-cycle Diesels. *Hercules Motors Corporation, Canton, Ohio.—Gratis.*

AGFA PHOTOGRAPHIC PAPERS, Their Properties, Processing and Applications, is a 48-page booklet which includes clear and detailed description of the various factors and conditions that govern the use of photographic papers. *Agfa Ansco, Binghamton, New York, or photographic dealers.—15 cents.*

ALUMINUM IN THE CHEMICAL INDUSTRY is a 52-page booklet divided into five parts: Choosing the Proper Alloy; Applications of Aluminum in the Process Industries; Coatings, Protection, and Maintenance of Aluminum; Chemicals and Alcoa Aluminum; Characteristics of Aluminum. Complete with a comprehensive index. *Aluminum Company of America, Pittsburgh, Pennsylvania.—Gratis.*

AMPRO PRECISION CINE EQUIPMENT is a catalog which describes and illustrates a complete line of silent and sound 8 and 16mm motion picture projectors. It is available to dealers in such equipment, as well as educational and industrial prospects. *The Ampro Corporation, 2839-51 North Western Avenue, Chicago, Illinois.—Gratis.*

ACTIVITIES IN THE FIELD OF VIRUS RESEARCH, by Paul de Kruif, is a report of the work being done by the National Foundation of Infantile Paralysis. It outlines the progress which has been made up to the present day and describes the long-range research effort which is continually being carried on. *The National Foundation for Infantile Paralysis, Incorporated, 120 Broadway, New York, New York.—Gratis.*

LEGAL HIGH-LIGHTS

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

By ORSON D. MUNN, Litt.B., L.L.B., Sc.D.

New York Bar
Editor, Scientific American

ETHYL

THE recent decision of the United States Supreme Court with regard to the licenses for making, using, and selling gasoline containing a patented fluid bearing tetraethyl lead has given rise to considerable newspaper comment. Much of the newspaper publicity implies that the decision is revolutionary in scope and has introduced new principles into our patent laws. Actually the decision is orthodox and is based upon well-established principles. Underlying the decision is the fundamental principle that after a patented article is sold in commerce by the patentee or his licensee the patentee can no longer exercise any control over the article.

In the decision under consideration the Supreme Court found that the patentee was the owner of patents relating to a gasoline additive containing tetraethyl lead and also to gasoline incorporating the additive. The patentee granted licenses to most of the large oil refining companies in the United States to manufacture, sell, and distribute motor fuel containing the patented fluid. The licenses prohibited the refiners from selling the patented fuel to anyone except retail dealers and jobbers licensed by the patentee. In addition, the license to the refiners provided that the refiners should maintain certain price differentials in the gasoline embodying the patented fluids.

The patentee also granted royalty-free licenses to jobbers to sell gasoline manufactured by the licensed refiners and it was the system of licensing jobbers which the Court found to be in violation of the anti-trust laws. The jobbers licenses provided that either party could cancel the license, with or without cause, on giving 30 days notice in writing.

The Court found that it was an established practice of the patentee to investigate the business ethics of licensed jobbers in order to ascertain whether they maintained the marketing prices, policies, and practices prevailing or ostensibly prevailing in the industry. As a result of its practice of investigating business ethics, coupled with its power to cancel the licenses at will, the Court found that large numbers of refiners and the majority of jobbers believed that it was necessary for the jobbers to maintain the required business ethics and to maintain prices in order to obtain and retain their licenses. From this it was concluded by the Court that the patentee was exercising control over the resale price of the jobbers for gasoline containing the patented fluid.

The Court pointed out that a patentee "may grant licenses to make, use or vend, restrict in point of space or time, or with any other restriction upon the exercise of the granted privilege, save only that by attaching a condition to his license he may not enlarge his monopoly and thus acquire some other which the statute and the patent together did not give." The Court held that the exercise of the resale price of the jobber was beyond the scope of the patent monopoly because the gasoline had already been sold in commerce by the licensed refiner. To correct this situation the patentee was enjoined from enforcing the requirement that licensed refiners should sell gasoline containing the patented fluid only to licensed jobbers. The patentee also was ordered to notify the jobbers that the jobbers' licenses had been cancelled.

In reaching its conclusion the Court pointed out that the patentee had established "the marketing of the patented fuel in vast amounts on a nationwide scale through the 11,000 jobbers and at the same time, by the leverage of its licensing contracts resting on the fulcrum of its patents, it has built up a combination capable of use, and actually used, as a means of controlling jobbers' prices and suppressing competition among them."

STYLE PIRACY

DESIGNERS and creators of original fashions in clothing have made repeated but unsuccessful attempts to protect original fashions which are new but do not rise to the dignity of invention and accordingly cannot be protected by patent from style piracy. The design and construction of garments, when they are new and embody invention, may be protected by patent. However, very frequently new designs and fashions in clothing having great commercial merit cannot be protected by patent and within a very short time after the designs are displayed on the market many copies, usually of a less expensive character, appear on the market.

In an attempt to protect designers and creators from copying of this character a trade association of hat manufacturers and designers was organized. The trade association established a registration bureau with which any creator of original designs and styles in hats could register his designs. In addition to this more than one thousand retail stores in the United States agreed to co-operate with the trade association by refusing to purchase any hats which were copies or piracies of designs registered with the association. Members of the association in turn agreed among themselves not to sell hats to any retailer who persisted in purchasing hats that were copies of the registered designs.

The Federal Trade Commission contended that the concerted action by the hat manufacturers belonging to the trade association was a violation of the anti-trust laws and ordered the association to stop further boycotts of retailers and manufacturers who had copied registered designs. The association appealed to the Federal Court and the order of the Commission was sustained. The Court conceded that design or style piracy was an evil that had adverse effects upon the creators of designs. However, the Court pointed out that under our law only designs embodying invention were subject to patent protection and that any other design could be copied at will by competitors. Since this was the policy of our law, the concerted action of the manufacturers belonging to the trade association was held to be a violation of the anti-trust laws.

In this connection the court made the following statement:

"We believe, therefore, that concerted action to eliminate style piracy extends beyond the permissible area of industrial self-regulation. The purpose of the milliners is to maintain their price structure, and to eliminate a distasteful 'evil' which the law nevertheless recognizes to be a socially desirable form of competition."

DIAZO-TYPES

PATENTS relating to chemical compositions and processes present a peculiar difficulty not encountered in connection with patents for other types of subject matter. Thus where an inventor employs, in a chemical composition or process, a specific element such as chlorine, he naturally does not wish to be limited in his patent to that particular ingredient. In an attempt to make his patent as broad as possible he might state that the entire halogen group of materials may be employed. If it should later appear that one or more of the halogen materials are inoperative in the process or composition then all of the claims of the patent specifying the use of halogens are invalid and only those claims limited specifically to chlorine are valid.

An example of this principle is contained in a recent case decided by a Federal Circuit Court of Appeals relating to a patent for photo-sensitive copy papers known as diazo-types, used in reproducing engineering drawings. The patent stated that the paper should be coated with two materials, one of which was stated to be "a diazo compound being formed with amino compounds containing at least one other amino group." The patent contained both product and process claims, each of which specify the use of the above material. At the trial of the case it was proved that not all diazo compounds of this character would operate but only those containing a quinonoid or anhydride structure. As a result of this evidence the Court concluded that the claims were too broad and covered materials which would not operate and accordingly were invalid. The principle of law involved was stated by the court in the following manner:

"Where within a general classification disclosed by the claims, are compounds which do not answer the description of the specification, even though there be a general quality common to them all, yet if there be no common quality in respect to their effectiveness in achieving the inventive concept, claims for their exclusive use cannot be sustained."

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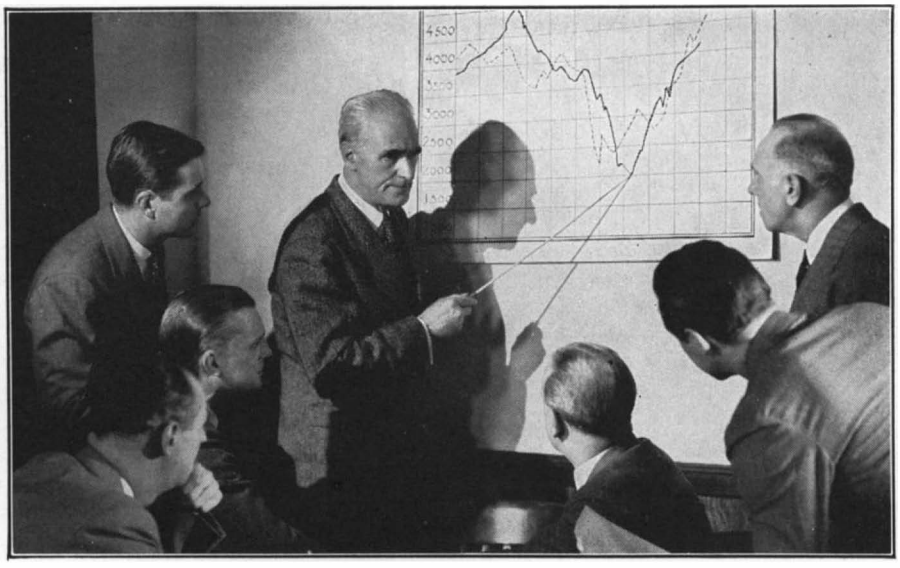

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